Combating Desertification and Land Degradation:

Proven Practices from Asia and the Pacific

EDITED BY
Yang Youlin, Laura S. Jin, Victor Squires,
Kim Kyung-soo and Park Hye-min

OCTOBER 2011
Changwon, Republic of Korea

산림청 KOREA FOREST SERVICE

UNCCD

녹색사업단 Korea Green Promotion Agency

[Editors]

Yang Youlin, Laura S. Jin, Victor Squires, Kim Kyung-soo and Park Hye-min

[Editorial committee]

Park Chong-ho, Im Eun-ho, Lim Jong-hwan, Lee Kyeong-hun and Kim Tae-eun

[Disclaimers]

Design and layout: Kyurag Lee at Uniqdesignlab

Korea Forest Service
Daejeon Government Complex 189, Cheongsa-ro, Seo-gu
Daejeon City, Republic of Korea, 302-701
Tel.: (82-42) 481-4229
Fax: (82-42) 472-3224
E-mail: forest@forest.go.kr
Website: http://english.forest.go.kr

ISBN: (978-89-88960-11-0 93500)

Cover photos: After 30 year efforts, barren mountains are revegetated with significant result, effective rehabilitation initiatives launched by Government of the Republic of Korea since early 1960s. The photos are from KFS.

Foreword

Don Koo LEE, Ph. D.
Minister of Korea Forest Service

This book covers successful efforts to combat desertification, restore degraded land and mitigate drought effects in 16 countries in Asia and the Pacific. It highlights the result of a collaborative effort between Korea Forest Service and the Secretariat of UNCCD with full support from national focal points of the participating countries. It aims to present some of the proven practices in combating desertification and mitigating land degradation within Asia and the Pacific. As such, this publication will serve as useful material in applying traditional and innovative practices and as a way to promote understanding of the complex social, economic and environmental interactions that inhibit rapid solutions to problems associated with desertification, land degradation and drought (DLDD) throughout the region and the world. It would be most fitting to get insight and inspiration from approaches and practices of the countries with successful stories on how they addressed DLDD.

DLDD is a global problem not only in drylands but also in humid ecosystems. Furthermore, prevention and mitigation of DLDD is essential for sustainable development. The Republic of Korea (ROK) also experienced severe deforestation and soil erosion in addition to extreme poverty in the 20th century. However, it has been successfully recovered through the participation of all sectors of the society to rehabilitate and plant trees on degraded mountain slopes. The restored forests eventually reduced soil erosion, floods and landslides and provided numerous ecosystem services including biodiversity conservation, carbon sequestration, clean water supply, and recreational space. The success of greening forest landscape has been a key factor in ROK's economic growth. Today, ROK has 64% of forests in its territory, including landscapes that are managed sustainably to safeguard fragile mountain ecosystems.

It is our hope therefore that this publication will contribute to a wider regional discussion of the linkages between land degradation and human welfare as well as strengthened national policy formulation based on the success stories from a number of countries within Asia and the Pacific Region.

In light of the progress achieved, I am glad that proven practices to combat desertification and to mitigate the effects of DLDD in Asia and the Pacific Region have been compiled in this publication. My deepest gratitude goes to those who have contributed to this publication and I believe that the sharing and exchange of knowledge and information on DLDD mitigation will be the first step toward environmentally sustainable growth and human welfare.

Preface

Luc Gnacadja
UNCCD Executive Secretary
Bonn-Germany

Since the adoption of the United Nations Convention to Combat Desertification (UNCCD) in 1994, the regional implementation Annex for Asia has achieved much progress and accumulated a wealth of good practices to combating desertification, land degradation and the effects of drought (DLDD).

The Tenth session of the Conference of the Parties (COP10) to the UNCCD will soon take place in Changwon, City of Gyeongnam, the Republic of Korea (October 2011). Such an important event will provide to the Parties to this Convention another excellent context to review the progress made in implementing the Convention in all affected countries including those in the Asia-Pacific region. More than any other region of the world, the Asia-Pacific region has made remarkable progress in the fight against DLDD. The Asia-Pacific region remains, however prone to storms, floods and drought cycles, which are becoming more intense and frequent.

Sustainable Land Management is considered the best way to transform agriculture in the Asia-Pacific region and build an enabling environment. At COP10, it is anticipated that Parties, especially those from the Asia-Pacific region will contribute taking bold decisions on ways to enhance the implementation of the UNCCD and its Ten-Year Strategy (2008-2018). Looking at actions taken so far by the Asia-Pacific countries, I am confident that such a region will find the adequate responses to restore and sustainably manage the land and soil for the well-being of the population affected by desertification, land degradation and drought.

I express my sincere thanks to the editors of the book and the various contributors that have helped to better acquaint the readers with the reality of DLDD in several affected Asia and the Pacific countries. I also express my gratitude to Minister Don Koo LEE, Korea Forest Service, for his leadership role and guidance provided to the authors throughout the elaboration of the book.

Acknowledgements

Jang Chan-sik
President
Korea Green Promotion Agency

It was only possible to have this final publication with the support of Korea Forest Service (KFS) and the Secretariat of United Nations Convention to Combat Desertification (UNCCD). It is well noted that without the consistent and patient technical support from the management of KFS and UNCCD Secretariat, this publication could not have existed.

Especially, the generous financial and technical support provided by KFS is deeply appreciated. As well, I would like to send special thanks to the editors, Mr. Yang Youlin, Ms. Laura S. Jin, Dr. Victor Squires, Mr. Kim Kyung-soo, Ms. Park Hye-min and the editorial committee, Dr. Park Chong-ho, Dr. Im Eun-ho, Dr. Lim Jong-hwan, Mr. Lee Kyeong-hun and Ms. Kim Tae-eun. Like all multi-author books there are many contributors, writers, sub-editors and proof readers, and this publication was made possible following months of collaborative work among the National Focal Points of the UNCCD, a number of reviewers and sub editors, principally in Bangkok and in Seoul.

For those National Focal Points to UNCCD from the concerned countries of Asia and the Pacific who contributed to the publication, I would like to send my sincere gratitude for their active contributions and supportive efforts.

Last but not least, I would like to thank Dr. Don Koo LEE, Minister of Korea Forest Service and Mr. Luc Gnacadja, Executive Secretary of the UNCCD Secretariat for their substantial support and technical guidance to edit this publication.

Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
A/R CDM	Afforestation and Reforestation Clean Development Mechanism
a.s.l.	Above Sea Level
AusAID	Australian Agency for International Development
CACILM	Central Asia Countries initiatives on Land Management
CAZRI	Central Arid Zone Research Institute
CCICCD	China National Committee for the Implementation of the UNCCD
CDM	Clean Development Mechanism
CGIAR	Consultative Group on International Agricultural Research
CNY	Chinese Renminbi Yuan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSOs	Civil Society Organizations
DLDD	Desertification, Land Degradation and Drought
DPRK	Democratic People's Republic of Korea
DNA	Designated National Authorities
DOE	Designated Operational Entities
DSS	Dust and sandstorms
ENSO	El Nino-Southern Oscillation
FAO	Food and Agriculture Organization
FFS	Farmer Field Schools
GEF	Global Environment Facility
GM	Global Mechanism
ha	hectare
ICRAF	World Agroforestry Centre
ICM	Integrated Catchment Management
IEM	Integrated Ecosystem Management
KFS	Korea Forest Service
KGPA	Korea Green Promotion Agency
KOICA	Korea's International Cooperation Agency
LADA	Land Degradation Assessment in Drylands
NAP	National Action Plan
NAPs	Nation Action Programmes
NCCE	National Coordinating Committee on Environment (DPRK)
NDVI	Normalized Difference Vegetation Index
NGOs	Non-government organizations
NRM	Natural Resource Management
RAPs	Regional Action Programmes
RMB	Renminbi (Chinese Currency)
REDD	Reducing Emissions from Deforestation and Forest Degradation
RFAs	Regional Forest Agreements
ROK	Republic of Korea

SALT	Sloping Agricultural Land Technology
SLM	Sustainable Land Management
SPA	Strategic Partnership Application
SRAPs	Sub-regional Action Programmes
SSFWM	Small-Scale Farmers both Women and Men
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VAF	Vegetable-Agroforestry
WMO	World Meteorological Organization
WB	World Bank

List of Editors

Yang Youlin
Asia Regional Coordination Unit
Secretariat of United Nations Convention to Combat Desertification
Bangkok, Thailand
E-mail: youlin.unescap@un.org

Laura S. Jin
Consultant
Korea Green Promotion Agency
E-mail: laurasjin@gmail.com

Victor Squires
Consultant on Dryland Management
Adelaide, Australia
E-mail: yourman1812@yahoo.com

Kim Kyung-soo
Asia Regional Coordination Unit
Secretariat of United Nations Convention to Combat Desertification
Bangkok, Thailand
E-mail: kim5@un.org

Park Hye-min
Assistant Director
International Cooperation Division
Korea Forest Service
E-mail: parkhyemin01@korea.kr

Editorial Committee

Park Chong-ho
Director General
Bureau of Forest Resources
Korea Forest Service
E-Mail: jhp61@forest.go.kr

Im Eun-ho
Director
International Cooperation Division
Korea Forest Service
E-mail: eunho99@forest.go.kr

Lim Jong-hwan
Senior Researcher
International Cooperation Division
Korea Forest Service
E-mail: limjh@korea.kr

Lee Kyeong-hun
Overseas Business Headquarters
Korea Green Promotion Agency
E-mail: lk123h@hanmail.net

Kim Tae-eun
Asia Regional Coordination Unit
Secretariat of United Nations Convention to Combat Desertification
Bangkok, Thailand
E-mail: Taen0602@gmail.com

List of Contributors

1. Australia
Derek White
National Focal Point to UNCCD
Department of Sustainability, Environment, Population and Communities
E-Mail: derek.white @ environment.gov.au

2. Bhutan
Chencho Norbu
Director
Department of Agriculture
Ministry of Agriculture
E-mail: norbuc@druknet.bt

3. China
Jia Xiaoxia
Deputy Director
National Bureau to Combat Desertification
State Forestry Administration
E-mail: jiaxiaoxia@forestry.gov.cn

Ya Jie
Inner Mongolia Forestry Survey and Planning Institute

Yuan Xiaodong
Bayannuur Forestry Planning Team
Inner Mongolia

LI Jianming
Bayannuur Forestry Planning Team
Inner Mongolia

Wang Wenbiao,
Chairman and CEO Elion Resources Group
Ordos, Inner Mongolia

4. DPRK
Ri Song-il
Director General
External Cooperation Department
Ministry of Land and Environment Protection

5. India
Rajneesh Dube
Ministry of Environment and Forests
E-mail: r.dube@nic.in

Swayamprabha Das
Consultant to NFP to UNCCD
Coordinator, SLEM Programme
Ministry of Environment and Forests
E-mail: slem.coord@gmail.com

Vivek Saxena,
IFS
Ministry of Environment and Forests
E-mail: viveksax1@gmail.com

6. Kazakhstan
Bulat Bekniyaz
Deputy Director
JSC Eurasian Water Centre
Astana, Kazakhistan 010000
E-mail: bbolat@mail.ru

7. Kiribati
Terrei Abete-Reema
Lands and Agriculture Development
Ministry of Environment
E-mail: tererei.ecd@melad.gov.ki

8. Kuwait
Salah Mudh' hi Fahed Al-Mudh' hi
Kuwai National focal Point to UNCCD
Chairman and General Director of EPA
Environment Public Authority
E-mail: dg@epa.org.kw

Farah A. Ibrahim
Kuwait National Coordinator for UNCCD
Director of Soil and Arid Land Department
Environment Public Authority
E-mail: farah@epa.org.kw

9. Lao PDR
Oloth Sengtaheuanghoung
Land Utilization Research Center
National Agriculture and Forestry Research Institute
Ministry of Agriculture and Forestry
E-mail: oloth.s@nafri.org.la

List of Contributors

Saysamone Phothisat
Director of Protection Forest Management and Forest Restoration Division
Department of Forestry
Ministry of Agriculture and Forestry
E-mail: saiphothisat@yahoo.com

10. Mongolia
Banzaragch Tsesed
Sustainable Development and Strategic Planning Department
Ministry of Nature, Environment and Tourism of Mongolia
E-mail: banzragch@mne.gov.mn

11. Pakistan
Amjad Tahir Virk
National Project Coordinator
Sustainable Land Management Project
Ministry of Environment
E-mail:amjad.virk@slmp.org.pk

Syed Mahmood Nas
Inspector General (Forests)
Ministry of Environment
E-mail: igf.moenv@gmail.com

12. Republic of Korea
Jae Soo Bae
Researcher
Korea Forest Research Institute (KFRI), Republic of Korea
Seconded Scientist
Center for International Research Institute (CIFOR), Indonesia
E-mail: j.bae@cgiar.org

Youn Ho-joong
Senior Researcher
Korea Forest Research Institute (KFRI)
E-mail: yount@forest.go.kr

Moon Kook-hyun
New Paradigm Research Institute
Seoul, Republic of Korea
E-Mail: moonkhkorea@yahoo.co.kr

Kwon Byong-hyon
President
Future Forest
Seoul, Republic of Korea
E-Mail: bhkwon@futurerofrest.org

13. Philippines
Silvino Q. Tejada
National Focal Point
Director of the Bureau of Soils and Water Management
Department of Agriculture
E-Mail: silvinotejada_bswm@yahoo.com

14. Sri Lanka
C. Stanley Weeraratna
Pelwatta Sugar Industries
E-mail: csweera@sltnet.lk

15. Thailand
Worapong Waramit
Acting National focal Point of Thailand to UNCCD
National Land Development Department
E-mail: wwaramit@hotmail.com

16. Uzbekistan
Gulchekhra Khasankhanova
Monitoring Specialist
Central Asian Countries Initiative for Land Management (CACILM)
National Secretariat
UZGIP Institute of the MAWR
E-mail: g.khasankhanova@mail.ru

Raisa Taryanikova
Head, National Secretariat
Central Asian Countries Initiative for Land Management (CACILM)
Centre of Hydro-meteorological Service
E-mail: raisa.taryanikova@ncsa.uzsci.net

Table of Contents

Introduction

Victor R. Squires, Yang Youlin, Laura S. Jin, Kim Kyung-soo and Park Hye-min
UNCCD Asia Coordination Unit, Bangkok

Asia and the Pacific, for the purposes of this book, encompasses a vast territory extending from Mongolia in the north to New Zealand in the south; from the Cook Islands in the east to Kuwait in the west (Map 1). The environmental diversity of Asia and the Pacific is therefore vast, and is contrasted by the region's coldest and hottest deserts, verdant tropical rainforests, extensive steppe, desert steppe, grassland and rangelands, mountains and plains. It is this great variation in geography, topography and climate that provides the rich and unique diversity found in the region's ecosystems. There is great disparity too in the ethnicity of its people's and the economic status of its nations.
The pressures on these rich natural resources and environmental systems have, however, been continuously increasing over the past few decades. Rapid population growth, urbanization, rising economic output and consumptive lifestyles, coupled with an increasing incidence of poverty, have all contributed to the region's struggle to mitigate desertification and arrest and/or reverse land degradation in all of its forms.

Scope and purpose of this book

Clearly, it is not possible to give a detailed account of the efforts to combating land degradation and desertification in all of its forms by each and every nation in this vast geographic region. Instead, we have selected specific examples and case studies from across the region that exemplify the various approaches from labor intensive, low technology solutions to large-scale measures that rely more on technology. The main purpose of the book is to provide information about successes, inspire others and acknowledge the work of those whose efforts have achieved success.

The ultimate questions that the book attempts to answer are:

- Where are we now on the path toward solving the problems of accelerated land degradation?
- Where do we want to be within the next 10 or 20 years?
- How do we get there? What measures need to be taken at the policy and legislative level, in the area of technology and know-how and in development of human capacity?

Emphasis is placed on giving a clear statement of the key problem(s) being faced and on discussion about the approaches taken to confront the problem (s). These are generally organized under 6 headings (i) why measures were being taken (ii) what was done (iii) who was involved (iv) what was achieved (v) what was the outcome, and (vi) some assessment of who were the beneficiaries.

How to use this book

The sketch map (Figure 1) shows the location of the countries represented in this book.

Whilst there were several alternative ways in which to set out the information contained in the book. It was decided to organize the content according to the principal agro-climatic and land use categories.

There are 9 such categories. For some countries there are problems that involve several of these classes. 1. Arid zone/desert margins ; 2. Semi-arid rangelands; 3. Semi-arid Agro-pastoral; 4. Semi-

Figure 1. Sketch map showing countries in Asia and the Pacific whose experience is highlighted in this book

arid rain-fed cropping; 5. Sub-humid cropland; 6. Sub-humid agro-pastoral; 7. Monsoon (dry) tropics; 8. Saline land; 9. Coastal dunes.

Guide to the book

Using the agro-climatic category (far left column) check for the type of problem being dealt with and the chapter in which the most extensive explanation is given. Refer to the key word index for additional references to the subject in other chapters.

Agro-climatic zone Main Land use	Sand dune fixation	Rehabilitation of rangelands	Mitigate Land Degradation	Re-forestation Re-vegetation	Control of Soil erosion by water	Control of Soil erosion by wind
Arid zone/desert margin	Chaps. 1, 3-4, 8-9, 11-12, 20	Chaps. 1, 3-4, 11, 7, 20	Chaps. 1, 3-4, 10, 13, 19-20		Chaps. 13	Chaps. 1, 3-4, 11, 20
Semi-arid rangelands	Chaps. 3-4, 20	Chaps. 4-5, 7	Chaps. 3, 5, 9			Chaps. 4, 7, 9
Semi-arid agro-pastoral	Chaps. 3-4, 20	Chaps.1, 3-4, 6-7, 10, 20	Chaps.1, 3-4, 6-7, 10, 20	Chaps.1, 3-4, 6-7, 10, 20		
Semi-arid rain-fed farming				Chaps. 3-4, 10, 19	Chaps. 3-4, 10,19	
Sub-humid cropland				Chaps. 2-5, 13, 10, 19	Chap. 19	
Sub-humid agro-pastoral			Chaps. 2, 6, 10, 13		Chap. 19	
Monsoon (dry) tropics			Chaps. 1, 6, 10	Chaps. 6, 10		
Saline land	Chap. 6, 12		Chaps. 1, 20	Chap. 20		
Coastal dunes	Chap. 19		Chap. 19		Chap. 8	Chaps. 8-9

1. Australia: Ecologically Sustainable Natural Resource Management

- Derek White

[BACKGROUND]

1. Resources

Australia is one of the twelve most biologically diverse nations in the world, the only developed nation to have this 'megadiverse' status. Australia is also the world's driest continent, excluding Antarctica, and has a high degree of rainfall variability from one year to the next.

2. Problem

Much of Australia's agricultural land is under pressure from either soil erosion, loss of natural vegetation cover, over-use of irrigation water and the impacts of introduced invasive species. Problems such as soil salinity, acidification and rising groundwater all appear to be on the increase. The environmental impacts of agricultural activity are the result of a complex chain of biophysical and other factors, which are linked to the natural characteristics of the land. Soil fertility is declining in 33 per cent of all cropped land, more than offsetting the improvement in the fertility of 10 per cent of the land through application of fertilizers.

The main causes of land degradation in the rangelands include over-grazing by introduced and native herbivores (total grazing pressure), mechanical removal of vegetation cover, woody weed invasion and land management without regard to climate variability. The effects of these processes include increased soil erosion, soil degradation, altered stream flow regimes, increased soil salinity and loss of biodiversity.

Since the early 1970s, there has been an increasing awareness of and concern for environmental issues in Australia. These concerns have found expression in a broad range of community led activities. They have also led to legislation, regulation and expenditure by governments, at national, state and local levels, to protect the environment.

Despite a dedicated effort from state governments and the communities and the range of policy initiatives to promote sustainable natural resource use, Australia still has some significant challenges ahead to achieve ecologically sustainable land management.

[ACTIVITIES AND PROGRAMMES]

1. National Strategies and Programs

Australia has in place a substantial body of legislation, programs and strategies for sustainable natural resource management at national, state, local and farm levels.

Both Australian Federal and State governments seek consistency between policies and programs aimed at natural resource management, industry development and drought effect mitigation. Many initiatives link ecological, social and economic objectives through development of integrated regional approaches to resource management. A range of strategies, such as the National Strategy for Ecologically Sustainable Development, agreed between the Federal and State Governments, have had significant influences on land management practices in the rural sector.
Arid areas have received particular attention through agreement on a set of National Principles and Guidelines for Rangeland Management. The National Strategy for Rangelands Management was prepared by a working group comprising representatives from key stakeholder groups, including government, industry, conservation, indigenous peoples and scientists. Rural and urban communities, industry and other interest groups provided significant input. The Strategy sets out a vision for Australia's rangelands based on the need for ecological sustainability and commercial viability of industry in the region. It identifies actions needed to protect and enhance the natural resources base that underlies most activity in the rangelands.

One of the key initiatives called upon in this strategy was the establishment of a system to monitor the trend and condition of Australia's rangelands. This initiative, being progressed through a partnership between the Federal and State governments, is known as the Australian Rangelands Information System and provides a model for other countries as they establish systems to monitor the trend and condition of their resources while simultaneously providing management orientated information to resource users.

The National Drought Policy was agreed between the Federal, State and Territory Governments in 1992. The Policy aims to encourage primary producers and other sections of rural Australia to adopt self-reliant approaches to managing for climatic variability, maintain and protect Australia's agricultural and environmental resource bases during periods of extreme climate stress and ensure early recovery of agricultural and rural industries, consistent with long-term sustainable levels. A review of drought measures triggered under the National Drought Policy was initiated as a result of the intensification of Australia's drought situation in 1994-95. Subsequent developments in drought policy have strengthened the emphasis on self-reliance and focused on the importance of drought research and development of programs aimed at maintaining a sustainable farming sector and minimizing the impacts of drought on the environment.

Federal, State and Territory Governments have developed a National Weeds Strategy in an attempt to better coordinate control efforts by the different spheres of government and landholders in addressing nationally significant weed species. A number of weeds including Prickly Acacia (Acacia nilotica), Rubber Vine (Cryptostegia grandiflora), Mesquite (Prosopis spp), Parkinsonia (Parkinsonia aculeata) and Athel Pine (Tamarix Aphylla) are serious pests in the rangelands and have been included in the inaugural list of 20 Weeds of National Significance.

Management of total grazing pressure is of concern to rangeland pastoralists. Total grazing pressure comes from the grazing and browsing of herbivores including stock, native species and feral pests. Grazing intensity of stock can be managed through best practice grazing management, and populations of native species are regulated through natural processes. However grazing by feral animals has an enormous influence on the ecology of the rangelands. Compounding this, the management of feral pests is very difficult over extensive areas. The 1996 release of the rabbit calicivirus disease has reduced the grazing impact of this pest species with subsequent environmental benefits. Efforts are also being made

to better manage feral populations of the larger ungulates such as horses and donkeys by population reduction and exclusion from watering points. A greater challenge is the management of populations of the smaller herbivores, such as goats.

Many rangeland areas contain habitat for rare, threatened and endangered species and have a significant number of endemic species or exhibit high species diversity. Biodiversity in these areas has been adversely affected by factors such as feral animals and weeds, modification of habitat by grazing, vegetation clearing and land degradation. The National Strategy for the Conservation of Australia's Biological Diversity and the recently introduced Environment Protection and Biodiversity Conservation Act 1999 are helping to address these issues.

2. Initiatives to Combat Desertification funded through Australia's Overseas Aid Program

Australia's overseas aid program assists developing countries in reducing poverty and achieving sustainable development. Many aid activities address the environmental causes of poverty, including desertification. The Australian Government, through the Australian Agency for International Development (AusAID), is currently supporting a range of bilateral programs to combat desertification in developing countries with a total funding commitment of approximately $58.5 million. AusAID also administers contributions to a range of multilateral organizations and Australian NGOs with a mandate for addressing desertification.

Australia's experience in tackling land degradation has been important in helping other countries to address their resource management problems. The Australian Government, through the Australian Centre for International Agricultural Research (ACIAR), funds agricultural research projects executed collaboratively by research institutions in Australia and developing countries on subject areas that are of high mutual priority. Land degradation and desertification are important focal points for this research. The Australian Government also funds international agricultural research centres, many of which operate within the framework of the Consultative Group on International Agricultural Research (CGIAR). Several of these centres are active in desertification research, and are supported by Australia both through core funding and funding for specific desertification related projects.

At present ACIAR conducts16 projects related to desertification, involving a total funding commitment of over $11 million. These project activities are concentrated in China, India, southern Africa and Southeast Asia. In 2001/02, ACIAR distributed core contributions of $1.55 million to four international agricultural research centres for activities in desertification research.

[SUBSTANTIAL EXAMPLES]

A. Case Study 1 - Grassy Ecosystem Management Kit: a guide to developing conservation management plans

Principal authors: Sarah Sharp (Environment ACT), Josh Dorrough (Arthur Rylah Institute) and Reiner Rehwinkle (NSW National Parks and Wildlife Service). (Funded by: WWF/NHT Grassy Ecosystems Grants)

1. Problem

Grassy ecosystems are subject to current and continuing threats likely to lead to their extinction. They are among the most modified and reduced ecosystems in Australia, due to the intense pressures on the areas that support them for settlement and agricultural practices. Less than 5% of the endangered natural temperate grassland remains in south-eastern Australia and less than 10% of box woodlands remain. While some of these sites are in reserves, and others could be added to the reserve system, management actions in many other sites may be adequate to retain these sites, both for conservation and other land uses.

Many grassy sites do not have management plans specifically prepared for them and existing management guidelines for grassy ecosystems do not provide adequate information for the majority of landholders to develop an integrated management plan. They provide recommendations, but usually contain little guidance in how they can be implemented.

2. Location/landscapes/land-uses

Treeless grasslands and grassy woodlands once covered vast areas of southeastern Australia. Since early European settlement, these grassy ecosystems have been recognized for their values for agricultural production, and as ideal sites for cities and towns and their associated roads and railways despite the seasonal lack of water. Periods of drought and overgrazing, infestations of rabbits and weeds, and the cultivation and pasture improvement boom since the Second World War have all resulted in dramatic changes and, at times, complete losses of the original grassy ecosystems. Even the least disturbed sites have been invaded by introduced plant species. Regionally, many native plant and animal species have declined or become extinct. Many animals occur in grassy ecosystems, some in particular communities, others are found more broadly, and use grassy communities for only part of their needs, such as for migration, feeding or breeding. Some species that are unique to particular communities, especially those that have severely declined or have been greatly modified, are also threatened with

extinction. Many have been declared threatened under Commonwealth, State and Territory legislation. Retaining existing bushland that includes grassy ecosystems will also retain habitat for many of these species.

3. Social information

Support from the community and government agencies is required to ensure that landholders are not financially and socially impacted by decisions to change current practices. The Commonwealth, State and Territory Governments, as well as several Non-Government organizations, provide opportunities for landholders to apply for funding to assist in making changes that have outcomes for conservation and/or sustainability. Increasingly, there is more information on the economic and social advantages in retaining grassy ecosystems. This includes the part grasslands play in sustainable agriculture and their roles in retaining water quality and the prevention of salinity. There is a demand to use native grasses for landscaping and for low-input farming. The scenic values of these ecosystems too, have often only recently been recognized. Some lowland grassland sites rival the alpine herb-fields in their wildflower displays, and areas dominated by native grasses have a subtle beauty, especially as they change from season to season.

4. What has been done

The project is to develop a kit for implementing adaptive management in a range of sites that are privately owned or managed by public authorities. The kit will facilitate the implementation of best practice management in the most significant sites, to be developed with the assistance of grassland liaison officers.

The project addresses and meets the following aims:

- An improvement in understanding and application of best practice management across a range of sites and tenures;
- Increased community involvement in the management of grassy ecosystems across their range;
- Knowledge generation about the distribution and conservation status of grassy ecosystem remnants, particularly those on private land.

The Management Plan development process is a series of decision steps, identifying what is there, issues, actions required, responsible bodies, and a timetable of when actions are to be implemented. The form of recording of these enables the process to be used to review the actions. It can be applied at a site level or landscape level. Collation sheets and a database on a CD or disks will be supplied to enable landholders to easily develop species lists, list issues and actions and collate and review data graphically.

The methods used to monitor species and the ecological communities depend on our objectives and required outcomes, our level of expertise, and the availability of resources. Monitoring methods range from checking that a species (or ecological community) is still present, determining whether intended actions have been undertaken (which may not necessarily assess what the actions have achieved), or retaining photographic records over time. More complicated monitoring methods involve detailed repeated surveys and analysis of the abundance of species over time.

5. Who has been involved

The project draws on the expertise of a wide range of grassy practitioners (ecologists, agronomists and landholders) within the Southern Tablelands and elsewhere, to refine the process of decision-making. Landholders have been involved in the design and testing of this kit to ensure that it remains relevant. Involvement was sought also from a range of scientists and practitioners. The kit was presented via workshops with individual Landcare groups, rural extension officers and conservation service rangers and comment sought on the content. The kit was trialed in a range of sites subject to different land uses. Training will be provided to extension officers to assist them to work with individual landholders and community groups such as Landcare.

For the kit to work, the landholders need to take responsibility for identifying issues and taking action within their resources, thereby taking ownership of the process. Most of the remaining grassy communities occur outside reserves so the actions of landholders has enormous influence as to whether these communities are maintained, improve in quality, or become further threatened.

6. Value of outcomes for ecologically sustainable natural resource management

The kit is still under preparation. It is envisaged that the kit will assist a wide range of landholders to apply conservation management in grassy ecosystems. In some cases assistance will be provided by extension officers, although the kit is being developed for landholders to develop and implement conservation site action plans independently. As landholders implement the site action plans developed using the kit they will increase their understanding of ecologically sustainable natural resource management.

B. Case Study 2 - Climate Risk Management

1. Problem

Australia's highly variable rainfall from year to year and the occurrence of droughts that may last for many seasons and cover large areas, have a huge impact on the environment, agricultural production and the income and well being of farming families and rural communities. Extended drought can result in devastating agro-ecological impacts including crop failures and huge stock losses. Soil loss and long-term changes in vegetation where weed species invade native perennials can result in long-term land and pasture degradation.

Drought was once regarded as a catastrophic and unpredictable event for which little could be done to mitigate its impact. It was possible for many affected farmers to receive financial relief when drought was declared. This, and the associated farming practices which these circumstances encouraged did little to ensure the long term sustainability of much of Australia's agricultural and grazing lands.

2. Location/landscapes/land uses

Cropping and grazing across areas of Australia with low and variable rainfall.

3. Social information

A new approach adopted by the Commonwealth, State and Territory Governments in the 1990's recognized drought as an accepted part of Australian farming. Financial relief is provided only in Exceptional Circumstances, i.e. where the event is rare (a one in 20 or 25 year event), severe, and lasting more than 12 months. Under this policy, primary producers and other sections of rural Australia are encouraged to adopt self-reliant approaches to managing climatic variability and to maintain and protect Australia's agricultural and environmental resource bases during periods of extreme climatic stress. This approach has focused property managers on adopting risk management strategies to manage climate and decrease the impact of drought on agricultural production and the environment.

4. What has been done

Farmers and graziers now have access to a range of crop, grassland and pasture simulation models, developed by various agricultural and natural resource agencies, to assist in monitoring agricultural conditions such as pasture cover, nutrient availability and meteorological conditions. In stressed conditions, action may be taken, e.g. by reducing stocking rates, to reduce the long-term impacts. Using an Australian-wide network of around 7000 rainfall stations to monitor rainfall deficiencies, conditions are reviewed nationally on a monthly basis to identify areas where serious or severe rainfall deficiencies exist.

Monitoring of current conditions is complemented by a Seasonal Outlook Service (http://www.bom.gov.au/climate/ahead), issued monthly by the Bureau of Meteorology. This forecast service maps probabilities of above, below or near average rainfall and temperatures over the coming three-month period. It also gives the probabilities of selected regions receiving certain thresholds of rainfall and provides information on the status of the El Nino-Southern Oscillation (ENSO), which has a major influence on much of Australia's climate. The outlooks, together with estimates of their reliability, enable property managers to employ risk management techniques in planning cropping schedules and stocking rates for the coming season. These management practices can reduce the environmental stress imposed by climate extremes such as prolonged drought.

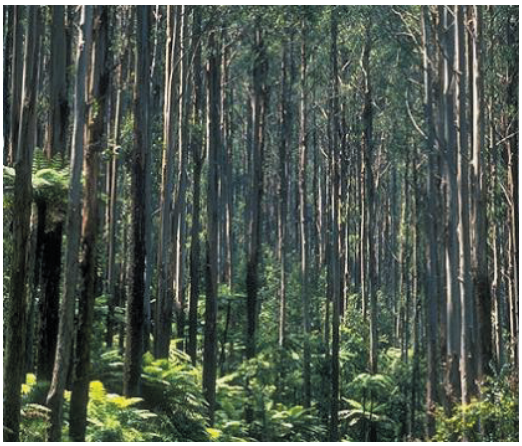
5. Who has been involved

Farmers, graziers, and scientists from various agricultural and natural resource agencies and the Australian Bureau of Meteorology have been involved in this project.

6. Value of outcomes for ecologically sustainable natural resource management

This risk management process involves using monitoring and prediction information on which decisions can be based. Through identifying areas with serious or severe rainfall deficiencies, monitoring agricultural conditions such as pasture cover and nutrient availability, and using probabilistic forecasts of seasonal rainfall and temperature the environmental stress imposed by climate extremes can be reduced.

C. Case Study 3 - Regional Forest Agreements



1. Problem

Prior to the development of the Regional Forest Agreements (RFAs) there was a long history of conflict over the use of public forests. The main protagonists in the conflict were the forest industry, who wanted secure access to forest areas for timber production, and the conservation stakeholder groups, who wanted more forests placed into secure reserve and better off-reserve harvesting practices.

Previously, the Commonwealth regulated the international export of woodchips under the Export Control Act, accrediting only those forest coupes from which timber could be removed for woodchip production. This accreditation, or refusal, would follow a full assessment of the National Estate values in that coupe. The situation was not ideal, and the solution was to develop a program in which enough forest was reserved to protect current and future conservation values, and enough left as a secure resource for the forest industry.

In 1992, the Commonwealth and the States agreed on a National Forest Policy Statement, which established a framework for the conservation and sustainable use of forests in Australia. It was agreed that future forest use would be determined on the basis of a detailed assessment process of conservation, forest management, social and economic issues. The results of this process would be incorporated in a number of RFAs.

2. Location/landscape/land uses

The RFA regions covered all forest and vegetation types from tall high production forests to open woodlands, heath lands and cleared land. The landscape ranged from coastal dunes, moist nutrient rich coastal valleys, steep escarpment country and dry inland tablelands. A wide range of land uses occurred in each region, including timber production, recreation and conservation reserves, mining, agriculture, tourism, and cottage industries such as honey production. Most of the land was either State owned land (managed by the State Government or leased to private individuals), or privately owned land. The Commonwealth owned small tracts of land in the some regions.

3. Social Information

The RFA regions all contained small timber towns whose primary means of employment was linked to the forest industry. Eco-tourism was also a primary employer in the regions. A full social assessment was undertaken for each of these owns, and the economic and social impacts were taken into account when developing the RFA. The communities were encouraged to participate in the process of developing and deciding the outcomes of the RFAs.

A Monetary Industry Structural Adjustment Help Package was available to individuals and industries affected by the RFAs, to help with upgrade of business facilities, to aid in value-added wood production, for retraining individuals or other associated costs.

4. What has been done

All available information on environment, heritage, social and economic values of the regions was gathered. Gaps identified, and projects (jointly funded by the Commonwealth and the State Governments) created to carry out the necessary research and surveys. While this information was being collected over a period of several years, interim agreements were put in place to control which areas were available for forest harvesting.

A reserve design criteria were developed to set targets for wilderness, forest ecosystems, and old growth forest values including reserve design guidelines. A negotiation and public consultation process was then undertaken, leading to the signing of the RFAs for eleven regions, covering parts of Western Australia, Tasmania, Victoria, and New South Wales. The regions averaged 3.6 million hectares in size and are valid for 20 years.

The RFAs were designed to:

- To create new formal reserves, and accredit off-reserve harvesting practices, so that where possible reserve targets were met, sufficient endangered species habitat was protected, and National Estate values were protected to an acceptable level;
- To provide or accredit a program for the further protection of values on private land;
- To provide security of access to timber resource for 20 years, which in turn would encourage the development of timber markets;
- To determine what the sustainable level of timber harvesting was for the remaining unreserved forest, and set in place a monitoring and evaluation program.

5. Who has been involved

The RFAs were signed by the Commonwealth and State governments. The process involved consultation with industry, conservation and community stakeholders. The formal consultation process was supplemented by ad hoc consultation by governments, stakeholder groups and the public through meetings and correspondence.

Public consultation, an important part of the RFAs, was undertaken throughout the process. Information and feedback sessions were organized around the regions, and continuing public consultation was provided by membership on technical groups and steering committees of key stakeholders groups.

Calls for written submissions were advertised in the newspapers, at strategic times, such as after the release of interim forest agreements, discussion papers and options reports. Tens of thousands of submissions were received for each region and used to inform the State and Commonwealth Governments during negotiations.

6. Value of outcomes for ecologically sustainable natural resource management

The RFA process contributed to our knowledge of forests values, the requirements necessary to protect these values, and how to effectively involve the community in the process. It was the first process to quantify targets for the protection of environmental values, which traditionally have been difficult to value in multi-use resource management.

The public consultation process was one of the most comprehensive, multi-faceted undertaken on environmental issues.

In particular the RFA was a prototype for the full comprehensive assessment of regional forest values, collating and initiating surveys, models and assessments ordinarily undertaken by separate State/Territory and Commonwealth agencies. A forest yield assessment was also undertaken for each region, on which ecologically sustainable forest management and harvesting could be based on.

Lessons learnt from the RFA process have contributed to the design and effective running of regional natural resource management programs, such as the Commonwealth-State/Territory National Action Plan for Salinity and Water Quality.

7. Standards and Targets

Australia is facing natural resource degradation through increasing salinity, deteriorating water quality and loss of biodiversity. These have direct and indirect impacts on agricultural production, towns and infrastructure and the viability of Australia's regional communities.

The Commonwealth and State and Territory Governments, in partnership with regional communities, are implementing two initiatives, the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality, to tackle natural resource management (NRM) problems. Under these programs, Governments will invest in priority actions under agreed natural resource management plans developed for Australia's catchments and regions.

Regional communities will establish targets as part of their plans, based on an assessment of the current state of the natural resources, and the outcomes we are seeking.

NRM regional targets are tools to:

- help communities set strategic regional objectives for their on-ground activities;
- focus action on priority issues and locations; and
- measure the success of efforts made through joint government and community investment.

Regional targets will set out a particular actions or outcome to be achieved by a specific date. Long-term targets will establish the resource condition outcome a region believes it can achieve within say 10-20

years, for example, changes to groundwater levels; stream salinity and vegetation cover. Short-term targets will identify the steps that will contribute to achieving the long-term targets, and focus largely on management actions or capacity-building, for example, the length of riparian zone protected; percentage of farms with whole farm plans in place; or area of revegetation.

The Commonwealth and State/Territory Governments will invest in the implementation of accredited regional plans, including the achievement of regional targets. Program investment will support both on-ground action, and also capacity building, including the development of skills, knowledge and information required for regions and individuals to respond effectively to the new challenges posed by integrated planning and target setting. Agreed regional targets will help align activities at the local regional, state/territory and national levels, so that effort is more strategic and effective.

D. Case Study 4 - Australian Bird Atlas

1. Problem

Over the last 20 years there have been many changes within the Australian natural environment. Native vegetation has been cleared, coastal development has expanded, population has increased, pastoral development is changing northern Australia, and the creation of roads, dams, irrigation projects and tree-planting programs all have effects on birds and other wildlife. Biodiversity values are particularly hard to measure across the landscape, the Bird Atlas project provides and utilizes data to monitor the maintenance of biodiversity values across Australia.

The first Bird Atlas, undertaken in 1977-1981, was a strongly supported, community based volunteer project coordinated by Birds Australia. The additional data from the second Atlas (1998 ?2002) provides a valuable means for measuring changes to the status and distribution of bird species across the whole of Australia from a known benchmark.

2. Location/landscapes/land uses

So far over 255,000 surveys have been carried out in 130,000 different locations covering 99% of the 10 blocks across Australia. Surveys have been carried out in remote locations from ocean vessels and specific monitoring carried out at internationally recognized Ramsar sites. An intensive survey component (involving the completion of habitat forms) has also been carried out, particularly in grazing and extensive cropping areas (e.g. wheat/sheep country), providing us with further information on the interaction between birds and land use.

3. Social Information

The project has encouraged community interest in bird watching and facilitates community education in biodiversity monitoring.

4. What has been done

The Bird Atlas utilizes volunteers to collect information on the distribution, abundance and habitat

requirements of birds. They also collect more specific information on threatened and exotic bird species, habitats, breeding and land use.

The data collected enables us to:

- Collect and analyze data on the distribution and relative abundance of Australia's bird species (including rare and threatened);
- Compare the distribution and abundance of bird species over a 20-year period;
- Explore relationships between birds and land management practices and changes in habitat;
- Investigate the effect of tree planting and revegetation programs on birds; and
- Examine regional and seasonal variation in the occurrence of bird species.

The first Atlas of Australian Birds project documented the distribution and relative abundance of Australia bird species between 1977 and 1981, including historical bird records from a variety of sources. It formed the largest environmental mapping project ever to have been carried out in Australia. More than twenty years later, the need to refresh our knowledge of bird distributions led to the new bird Atlas project. On completion of the new atlas project, 55,000 bird surveys have been carried out, with nearly 4,300,000 bird sightings and 759 bird species recorded.

Birds Australia is currently comparing the two atlases. They are mapping bird species distributions, past and present, to study and quantify any changes over time and to examine whether patterns of change are consistent across different regions.

5. Who has been involved

Over 7,000 volunteers including state and regionally based bird clubs, naturalist clubs, landholders and other interest groups from the Australian community carried out 255,000 surveys and submitted 4.3 million bird records.

Government agencies, researchers, schools and the community in a wide range of conservation planning and land management applications use the information collected through the Atlas extensively.

The Commonwealth Government, and all Australia's state governments, have fully supported the project and will use its results to help with conservation planning in the future. Information from the Atlas project will help identify Australia's Important Bird Areas as part of a worldwide conservation program headed by BirdLife International.

6. Value of outcomes for ecologically sustainable natural resource management

The Bird Atlas assists us in the conservation and management of Australian birds by:

- Documenting the distribution and relative abundance of birds across the Australian continent;
- Identifying broad changes in the distribution of bird species by comparing the data collecting in the first atlas project with those in the new one;
- Recording detailed data on occurrence of threatened species as listed by the Commonwealth and State Governments;
- Recording the habitat affinities of bird species;
- Providing information to assist in directing and evaluating the re-vegetation activities funded through

Bushcare to maximize conservation benefits; and
- Using birds as a surrogate for biodiversity by establishing a long-term, community based on-ground monitoring program to monitor maintenance of bird populations across a range of land-uses.

The Bird Atlas data enables us to see trends in the distribution of birds and in some cases use birds as indicators, such as for the presence of particular food resources. It enables us to identify hotspots of bird diversity and core areas that need to be protected, as well as danger areas where birds are in decline from various threatening processes. All of this information provides an essential framework for directing and evaluating the activities funded through the Bushcare Program.

E. Case Study 5 - Murray-Darling Basin Initiative

1. Problem

The development of water, land and other environmental resources of the Murray-Darling Basin has created numerous economic and social benefits. However, the use of these resources has also caused significant environmental degradation. Over-allocation of water, the regulation of rivers and the removal of native vegetation has created many environmental problems including increasing land and water salinization and the loss of important riverine, wetland and floodplain habitats and their associated ecosystems. These environmental issues are being addressed as part of the Murray-Darling Basin Initiative.

2. Location/landscapes/landuses

The Murray-Darling Basin covers 1,061,469 km©˜, which is equivalent to 14% of Australia's land area. The Basin is Australia's most important agricultural region, supporting approximately 75% of Australia's irrigated agriculture, and accounting for 41% of the nation's gross value of agricultural production. The Basin's natural resources are also rich in biodiversity and cultural heritage values. A number of the Basin's wetlands are recognized under the Convention on Wetlands of International Importance. The Murray-Darling Basin is also home to icon species including the Murray cod and Murray crayfish.

3. Social information

The 1996 census reported a Basin population of almost two million, which was 10.95% of Australia's total population. The Basin is administered by five State/Territory governments, the Commonwealth, and more than 200 local governments. These governments manage the resources of the Basin in partnership with catchment organizations, landcare groups and numerous other community organizations.

4. What has been done

The Murray-Darling Basin Initiative is the name given to the partnership between the governments and the community to give effect to the 1992 Murray-Darling Basin Agreement. The Agreement aims to promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin.

In response to the declining health of the Murray-Darling system, the Murray-Darling Basin Initiative has produced a number of key actions including:

- The cap on water diversions in the Basin, which was seen as an essential first step in establishing management systems to achieve healthy rivers and sustainable consumptive uses;
- Environmental flows to improve the ecological condition of the River Murray. The Murray-Darling Basin Ministerial Council has directed the release, for public comment and further analysis, of three environmental flow scenarios, the return of 350, 750 and 1500 gigalitres of water to the River Murray;
- The Sustainable Rivers Audit, a broad river health assessment tool that will assist in identifying the effectiveness of current river management initiatives; and
- Integrated Catchment Management in the Basin complementing other Commonwealth and state Programs including the National Action Plan for Salinity and Water Quality and the Natural Heritage Trust.

The Initiative has produced a number of linked strategies, including the Basin Salinity Management Strategy and the Native Fish Strategy, which include specific actions and targets to improve the health of the Murray-Darling Basin's natural resources.

5. Who has been involved?

The entire Basin community is involved in the Initiative. The Initiative is a partnership between the Basin governments and the community.

6. Value of outcomes for ecologically sustainable natural resource management

The Murray-Darling Basin Initiative contributes towards ecologically sustainable natural resource management by:

- Using an integrated catchment management approach for assessing and improving the health of the Basin's natural resources;
- Targeted investment in on-ground actions and research that will result in improvements in the ecological health of the entire system; and
- Creating a partnership approach to the management of the Basin's natural resources, which is inclusive of the entire Basin community, and encourages governments to work together for a common goal.

F. Case Study 6 - Remote sensing of grazing impact in northern South Australia & Barkly Tablelands, NT

1. Problem

Measuring change over vast areas of land and separating real trends caused by grazing impacts from background noise caused by climatic variability.

2. Location/landscapes/landuses

Cattle grazing is conducted on the floristically simple, extensive, black soil plains of the Barkly Tablelands in the north, and on more complex landscapes of northern South Australia.

3. Social information

Both regions are occupied by a small number of large pastoral holdings, under leasehold tenure with ultimate responsibility in the public interest resting with State Governments and their respective Pastoral Boards. The Pastoral Boards are concerned to have methods to determine whether there are long-term deleterious effects of grazing in different paddocks. Existing ground-based techniques are inadequate in separating grazing effects from seasonal variability across the vast areas involved. Remote sensing methods are more cost-effective for administration agencies given the relatively low income they receive from lease rentals from this land. Pastoralists are also concerned to know the effects that their grazing may be having, but have only very subjective methods to keeping track of this over such large areas.

4. What has been done

Satellite-based methods originally developed and applied in central Australia were transferred and modified to suit these two new environments. This involved a deliberate policy of agency personnel initially working closely with CSIRO scientists, and then returning to their home agencies with subsequent support from CSIRO when necessary. This proved effective in transferring the technology and its use into the agencies that need to use it.

Summaries of the outcomes:

- Index of vegetation cover developed for each region that allows levels of vegetation cover to be monitored through time;
- Customized analysis software adapted to the specific requirements of each client; and
- Training and documentation to provide clients with confidence in independent use of the technology

5. Who has been involved

CSIRO staff from the Alice Springs Centre for Arid Zone Research, agency staff from the former SA Department of Environment, Heritage & Aboriginal Affairs and NT Department of Infrastructure, Planning & Environment, with cooperating pastoralists from each region.

6. Value of outcomes for ecologically sustainable natural resource management

Ability to track changes in the long-term across extensive regions, using methods that are now accepted to provide a robust measure of land condition. Implementation by agencies has sought to supplement remote sensing analyses with more detailed information about vegetation and soil collected at fixed monitoring sites.

G. Case Study 7 - Indigenous Land Management Facilitators

1. Problem

Until recently there has been a lack of practical two-way links between Indigenous land managers and other individuals and agencies involved in sustainable land management and nature conservation activities. Consequently there was often a lack of awareness between indigenous communities and Commonwealth Government policy makers with regard to particular land management issues and initiatives within regions.

2. Location/landscapes/landuses

All regions of Australia

3. Social information

The Federal Government recognizes that Indigenous (Aboriginal and Torres Strait Islander) Australians are a major stakeholder in the management and protection of Australia's natural and cultural resources.

4. What has been done

To help Indigenous Australians address their land management needs, contribute to national objectives and to gain access to the $1.5 billion Natural Heritage Trust funding, the Federal Government has established a national network of 13 Indigenous Land Management Facilitators. The Facilitators provide assistance to Indigenous people involved in land management. They are funded through the Bushcare and National Landcare Programs, and are employed through regionally based host agencies covering all regions.

The role of the Indigenous Land Management Facilitator is to:

- Act as a link between Indigenous land managers and other individuals and organizations involved in promoting sustainable land management and biodiversity conservation;
- Ensure that Indigenous communities within a region are aware of the land management issues and initiatives in their region;
- Provide information to the Indigenous community about the Natural Heritage Trust and other programs of support available;
- Provide feedback to Commonwealth Government policy makers on land management issues of

concern to Indigenous communities; and
- Raise awareness by Government agencies and non-Indigenous communities of Indigenous values, aspirations and capacity in land management.

5. Who has been involved

Indigenous land manager facilitators, indigenous and non-indigenous communities, and government policy makers have been involved.

6. Value of outcomes for ecologically sustainable natural resource management

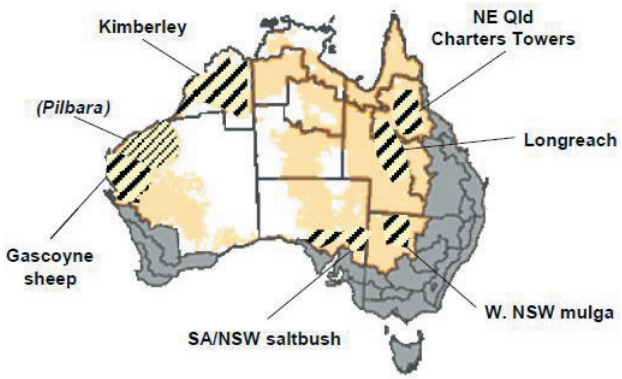
The goal of the Indigenous Land Management Facilitators Program project is to encourage Indigenous communities to participate in Natural Heritage Trust projects on land under their care, or in which they have an interest.

The facilitators provide information to Indigenous communities about the types of support and technical advice that is available to assist them with the land management issues on their lands. The facilitators also provide feedback to Commonwealth Government policy-makers on land management issues that are of concern to Indigenous communities, and help raise awareness within Government agencies and the non-Indigenous communities of Indigenous values, aspirations and capacity in land management.

Land management projects involving Indigenous communities include:
- Establishing nurseries for revegetation with native plants;
- Controlling rabbit and weed;
- Reducing the extent and effect of seasonal wild fires;
- Fencing out stock from ecologically sensitive areas such as river banks; and
- Developing interpretation trails to inform the broader community about Indigenous land management practices and the benefits of protecting cultural sites.

H. Case Study 8 - RiskHerd[1]

The rangelands of Australia showing areas occupied by sheep or cattle, this region was the scope of the RISKHerd project



[1] RISKHerd: taxation policy instruments and grazing management in the rangelands (funded by Land and Water Australia's Climate Variability in Agriculture Research & Development Program with CSIRO). Principal investigator: Mark Stafford Smith, CSIRO Centre for Arid Zone Research, Alice Springs, NT 0871. Mark.StaffordSmith@csiro.au

1. Problem

The RISKHerd project evolved out of concerns expressed by producers and policy stakeholders that federal government taxation-policy instruments designed to assist farmers and graziers in managing production risks were actually undermining efforts for sustainable resource management within the pastoral industry.

2. Location/landscapes/landuses

The project looked explicitly at 6 regions of the rangelands of Australia, including sheep and cattle enterprises on vegetation systems with different degrees of resilience, with different levels of climatic variability and different access to markets.

3. Social information

The project sought to link policy-makers at a national level with regional farmer groups in a way that permitted some two-way flow of information and understanding.

4. What has been done

The project had 3 interwoven strands - policy consultation, producer consultation, and modelling - operating at national and regional levels. The involvement of a national policy steering group guided preliminary analyses based on existing data and thereafter provided direction to the remainder of the project. Consultation with producers in six main regions around the rangelands involved surveying their use of tax instruments then discussing these in more detail with a subset of people in each region. From this information (and other sources), we constructed models of typical enterprises in each region and analyzed the implications of using different tax instruments on these, looking at a stochastic analysis of thousands of realistic climatic sequences coupled with sensible probability distributions of prices and other financial and biophysical drivers. The models were coupled models of pasture production and condition, animal production and farmer level management decision-making, with farm-level economics and a taxation module which accounted for the policy options. Error propagation between model modules was managed with great care! The regional surveys and discussion provide a rich source of understanding about why different instruments may or may not be popular in different regions, thereby helping us interpret the modeling results. These have been finalized in seven major reports but are still being summarized into a 16-page policy-maker communications document and on to a CD-ROM.

5. Who has been involved

Innovatively, the project engaged federal policy-makers and lobbyists as well as individual farmers in regions with different production characteristics around the rangelands. The federal steering group included senior participants from the National Farmers Federation (the national farmers' lobby group), Agriculture Forestry Fisheries Australia (the national department of agriculture), the Department of Treasury, the Australian Taxation Office (federal agency responsible for collecting tax within Treasury's policy guidelines) and NSW Agriculture (a state department of agriculture). Some 150 pastoralists were surveyed across the continent, and about 30 of these interviewed in detail to provide data for modeling. Where possible, pastoralist groups were involved to broaden the involvement. Tax issues turned out to

be close to the heart of many.

6. Value of outcomes for ecologically sustainable natural resource management

The findings showed that there are some notable opportunities to consider changes that could reduce tax-related public investment in the grazing industries, whilst benefiting the long-term future of the industry and its natural resource management. An eventual move towards a more market-oriented herd valuation system could permit the removal of livestock elections and even re-consideration of income averaging, thus dramatically changing three major current tax instruments. Benefits could include better signals in relation to sustainable resource management, a better ability to respond to emerging technologies that assist with self-reliance, and a reduction of cost to the public purse.

The retention of farm management deposits (another tax-related instrument) would help with some issues not covered by these changes. Such a change would be at a short term financial cost to pastoralists which can be argued to be comparable to the long-term financial implications of the resource changes promoted by low valuations, at least in the regions where we have been able to formally assess these. However, there are major transition costs, which industry would not be likely to accept in their entirety. The project showed why this is so and why it might still be in the public interest to consider such a transition.

The study focused on grazing management in the more remote and lightly settled parts of the continent. Obviously changing the system would have implications for agriculture in other regions, and the findings do not necessarily apply equally to these. Because of this it was not expected that there would be instant policy changes as a result of the project, especially given the contentious transition issues.

However, the study has added to the increasing weight of evidence in favour of some policy changes in this area, and the abbreviated policy-maker summary is expected to stay on the shelves of the participating agencies towards the day when the political environment allows a new review of taxation policy to occur. The study has also highlighted how the implementation of some other investments in self-reliance for agricultural industries is being blocked by out-of-date taxation conditions.

I. Case Study 9 - Assisting India (Overseas Example)

Title: Integrative technologies for assessing the extent and cause of degradation in arid community rangelands, Rajasthan, India.

Principal investigator: Dr Margaret Friedel & Gary Bastin (CSIRO), Dr Suresh Kumar (Central Arid Zone Research Institute, Jodhpur, India) (Funded by: ACIAR, CSIRO)

1. Problem

Increasing human and animal (sheep, goat, cattle and buffalo) populations are placing extreme pressure on the soils and vegetation of arid northwest India. However, as in arid Australia, rainfall variability from year to year makes it very difficult to determine the extent and precise causes of land degradation. Remote sensing technology developed by CSIRO for monitoring land degradation is being modified and

evaluated for its effectiveness in assessing land degradation in this environment.

2. Location/landscapes/landuses

Jodhpur region (central Rajasthan), India. Main landuses are subsistence dryland cropping based on monsoonal rainfall and grazing of communal lands.

3. Social information

Socio-economists and livestock experts are establishing relationships with village people (village entree) and collecting economic, social and livestock data that will assist in interpreting trends derived from remote sensing analyses. These scientists are the conduits to explain assessments of degradation to village people and obtain information from them to help explain spatial and temporal patterns detected through the analyses.

4. What has been done

The project is midway through its fourth year. The main work areas are:

- apply and adapt Australian-developed techniques, using remotely-sensed data, for assessing land degradation, to Indian desert environments;
- gather ground-based survey data on socio-economic factors, the natural resource base and animal production for interpreting the results of remotely sensed analyses;
- develop means of information exchange with village communities in order to explain land degradation; and
- develop capacity with Indian colleagues for their independent use of all methodologies.

5. Who has been involved

CSIRO scientists at the Alice Springs Centre for Arid Zone Research (Margaret Friedel, Gary Bastin, Vanessa Chewings, Janine Kinloch) and a multi-disciplinary team of scientists at the Central Arid Zone Research Institute (CAZRI), Jodhpur (Rajasthan, India).

6. Value of outcomes for ecologically sustainable natural resource management

For India: Ability to separate human-induced degradation of vegetation due to grazing and timber collection from that due to natural causes (climatic variation). It is possible to do this over large areas in a repeatable manner.

For Australia: Knowledge that Australian developed technology is applicable/useful in the arid regions of other countries, and extension of the conceptual models on which the methodology is based to encompass additional environments that may contribute to future uses in Australia.

[SUMMARY]

Australia has well-established domestic initiatives to address the global challenge of combating desertification in addition to providing support and assistance to other affected countries. Domestically,

the diversity of Australian landscapes, and the continent's erosion prone soils and climatic extremes has necessitated a coordinated and strategic approach to sustainable natural resource management. This approach centres on collaborative approaches between all levels of government, industry and the community. While agricultural and pastoral activity are critical components of our national economy, Australian landscapes are generally not well suited to many of the land use and management practices imported from other continents over the last 200 years. This has catalyzed governments, research institutions, industry and communities to find ecologically sustainable approaches to land management. As a result, Australia has amassed considerable experience and expertise in managing and, where possible, reversing the decline in Australia's natural resource base. Australia has in place a substantial body of legislation, programs and strategies for sustainable natural resource management and has developed a range of domestic policy initiatives to encourage and build capacity in communities to address land degradation.

References

Fourth National Report for Implementing the UNCCD, 2010.

2. Bhutan: Sustainable Land Management and Its Application

- Chencho Norbu

[BACKGROUND]

Bhutan is a small landlocked mountainous country in the Eastern Himalayan range. Farming is the main source of livelihood for more than 69% of the population and a wide range of crops from low subtropical to high cool alpine species are grown. The arable land is round 8% and the forest area extends beyond 70% of the total geographic area. There are a number of rivers and streams that drain into the four main river basins of the country. The monsoon rain, glaciers and glacial lakes are the main sources of water for these river systems and these rivers provide huge potential (estimated potential is about 30,000 MW) to develop clean energy. Land degradation has become a big concern in the recent years because of increased anthropogenic activities. Crop production, quality of water, road networks and local biodiversity are being directly affected by: 1) soil erosions (to be more precise, surface erosions in particular); 2) landslides; 3) mass wasting and flash floods.

Figure 1. Loss of farming land through formation of Ravines and Gullies

[ACTIVITIES AND PROGRAMMES]

1. Conservation and Soil Fertility Programs

The farmers use farmyard manure applied at the rate of 3 to 5 tons/ha as the main source of plant nutrients. The use of imported chemical fertilizers and soil conservation measures were promoted to increase crop production. The farmers were provided incentives of 300.00 Ngultrum[2] and 500.00 Ngultrum per acre of dry land to establish contour bunds and terraces respectively in 1980s. The adoption rate of these programs was poor mainly because it was more of top-down directive, a blanket recommendation across the board. The farmers were rarely consulted on the technology options and the

[2] The currency of Bhutan since 1974.

physical limitations of farm lands were not assessed. There were no established mechanisms in place to share lessons learnt, coordination among sectors and programs leaders rarely took place, and in many cases monitoring of programs was neglected. For example, currently there are a number of agencies involved in development and implementation of good land husbandry practices: the bioengineering works by the department of roads, the land development works by the department of agriculture, soil conservation by department of forest, rangeland management by department of livestock, the hydrology studies by the department of energy, and the research on soil fertility by the Regional Research Centres under the Ministry of Agriculture. The principles and practices of Sustainable Land Management (SLM) to improve local resources touch a wide range of sectors and stakeholders and yet there is no system in place to learn from each other. Although it is challenging to bring stakeholders together, frequent consultation and coordination among key stakeholders is essential to make SLM programs effective.

2. Bhutan has ratified (Joins) UNCCD and became UNCCD family member

Bhutan ratified the United Nations Convention to Combat Desertification (UNCCD) in 2003. During the same period the Global Environment Facility (GEF) was recognized as a financial mechanism with inclusion of the Sustainable Land Management as one of the Operational Programs (OP 15). Bhutan secured GEF grant of US $ 7.6 million through OP 15 in 2006 with the support from the World Bank (WB) to implement full scale Sustainable Land Management Project (SLMP) for the period of six years. The project aimed to support both prevention as well as rehabilitation of land degradation, and to mainstream Sustainable Land Management into its development strategy framework. Following this project, another US $ 500,000 medium size project was secured in 2007 from GEF regional allocation with the help of UNDP to mainstream SLM and build local capacity on SML principles and technologies.

3. GEP OP 15: SLM Project Preparation with Assistance

The project formulation started in 2004, and it took almost two years to complete the requirements of GEF and WB. WB as an implementing agency of GEF, fielded in a series of missions to work with the Bhutanese task force comprising of members from the various relevant sectors. A number of exciting exercises (Figure 2 and 3 below) were conducted with the help of consultants to identify causes of land degradation and possible interventions, and to meet the social and environment requirements of WB projects. These exercises were supplemented by a series of field visits, workshops and consultations with participation of stakeholders ranging from the rural farmers to the highest bureaucrats, the Secretaries of the Ministries. Indeed, these exercises helped participants understand land degradation issues, and enhanced their capacity to actively participate in a series of SLM discussions. The Bhutanese task force later transformed into a Multi-Sectoral Task Advisory Committee during the course of project implementation.

Figure 2 and 3. Consultation with the community members

A key to successful engagement of the farmers, planners, researchers, donors and politicians in identifying sites, issues of land degradation and possible interventions was good SLM knowledge based communication/coordination skill and patience to listen to the farmers with deep respect. Most of the key stakeholders either from central agencies or local institutes had limited knowledge of SLM technologies and land degradations issues and these too were confined to their local environment or institutes experiences. The farmers assumed soil erosions as a natural process (that happens every season), and all types of land slips, gullies and ravines formation as a rare event (associates mostly with local beliefs- a Natural Curse). At many sites and consultations, the farmers looked out for immediate return from their SLM investments while the key stakeholders from participating institutes were concerned with the budget allocation. Some of the most frequently asked questions were, "what would be my sector's budget share from this project? What incentives do we get as a party to this project? and how would I be compensated for using my land as an experimenting ground?"

Figure 4. A common site: topsoil erosions

Figure 5. Steep dry land farming on slope

The collection of baseline information of sites and the review of policy documents were another tedious exercise given that the record keeping was poor and information management weak. The farmers normally depend on their memories or oral history than on written documents while the information within the central institutes were not organized nor collated. The participants began to appreciate the value of this baseline information as the project log frames were developed and outputs were quantified. This information also served to minimize duplication of SLM efforts by various departments of the government.

4. National Land Management Campaign

The first National Land Management Campaign was organized to educate, to raise awareness and to seek active participation of stakeholders. Eight sites were selected in Trashigang Dzongkhag (District), the Dzongkhag with the highest population density where almost all farming is done on steep slopes greater than 25 degrees that had highly visible surface erosions, land slips, ravines and gullies (Figure 1, 8 and 9). The farmers, local leaders, planners, researchers, and the heads of the departments and senior officers of the Agriculture Ministry participated in this campaign for 21 days in the month of July in 2005. The activities implemented during this period were establishment of hedgerows (fodder grasses planted), terraces and contour bunds along the contours of sloping farm land; construction of stone and log check dams in gullies and ravines; and plantations of fodder and tree saplings on the degraded land. This was a special occasion for many senior officers from governmental departments to work with the local farmers during the campaign period. A review was carried out in all sites after a period of 5 to 6 months. Hedgerows, terraces and check dams (Figure 6 and 7) were well established at many sites although in some places fodder grasses and tree saplings had been grazed down by free grazing animals. A number of farmers have shown interest to take up these activities but many were limited by the size of land holdings (average land holding size is less than 2 ha) and the traditional habits of letting cattle to graze openly once the harvest is collected for the year. For these reasons, good land husbandry practices was not going to work without planned consultation with the farmers and local leaders. The process was more about understanding the needs of farmers and local environment than SLM technologies itself.

Figure 6. Stone Check dam in July 2005

Figure 7. Stone Check dam in Dec 2005

5. SLM Project Implementation

Three project sites were identified to implement SLMP activities. The project sites varied in degree of land degradation, types of land degradation and scale of interventions. The project has four components:

a) Pilot projects to demonstrate effective application of land degradation prevention approaches;
b) Mainstreaming of practices for protection against land degradation;
c) Policy support and guidance for mainstreaming land degradation prevention practices; and
d) National level support for coordination of implementation of land degradation prevention practices.

Most of the settlements of these pilot sites were scattered from 500 over 2000 metres a.s.l. and the land degradation problems varied widely because of difference in climatic zone and the types of crops grown. These bio-physical differences coupled with the variation in livelihood assets ownership, finding suitable SLM intervention during local resource planning process have become challenging. The priority of poor farmers was to increase income through improved farming while the focus of better off farmers was on infrastructure development like roads, electricity and schools. The management of common resources like watershed and grazing areas are hardly appeared in their list of priorities.

The field activities focused mostly on soil fertility and conservation improvement to increase crop yield, and reduce soil erosions, particularly on steep slopes. The demand for assorted tree saplings, fruit trees and fodder grasses was high and the farmers normally used degraded community land for plantation. The areas where threats of land slips were high, fencing materials were provided to create buffer zones for plantation. Where there was water scarcity both for drinking and irrigation, supports were provided to renovate irrigation canals and harvest water during the rainy season. A series of short and long term trainings were provided to the farmers, local leaders, extension service staff and researchers. During the course the project implementation a number of documents were published to share lessons learnt and most of these documents are now available at the website of the Ministry of Agriculture of Bhutan: www.moaf.gov.bt.

Figure 8 and 9. Before and after land management campaign in December 2004 and 2005

6. GEF Small Grants Program (SGP): Focal Area- Land Degradation.

A number of SGP projects focused on biodiversity and climate change focal area were executed by the local community leaders across the country. These projects were prepared with assistance from the local extension service and research officers. This SGP of GEF executed by UNDP Country Office in Bhutan from 1999 is a popular program because funds are accessible to local communities to initiate community driven environment projects. The focal area of land degradation gained momentum with Bhutan's ratification of UNCCD in 2003. The national land management campaign in 2005 and the full size SLM project preparation from 2004 to 2006 influenced the local leaders, extension service and researchers on land degradation issues. There were 16 projects listed under SGP on land degradation

focal area from the period 2005 to 2010. Most of these projects were implemented by the community members where GEF-SLM project could not cover in spite of there being acute land management problems.

[SUMMARY]

The SLM projects preparation under the guidance of WB and UNDP was long but the exercises, workshops, consultations and field visits during the project formulation were very informative and educative. Many local leaders are now concerned with the land degradation issues since it has direct bearing on their food production and local ecosystem services. This awareness has brought local communities together to implement a number of SGP on land degradation focal area, and inclusion of land management plans in their local five-year development plans.

Small-scale cropping farmers respond positively to incentives, and there is no better incentive than providing a wide range of seeds and seedlings for hedge rows on steep sloping farmlands. It reduces topsoil erosions by formation of bunds and ridges, and importantly sequesters carbon through green flush vegetation. Fodders from these bunds provide a good feed stock to cattle and in the long run, results in crop yield increase. For these good reasons, best SLM practices can secure household food security, minimize water pollution by sediments, and increase local vegetation coverage around farming communities living on the fragile mountainous environment. In other words, farmers' field is where we can operate the three Rio Conventions: UNCCD, CBD and UNFCCC through SLM best practices.

References

1. Bhutan National Land Management Report 2006.

2. The Project Appraisal Document, 2005, Bhutan.

3. The Annual Reports of SLMP: 2006-07, 2007-08, and 2008-09, Bhutan.

3. China: Combating Desertification on a Grand Scale

- Jia Xiaoxia, Ya Jie, Yuan Xiaodong, Li Jianming andWang Wenbiao

[BACKGROUND]

China is the world's fourth largest country (after Russia, Canada, and US); the Himalaya Mountain Ranges on the border with Nepal is the world's tallest peak. It is located in Eastern Asia, bordering the East China Sea, the Korea Bay, the Yellow Sea, and the South China Sea, between DPR Korea and Vietnam.

China's topography is very complicated: Mountain - 33% (316.8 ten thousand km^2), highlands - 26% (249.6 ten thousand km^2), Basin - 19% (182.4 ten thousand km^2), plains -12% (115.2 ten thousand km^2, hills - 10% (960,000 km^2).

China's current weather is extremely diverse; tropical and sub-tropical in the south to temperate and sub-arctic in the north. The climate of China varies greatly. The northern zone (including Beijing) has summer daytime temperatures of more than 30 degrees Celsius and winter of Arctic severity. The central zone (including Shanghai) has a temperate continental climate with very hot summer and cold winter. The southern zone (including Guangzhou) has a subtropical climate with very hot summer and mild winter.

The following table and map summarize the Index of aridity.

Table 1. Index of Aridity (the ratio of annual precipitation to potential evaporation)

Types of Climate	Index of Aridity	Area (103 km^2)
1.arid	0.05~0.20	1,427
2.semi-arid	0.20~0.50	1,139
3.dry sub-humid	0.50~0.65	751

(Source: China Country Paper to Combat Desertification, China Forestry Publishing House, 1997)

Figure 1. Map of Desertfication-prone Area in China

1. Problem

China is one of the countries that severely suffer from desertification over a vast area, wide distribution and complex. The area is prone to desertification is 3.317 million km^2 accounting for 34.6% of the total territory. According to the findings of National Desertification and Sandification Monitoring and Survey Report in 2004, by the end of 2004, the area of desertification-prone land was approximately 2.6362 million km^2, taking up 27.46% of the total territory. Also, 79.48% of the area is prone to desertification, which is higher than the world's average of percentage, 69%. The desertified lands in China spread out through 18 provinces, including Xinjiang, Inner Mongolia, Tibet, Qinghai, Gansu, Hebei, Ningxia, Shaanxi, Shanxi, etc.

Desertified land areas, particularly caused by wind erosion totals at 1.839 million km^2, taking up 19.16% of the total territory of China, or 69.77% of the total land territories of 13 provinces, autonomous regions and municipal cities in Northwest, Northern and Northeast China. It thus forms a wide zone affected by dust and sand storms, which is 4,500 km long east-west orientated and 600 km wide north-south orientated, which stretches from the Tarim Basin in Xinjiang to the Songhuajinag and Nengjiang Plain in Northeast China.

The desertification-prone land areas caused by water erosion totals at 259,300 km^2 on the Loess Plateau, which is located in the upper and middle reaches of the Yellow River. The desertification-prone land areas caused by freezing and melting processes of soil is also estimated about 363,600 km^2, in the alpine

zone of the Qinghai-Tibet Plateau. The area of desertification-prone land caused by salinization and alkalization totals at 173,700 km^2, around oases in the Tarim Basin, the alluvial plain at the north foothills of the Tianshan Mountain, the Great Bay Plain of the Yellow River and the North China Plain. In addition, another 104,900 km^2 of desertification-prone land areas affected by roughness land surface and stone covered land are mainly distributed in three Yunnan, Guizhou Provinces and Guangxi Zhuang Autonomous Region.

2. Causes of desertification

The causes of desertification in China are mainly climatic variation and human activities, among which human factors are the major ones.

Desertification has been accelerated by the population growth, the pressure from economic development, less awareness of ecosystem, over- grazing, over-cutting of fuel wood, deforestation and destruction of vegetation caused by reclamation of steppe, desert steppe and range land, inappropriate farming system on slope/hilly areas and the decrease of vegetative coverage.

Since the 1970s', China's semi-arid and dry sub-humid zones were simultaneously attacked by high temperature and scarcity of precipitation. Given current industrial and energy development, China has reduced 959,000 km^2 of land in the sub-humid areas and will reclaim 843,000 km^2 of land in arid and semi-arid areas by 2030. Dust and sandstorms (DSS) demonstrate the harmful and destructive impact of climate change. In May 1993 a sandstorm attacked over ten counties in four provinces and autonomous regions in Western China, including Xinjiang and Gansu. The loss of topsoil and arable soil under impacts of wind erosion was 10 to 15 cm in depth, and the loss of fine sand surface was 20 to 150 cm in depth. The total estimated economic loss was 56 billions Chinese Renminbi (RMB) Yuan (about $USD 8 billion).

[ACTIVITIES AND PROGRAMMES]

The Government of China attaches great importance to combating desertification and pays more attention to it (http://www.unccd.int/cop/reports/asia/national/2006/china-eng.pdf). Especially since the beginning of the 21st Century, the Government has incorporated ecological improvement strategy into the overall development of the national economic and social development, with combating desertification as one of the main targets (Fourth National Report for Implementing the UNCCD, 2010). Consequently, several significant actions have been taken, including promulgation and execution of the Law on Combating Desertification, and implementation of a series of integrated ecological improvement programmes. The pace of prevention and control of desertification is speeding up, with historic breakthroughs being made. The desertification processes are under control.

1. Activities have been conducted

Table 2. Examples of the bilateral projects undertaken to control land degradation in China

	Name of project	Project implemented within the framework of the NAP/SRAP/RAP? (Yes/No)	Project within the Framework of UNCCD	Time-frame	Partners involved	Overall Budget (10,000 US$)
1	Forest Resources Management project in Qinghai Province	yes	National Action Programme	2002 to 2007	Australia	805
2	Establishment of Protective Forest (Construction) Project at the middle reach of the Yellow River in Shanxi Province	yes	National Action Programme	2005-2006	Japan	335
3	Tree Planting and Reafforestation Project in five provinces of Western China	yes	National Action Programme	2002-2007	R. of Korea	500
4	Demonstration Project of Integrated Forest Management and in Beijing District	yes		2005-2008	R. of Korea	100
5	Sustainable Forest Management of Western China	yes	National Action Programme	2004-2008	Germany	600
6	Soil and Water Conservation of Miyun Reservoir in Beijing	yes	National Action Programme	1997-2007	Germany	600
7	The Second Phase of Implementation on Forest Protection and Biodiversity	yes	National Action Programme	2004-2007	Netherlan ds	168
8	China-UE Collaborative Project of Natural Forest	yes	National Action Programme	2002-2006	UE	2028
9	The Project on the watershed Management in China	yes	National Action Programme	2004-2010	England	1309
10	China-Sweden Capacity Building Project on Environment Management in Bijie District	yes		2005-2008	Sweden	134

2. Recent Activities

To implement UNCCD, the Chinese Government has established an effective cooperation mechanism, set up various management agencies at different levels and promoted good cooperation among sectors.

In Inner Mongolia of China, private sectors from Republic of Korea have been involved actively in dust and sandstorm control projects by planting trees and establishing biological approaches.

[SUMMARY]

China is one of the countries in the world suffering from severe desertification over a vast area, wide distribution and complex processes. However, China has made achievements and progress in combating desertification and rehabilitating land degradation through implementation of its national action plan to

combat desertification and international cooperation in the field.

The continuous expansion of desertification has been mitigated to some extent and the environmental conditions in some areas have been improved.

Now, environmental conditions in desertification-affected areas have been improved considerably on the regional scale and livelihoods have been greatly improved.

China's efforts to combat desertification predated UNCCD; under the "Three North Region Protective Shelterbelt Development Programme", replantation and revegetation activities have been carried out since the 1970s: Populus spp. trees were planted in desert areas of Inner Mongolia; These two photos show the landscape before and after plantation. FAO/17952/J.Y. PIEL

4. China: Proven Approaches - Two Case Studies

- Jia Xiaoxia, Ya Jie, Yuan Xiaodong, Li Jianming andWang Wenbiao

[SUBSTANTIAL EXAMPLES]

A. Case Study 1 - Direct payment for ecological service: Case of "Grain for Green" Project in Hangjinhouqi County, Inner Mongolia Autonomous Region, China

1. Problem

China is suffering from serious land desertification which happens in 27% of its total land territory, distributed in 18 provinces (SFA 2010). Overgrazing, reclamation of crop farming and abundance of dry farming, cutting trees, shrubs and blind collection of herb medicine, overuse or mis-management of water resources are identified as the leading causes of land degradation (SFA 1998, Zhu 2005) which link to farmers' land use practices. Bad practices cause land degradation and good practices keep land healthy.

However, adoption of practice depends on mainly two factors that if the practice itself tackling the problem to be designed for, and if the farmers are enables to use it (Pannell et al 2006) which are technical feasibility and institutional feasibility. Changing the enabling environment will change the perception, knowledge, capacity and incentives and as result it will generate farmers' enthusiasm to change practices. (Jones, S2002).

The case of complex of mixed plantation of tree and grass demonstration in Hangjinghouqi County, Inner Mongolia under national programmeme of conversion of cropping land and/or dry farming land to revegetated or replanted lands has well illustrated the success of appropriate integration of two key elements.

2. "Grain for Green" Programmeme and key points of its policy development

In 1998, devastating flood swept the Yangtze River and the Yellow River Basins and serious sand storm attacked Northern China. The investigation after the flood and sand storm disasters indicated that deforestation at upstream and headwater area, steep slope and foothill cropping and overgrazing are the causes of soil erosion and desertification (Xu, J.T et al 2006). In 2002, the full size project of "Grain for Green" formally initiated. The project aims to reduce soil erosion at upper and middle reaches of the Yangtze River and the Yellow River Basins and dust-sand sources areas through converting total 14.67 million ha of land at marginal zone with low grain yield and high erosion to bush land/woodland or grassland and reafforested lands by 2010(SFA2003).

Calculation and assessment of investment and benefit are the basis to take action. It is argued that (Pannell et al 2006) when farmer's personal goals cannot be achieved from adoption, or the benefits will be less than their investment (cost), they may have difficulties to adopt. To ensure smoothly implementation of the programme, the State Council of China has promulgated the Regulation on "Grain

for Green" which stipulated and endorsed the policies of direct payment for environmental services, integration of ecological and economic benefits, principle of volunteerism and farmers participation and securing property right for farmers (RGFG2002, Xu et al 2006, Bennell 2007), all target improvement of farmers' adoption of the measures/technology to control land degradation through increase of incentives.

- Direct payment for environment services: Based on geographical conditions and estimation on normal average agriculture yield, the regulation sets payment policy that central government provides farmers 2.55 tons/ha of food/grain for stopping steppe slope cropping and dry farming on foothills in the Yangtze River Basin regions and 1.50 tons/ha of food/grain in the Yellow River Basin regions (RGFG 2002). In addition, 750 RMB Yuan/ha/per year cash subsidy is provided to contracted householder/stakeholders for family costs. The government provides free seeds or tree seedlings and 300 RMB Yuan/ha/per year is provided for maintaining the project site and appropriate management during project implementation.

  The policy is developed to reduce the externality of the farmer's practices in producing public benefits. For this purpose, the direct payment creates two incentives, a) to off-set farmers' loss in short term, b) to encourage the farmers to do tree planting and maintenance and appropriate management to reduce soil erosion. Abandoned steep slope cropping and dry farming on foothills further released farmers from low yield and high erosion cropping farming, enabled them to get income or profit from replantation and revegetation (forest) management and off-farm (service industry) employment.

- Integration of ecology service and economic benefits: The project is technically designed to allow a combination of environmentally and ecologically friendly trees and cash plants which enable farmers a long term alternative income from cash plants. In light of the primary principle of policy, the duration for providing food/grain subsidies to farmers is set for five years for cash plants on abandoned dry farming or cropping lands, eight years for ecologically purposed biological plantation; and two years for grass plantation. After the first phase of eight years, for stabilizing the artificially restored ecosystem and further development of the local alternative livelihood, the State Council of China made a decision to extend the subsidies policy for a second phase and increased the rate of subsidies in line with the National Social and Economic Development Plan (Five-year Plan) in 2007 (SCC 2007).

- Property rights for long-term management: The Regulation defined that the trees and grasses to be planted on the contracted land and the harvests/yields from the land belong to the farmers' private property right. A 70-year land use contract, 20 years longer than the term of normal arable land contract is granted to the farmers with the right of succession and transfer (RGFG 2002). The purpose of such land tenure arrangement aims to guarantee a long-term project maintenance and management of the tree plantations and ensure environmental benefits for both private and general public after expiry of the subsidies policy.

- Voluntary based participatory process: Another important policy is voluntarism principles. It presents precedent transition from the previous "command and control", "top-down" and governmental agency oriented project to a decentralized, farmer participatory project management style. According to the Forestry Development Report (SFA 2004), up to 2003, more than four million

farmers were directly involve in "Grain for Green" Programme which is known as the largest ecological improvement programme developed and engaged mainly for farmers in the world.

3. Case study in Hangjinhouqi County, Inner Mongolia

Hangjinhouqi County is one of the project counties of the State Grain for Green Programme in Bayannuur City, Inner Mongolia. The project area is located in irrigation area of the Yellow River, the east periphery of the Ulan Buh Desert. It is an important national agricultural base and is characterized by an arid climate. Natural vegetation of the area is rarely seen, and tree-bush plantation consists of Populus spp. Sophora japonica, Ulmus spp., Elaiagnus angustifolia, and Tarimax spp. Long-term careless agricultural activities have caused decline of land productivity. Salinization, alkilization and sand movement/fixed dune re-activation are intensified increasingly and becoming major constraints of local economic development and sustainable land management.

In 2000, the Central Government initiated the project of conversion of steep slope cropping and dry farming along foothills in desertification-prone land areas or affected regions to woodland, bush land or revegetated and replanted lands and grassland with aims to halt the cultivation of severely degraded mountainous cropping land and dry farming lands, restore vegetation cover by planting trees and forage/fodders (herbage), to improve the ecosystem services. Food and cash subsidies are set in line with the policy that annual food supply of 1.50 tons/ha is provided to the contracted householders for compensating their potential loss of stopping steep slope and dry farming and 750 RMB Yuan/ha/per year (1US$=8.2 RMBYuan in 2000) cash subsidy is provided for family consumption. However, the government provides seeds or tree seedlings and 300 RMB Yuan/ha for maintaining (tending) and daily management of the contracted areas during the implementation of the "Grain for Green Project".

4. **Technical components:** In consideration of the long-term livelihood and ecology service, integrative planting model of mixed trees and perennial forage/fodder was selected as dominant model in the Grain for Green Programme in Hangjinhouqi County.

Major technical components include: (1) tree (forage/fodder) species selection - for trees Populus popularis and Populus alba var. pyramidalis; and forage/fodder of high quality leguminous plant such as Medicago sativa; (2) planting scheme - using the two-row belt scheme with row/plant spacing of 2m and belt spacing of 8m; inter-cropping forage/fodder such as Medicago sativa between belts; (3) soil preparation - carrying out complete soil preparation using machines to loosen soil layers in the first year at depth of 35cm; pit soil preparation for tree planting with a specification of 50X50X50cm; (4) seedlings - selecting healthy winter-stored seedlings with basal diameter > 3cm; removing all side branches and soaking the seedlings for 2-4 days with fresh water before planting; (5) plantation - To be carried out in May and irrigated with sufficient water immediately after planting; (6) Maintenance - watered once each month in late May, June, July, and October; disease and insect control twice a year, including beetles and Tettigella viridis, and prevent animal browsing and human damage. After the plantation, Medicago sativa seeds are sown between tree belts at a row spacing of 30cm and seed quantity of 15kg/ha.

5. **The overall benefits** of this approach include: (1) inter-cropping of trees and forage/fodder is good to tree growth; Medicago sativa as a perennial plant covers land surface and holds soil in all seasons and increases vegetation coverage with trees, with significant results for reducing wind erosion and stabilizing shifting sands; (2) brings about economic benefits. It is estimated that the one ha of inter-

cropping of tree-forage/fodder will cost 3,228 RMB Yuan, excluding manual-labours. The total inputs for one ha is as followings: tree seedlings 2,778 RMB Yuan; Medicago sativa seed 300 RMB Yuan, water and fertilizers 150 RMB Yuan. However, the approximately estimated output or annual income is 8,100 RMB Yuan, including the profits from Medicago sativa, fodder production 1,200 RMB Yuan from timber production. The total annual net profit is 6,072 RMB Yuan/ha; (3) release surplus rural labour as odd jobbers for urbanization, manufacturing, breeding poultry and livestock and offering service industry.

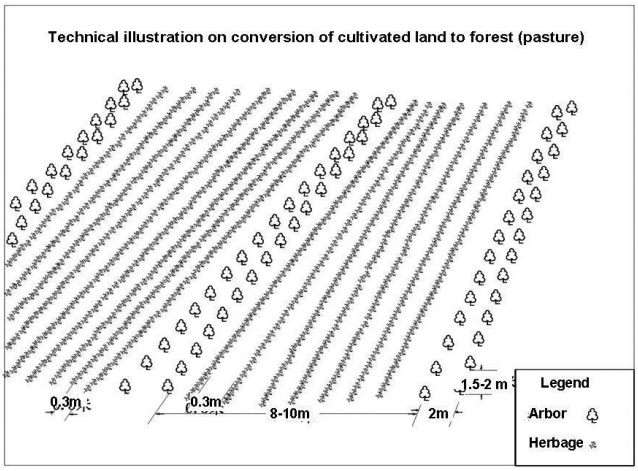


Figure 1. Two-row belt scheme with row/plant spacing of 2m and belt spacing of 8m. Trees species include Populus popularis and Populus alba var. pyramidalis, inter-cropping forage/fodder is Medicago sativa. Drawing by: GUO Huimei, Inner Mongolia Forestry Survey and Planning Institute

Implementation approach: The Project was implemented under overall arrangements of the county government and technical guidance and operational organization by Forestry Section of the County (Department). Major steps include: (1) The County Government was responsible for technical and coordination meetings participated by all relevant officers and technicians, Agriculture Section, and Food programme Section, and communities/township officers, and responsibilities and targets are designed to all concerned officers and technicians; (2) forestry offices organize technical staff to design and submit operational plans; (3) township administrations organize farmers to learn the related policies, and on a voluntary basis and in accordance with conditions on land to be converted, to determine the size of land for conversion; (3) Farmers optionally plant trees and forage/fodder based on technical schemes provided by forestry offices; (4) forestry offices inspect the result of reafforestation and/or replantation, and advise food supplies offices to make payment to contracted farmers either in cereal/grain or cash equivalent; township administrations are authorized to make payment in cash. The policy of subsidy is effective for eight years, after which farmers will receive 50 per cent of subsidized food/cereal/grain or cash, and rest 50 per cent will used by the County for public-purpose ecology improvement.

The project policies of conversion of steep slope farming and dry farming on foothills to woodlands/bush land and tree plantation are warmly welcomed and well operated by farmers and local communities, and promoted by the County, township administrations and forestry offices. Ecology service and economic benefits from implementation of the project are significant and adopted by farmers. The public wish for long-term policy stability, and increases in tasks over time. Up to 2009 the whole County has converted

40,000 ha steep slope cropping lands and dry farming land on foothills to woodland, bush land and tree plantation, and farmers received 96 million RMB Yuan in subsidized food/cereal/grain and cash.

Figure 2. Inter-cropping of trees and forage/fodder (herbage) on a previously degraded land in Chagan Township of Hangjinhouqi County.

Figure 3. Inter-Cropping of trees and forage/fodder on an abandoned Cropland in Chagan Township of Hangjinhouqi County. (Source: LI Jianming)

6. Conclusion

The case of Hangjinhouqi County proves that the joint-function of well selected model of inter-cropping of the trees and grass/fodder, policy incentives of Grain for Green and well organized implementation of the project has played effective effects in accelerating revegetation and replantation in irrigation area of the Yellow River Basin and in adjusting and optimizing rural production structure, and offering lessons and experiences of demonstration and pilot project implementation and management to the similar projects of in other Western China regions.

"Grain for Green" programme, as the first programme that offering direct food/cereal/grain and cash for farmers to improve ecology shows that it is a significant transition of the conventional ecological programme implementation. Policy development reflects the consideration to combine farmers' economic benefits with general public environmental benefits and integrated short-term compensation with long-term alternative livelihood. The property rights and land tenure arrangements and voluntarism principles improve ownership of the farmers to the projects and eventually ensure effectiveness of the rehabilitation of land degradation and transfer of controlling measures.

B. Case Study 2 - Elion Resources Group Desertification Control and Desert Industry Development in Kubiqi desert, Elion Resources Group Limit Company (Private Sector Contribution)

1. Introduction

Over 20 years ago, Qian Xuesen, an influential figure in science and technology in China, predicted that the some 1.6 billion mu (15 mu = 1 ha) of deserts in Western China would generate billions in fortunes. He believed that the potential of the desert and the Gobi stood far from being fully realized. Therefore, he suggested developing a knowledge-intensive agricultural industry in this "barren land" by using modern technology, including scientific and technological achievements in physics, chemistry, biology, as well as relying on the photosynthetic properties of plants. He further predicted that such an industry would cause the "sixth industrial revolution" of 21st Century China.

In the 20 years since Qian Xuesen first proposed his "desert industry theory", the private enterprise of Elion Resources Group (Elion) emerged as the Western part of China opened up. Elion strived to be the first to implement Professor Qian's "desert industry theory" for the betterment of everyone against all the odds in the "sea of death" namely the Kubuqi Desert. Elion's achievements include developing desertification control into a new industry that uses new energy in an integrative fashion and spurs a new economy. As a result, the "sea of death" now has patches of oases, while a green road of desertification prevention and control built by Elion has helped the people and the region to reap economic benefits while attracting worldwide attention toward China's efforts in desertification control.

Elion is a key enterprise at the state level. While developing a renewable-energy based economy, Elion has actively engaged in the desertification control of the Kubuqi Desert and the development of the desert industry for 20 years. Specifically, Elion has invested RMB 1 billion and turned 3,500 square kilometers of the Kubuqi Desert green. It has also developed three new economic industries in desert ecology: 1) a desert liquorice planting and pharmaceutical industry that commands an annual operating revenue of RMB 3 billion, 2) a desert Seven-Star Lake ecological tourism industry that draws on average 200,000 visits per year, and 3) a desert solar energy industry. Elion's persistent ecological transformation of the Kubuqi Desert has not only increased its own economic benefits and improved its business structure, but has also resulted in tangible environmental benefits. The latter include controlling further desertification of 7,000 square kilometers of land, constraining sand storms, and absorbing significant amounts of CO_2. These results have helped to realize a multi-win approach of "accounting for both ecological and livelihood needs; simultaneously developing desertification control and generating economic benefits; and combining economic growth with afforestation". Elion's efforts have formed a flagship for China's sustainable development and set an example for global desertification prevention and control.

2. What has been done

- "Valuing ecological protection isn't something that we just picked up today. We have actively pursued it since we launched our business"

Elion was established in the hinterland of the Kubuqi Desert, by the Halamangnai salt lake, which contains rich chemical raw materials such as natural alkalis, mirabilite, and salt. Despite these rich chemical resources, the harsh natural environment of the desert made transportation a bottleneck for Elion's development. Originally, hundreds of thousands of tons of equipment, raw materials, and products could only be transported through a simple road and by going a roundabout way in excess of 330 kilometers.

In order to further expand the enterprise, in 1997, Elion obtained a loan of over RMB 70 million to construct a 65 km-long desert-spanning highway jointly with the local government. The construction of this road not only saved Elion's transportation expenses by over RMB 10 million annually, but also solved transportation problems for local peasants and herdsmen, thus spurring local economic development.

To protect this Channel of Life leading out of the desert, Elion lined both sides of the road with vegetation including medicinal herbs, forming a green corridor 65 km in length and 3 to 5 km in width, deep in the desert. Such persistence by Elion to carry out desertification control, road construction, vegetation, and desert industry development in such a harsh environment has led Elion to forge a new path of science,

practicality, and development potential. Impressed members of the international community have exclaimed, "from here we saw the hope of managing desertification". This is also the first step that Elion has taken, in marching into the desert to carry out desertification control on a large scale.

Through the process of desertification control and afforestation, Elion has established its strategy for combating desertification and utilizing the desert that is pillared on "road zoning, segment management, desert fringe expansion control, hinterland penetration, technological support, and industry leadership".

- "Desert fringe expansion control and hinterland penetration"

Elion constructed a 242-kilometer-long "desertification-controlling and river-protecting desert-fringe-expansion-controlling forest" at the northern fringes of the Kubuqi Desert and southern rim of the Yellow River that controls expansion of the desert at its northern fringes and constrains the large-scale desertification and silt-flow into the Yellow River.

The desert-spanning highway that Elion built partitions the desert into many small segments. In order to shield the highway from encroaching sand, Elion planted a road-protecting green belt 5 kilometers in width through aerial seeding and manual planting along both sides of the road. The widening of the green belt accordingly reduced the area of the desert being partitioned into small parts. To date, the construction of five "desert-spanning highways" that total 234 kilometers in length has realized the aim of "controlling desertification segment by segment". Wherever roads are built, access to water and power will also follow, as does afforestation/re-vegetation. Not only did the construction of such "desert-spanning highways" fundamentally resolve issues of product transportation for enterprises, but it also helped resolve the many challenges faced by the local community in accessing medicine, education, consumption of goods, and production opportunities. According to rough statistics, such measures have benefited people living in a desert area of 11,000 square kilometers, and helped improve the standard of living for over 30,000 peasants and herdsmen

- "Technological support and industry leadership"

For 20 years, in addition to relying on technology for advanced desertification control and desert utilization from China and abroad, Elion has also formulated a scientific and feasible desertification control afforestation technology system and accumulated valuable experience through practice. As the ultimate aim of ecological construction is to improve the people's living conditions, Elion's advocated industrial desertification control method has become the system's biggest highlight. With a market-oriented strategic vision and innovation mechanism, Elion's leader Wang Wenbiao, has actively used the desert's natural scenery, unique conditions, xerophytic medicinal materials such as liquorice, and the ecological results of 20 years of desertification control, to implement a liquorice pharmaceutical industry, a desert tourism industry, and a new desert energy industry. By "turning the desert's disadvantages into advantages, turning the harms of the desert into benefits, and turning a dependency on investment into a capacity to generate revenue", Elion has created both ecological and economic benefits.

Currently, Elion has formed comprehensive industry chains of planting, production, and marketing for Chinese medicine, primarily liquorice, while helping to mainstream traditional Chinese medicine. Traditional Chinese medicine industry has gradually expanded and established a centre for sales

management and research & development in Beijing with Inner Mongolia hosting the planting and production bases. In addition, Elion has achieved breakthroughs in fields such as the construction of a traditional herbal Chinese and Mongolian medicine, construction of a processing base, and the establishment of a market network project and development of new products. By 2009, the scale of the liquorice-focused traditional Chinese medicine-traditional Mongolian medicine (herbal medicine) base had reached 150,000 ha while revenues from the pharmaceutical industry had reached RMB 3 billion.

On average, Elion's Seven-Star Lake tourism area in the Kubuqi Desert attracts over 200,000 visits each year. The attraction has been acclaimed as a National AAAA Scenic Area, "National Trial Base for Desert Tourism", and "National Water Scenic Area". The site has hosted large-scale contests such as the "International Desert T3 Cross-Country Challenge", "International Miss Tourism Competition", and the "National Desert U2 Vehicle Cross-Country Challenge". Given its ability to exemplify desertification control, Elion's Seven-Star Lake tourism area in the Kubuqi Desert has hosted the Kubuqi International Desert Forum twice, in 2007 and 2009, and has become the forum's permanent venue as a result of having received favorable approval from society. At the Second International Desert Forum in 2009, the Ministry of Science and Technology also recognized the Seven-Star Lake as the "National Scientific Achievements Transformation Base for New Energies in Desert" as well as the "International Science & Technology Cooperation Base".

During the ecological construction process, Elion formed close bonds with the local peasants and herdsmen. Elion signed a cooperation agreement with the local peasants and herdsmen, making them shareholders based on their right to use the "barren desert and waste land", and a leaseback arrangement. The agreement also involved integrated planning, implementation, and management, and desertification control by segments. The efforts of fencing and restricting grazing, fencing and replanting (including aerial seeding), natural vegetation restoration, and mixed planting of vegetation including herbal medicines on a large scale helped to change parts of the desert into oases, thus generating advantages for ecological industrialization in the desert. At the same time, these actions also inspired locals to take even more initiative with respect to the ecological management of the desert, thus benefiting tens of thousands of people in the local community.

Throughout the implementation of the ecological construction of the desert, local peasants and herdsmen acted as both shareholders of the company and members of the ecological labor force. The approximately ten thousand peasants and herdsmen who participate in the ecological construction each year can earn nearly RMB 60 million in direct revenue. In April 2006, Elion also invested some tens of millions in RMB in building a modern village for herdsmen who had for generations lived in the depths of the desert. The availability of complete facilities of water, electricity, communication and road networks, allowed them to lead a new life of "intensified and integrated production, management, and development".

3. Elion's desertification control and desert industry development: "Six main projects, five key benefits, and four major transformations"

("From a desert-spanning road to a liquorice belt; from one ecological chain to multiple industrial chains" - as such, Elion views the desert as a natural resource that may be utilized.)

- Six main projects for desertification control

1) The construction of five desert-spanning highways totaling 234 kilometers in length paralleled the development of an integrated mode of desertification control that combines "networks of roads, electricity, water, communications, and trees/vegetation".
2) A desertification-controlling and river-protecting forest for desert encroachment control was established along a long narrow belt at the northern fringes of the Kubuqi Desert and the southern banks of the Yellow River. The tree plantation is 242 kilometers in length and 3-5 kilometers in width.
3) The development of the liquorice-focused desert Chinese medicine processing industry stimulated desertification control and led the local community to ameliorate their economic situation.
4) The development of desert tourism and construction of the made use of the natural scenery and the results of the ecological improvement of the desert while combining the natural scenery of the plains and the desert as well as the Chinese medicine base.
5) Ecological migration for herdsmen scattered throughout thousands of ha in the desert helped them settle into "new herdsmen villages" and experience "intensified and integrated production, operation, and development". A "desert ecological enclosure and protection area" of 1,500 square kilometers was also established.
6) Having hosted two Kubuqi International Desert Forums, the Seven-Star Lake is now the forum's permanent venue.

• Five key benefits of desertification control

1) Significant ecological benefits. Kubuqi's large-scale ecological construction has basically contained regional sand storms, reducing their frequency from 60-70 per year over a decade ago to 3-5 today, significantly benefiting Beijing and its surroundings. In addition, the desert control strategy of "desert fringe expansion (encroachment) control and reconstructing the hinterland", especially the afforestation project along a narrow belt of the Yellow River and the desert, has effectively protected the river while curbing expansion of desertification. Finally, a large carbon sink was created as the afforestated area of 3,500 square kilometers could control the desertification of over 7,000 square kilometers. This afforestated area is estimated to absorb 5 million t CO2 each year. Thus, the Kubuqi Desert is no longer a "sea of death", but a vibrant oasis.

2) Significant social benefits. By trading their barren desert into stock shares, local herdsmen became shareholders of the enterprise as well as members of the ecological construction labor force, thus changing a passive past into a future of initiative, disadvantages into advantages, and the desert's harms into benefits. They now enjoy both dividends and labor income. In recent years, the annual labor income of the nearly ten thousand farmers and herdsmen participating in ecological construction has reached over RMB 60 million. This not only drove local economic development, but also improved the local living environment and investment environment.

3) Significant economic benefits. Elion fundamentally possesses the capitalization condition to manage the land within the region. In 2010, Elion established the nation's first desert industry group. Based on the original development of ecology and tourism, it focuses on the twin themes of "developing a new ecological and low-carbon economy of the desert" and "developing a new profit model for the desert industry". The aim is to build the new image and open the new phase of Elion's desert industry, so as to ensure its rapid yet sustainable development.

4) Significant benefits from leading by example. Catalyzed by Elion's successful practice of desertification

prevention and control and desert utilization, large scale planting of trees/shrubs, grass, and herbs, and industry leadership, and guided by the local government, local farmers and herders have built large-scale bases of forest, grass, and herbs in recent years.

5) Significant environmental benefits. The desert turned into an oasis, water resources were conserved, the micro-climate improved, sandstorms threatening Beijing were curbed to a great extent, and silt flows to the Yellow River were minimized. These contributions tangibly changed the local living and production environment. Through 20 years of cultivation, the Kubuqi Desert has turned into an industrial base that integrates desertification control, afforestation, planting, cultivation, processing, and tourism, thus fundamentally realizing the multi-win aims of "greener desert, improved environment, better-off farmers, and stronger enterprises".

• Four major transformations in desertification control

Elion's desertification control methods have protected the Yellow River, improved the local economy, and ultimately realized four major transformations: "passive desertification control" to "active desertification control"; "attempting to conquer nature" to "striving to sustainably utilize natural resources"; "deserts pushing people back" to "people pushing deserts back"; and an "impoverished barren desert" into a "green industry".

Over 20 years, Elion has built an industry based on ecology, and improved ecology through industry. By valuing sustainable development as its highest responsibility in the desert industry chain, Elion has improved both the natural environment and human living standard.

Elion's method of using industry to control desertification: Pioneer in China and the world
The latest government policy explicitly stated the need to "build a sound ecosystem and fundamentally form an environmentally-friendly industrial structure that would efficiently use energy and natural resources" to "firmly instill in the public an awareness of nature conservation".

Over 20 years, Elion has adhered to the spirit of "perseverance, pioneering, and loyal implementation" in facing the harsh natural environment. Passionate about benefiting the local community and giving back to society, Elion has remained dedicated to desertification control. Through toil and sweat, Elion has cultivated a vibrant oasis out of this barren desert. Tangible environmental improvements include conserving water, controlling desertification, improving the microclimate, curbing sand storms, and blocking silt flows into the Yellow River. Elion's contributions exemplify China's private enterprises' implementation of the scientific developments and harmonious developments called for by the government. Elion's efforts further epitomize steps taken by China's private enterprises in carefully carrying out social responsibilities and perseverance in improving the ecological environment and coping with climate change.

The unique desert industry that Elion developed from a foundation of desertification control creates a set of effective measures in desertification prevention, which integrates networks of roads, electricity, water, communications, and plantations. Such measures in turn drive and exemplify desertification control nationally while showcasing to the world China's effectiveness and enthusiasm in improving the ecological environment and coping with climate change.
"A flourishing ecology fosters a flourishing civilization". This motto has been deeply engraved in the

hearts of Wang Wenbiao and the 6,000-strong Elion team.

Ceaseless efforts in afforestation and combating desertification

The green economy is one of the most vibrant and potential-wielding economic forms of the 21st century. Developing the green economy is one of the most important moves to accelerate the transformation of development methods, as well as an inevitable path to cope with climate change and an energy crisis, while confronting a new round of industrial transition and upgrading. Having acutely grasped the opportunity of "restructuring and rapid transformation", Elion is poised to play a leading role in the new round of energy industrial revolution.

On January 17, 2010, Elion completed its scientific desertification control strategy for moving forward. By 2015, Elion aims to have turned 10,000 square kilometers of the desert green, and sequestered 10 million tons of carbon annually.

At both National People's Congress (NPC) and The Chinese People's Political Consultative Conference (CPPCC) Sessions in 2010, Wang Wenbiao, Vice Chairman of All-China Federation of Industry and Commerce and Chairman and CEO of Elion Resopurces Group, has expressed that "the importance of ecology protection is not new priority concern we focused recently." Elion plans to grasp the opportunity arising from the state's greater emphasis on the environment. It aims to fully rely on the results and experience of its 20 years in desertification control to promote its methods of integrating desertification control, sustainable development, and protection of the Yellow River.

Furthermore, it hopes to expand its existing work on desert industry development, new energy development, international conferences, and amelioration of the local community's economy. Elion should also build the Elion Desert Industry Group into a scientific development pilot platform that is oriented towards economics, pilot projects, innovation, and representativeness. By integrating the three triplets of "the state, local government, and enterprises", "industries, universities, and research institutes", and "ecological, economic, and social benefits", Elion would act as a model base and spotlight for fully implementing the spirit of the government policy. Elion would also be a platform for private enterprises to undertake social responsibilities and a window through which the region of ethnic minorities can showcase themselves.

"Implementing Qian Xuesen's desert industry theory for the betterment of everyone" is Elion's simple dream. "Ceaseless desertification control and afforestation as long as the enterprise moves forward" is Elion's relentless pursuit. Currently, the worldwide competition to snatch market shares in the low-carbon economy has already been triggered. Already commanding a sizeable share in the green economy, Elion is building a new "green empire" of desert industry. Perseverant, pioneering, and dedicated, Elion is blazing a trail of developing the "desert's new ecological low-carbon economy" as part of China's journey to an ecologically sound future.

References

1. Bennett, M.T., 2007, China's sloping land conversion program: Institutional innovation or business as usual? Ecological Economics (2007).

2. Blaikie, P., 1989, Explanation and Policy in land degradation and Rehabilitation for Developing

Countries, Land Degradation & Rehabilitation, Vol.1, 23-37(1989).

3. CHINA NATIONAL REPORT ON THE IMPLEMENTATION OF THE UNITED NATION°ØS CONVENTION TO COMBAT DESERTIFICATION, June, 2006 China National Committee for the Implementation of the UNCCD (CCICCD).

4. China's Plantation Forests for Sustainable Wood Supply and Development, Prof. JIANG Zehui, Dr. S.Y. Zhang.

5. Drylands Development and Combating Desertification: Bibliographic Study of Experiences in China, FAO ENVIRONMENT AND ENERGY PAPER 15.

6. Forestry Bureau of Inner Mongolia 2005, Extension and application of tree - forage herbage inter-plantation in conversion of cultivated land to forest and pasture in irrigation area of Yellow River. Proceedings of Inner Mongolia Forestry Science and Technology (2001 - 2005), p. 62-64.

7. Pannell, D.J., Marshall, G.R., et al., 2006, Understanding and promoting adoption of Conservation Practices by Rural Land Holders, Australia Journal of Experimental Agriculture, 2006, p. 1407-1424.

8. Pretty, J.N. and SHAH, P., 1997, Making soil and water conservation sustainable: form Coercion and control to partnership and participation, Land Degradation & Development, Vol.8, p. 39-58 (1997).

9. RCFC 2002, Regulation on Conversion Farmland to Forest (Tui Geng Huan Lin Tiaoli), in Chinese. http://www.china.com.cn/chinese/PI-c/252509.htm.

10. SFA 2010, China Country Report to Combat Desertification, Forestry Publishing House, Beijing.

11. SFA 2005 State Forestry Administration, China 2004, Forestry Development Report, China Forestry Publishing House, Beijing.

12. SFA 2003, State Forestry Administration, China 2002, Forestry Development Report, Forestry Press, Beijing.

13. State Council of China, 2007, Notice on Policy about Grain for Green, State Council No.25, 2007. www.gov.cn/zwgk/2007-08/14/content_716617.htm.

14. State Forestry Administration 2000, Forestry ecological development and treatment models in western region. Forestry Publishing House of China, Beijing, 2000, p. 71-73.

15. Unasylva - No. 206 - GLOBAL CONVENTIONS RELATED TO FORESTS, 2001 An international journal of forestry and forest industries - Vol. 52- 2001/3 FAO - Food and Agriculture Organization of the United Nations.

16. Xu, J.T et al., 2006, China's ecological rehabilitation: Unprecedented efforts, dramatic impacts, and requisite policies, Ecological Economics, Volume 57, Issue 4, 1 June 2006, p. 595-607.

5. Democratic People's Republic of Korea: Dryland Degradation Control and Mitigation of Desertification

- Ri Song-il and Yang Youlin

Figure 1. Prolonged droughts bring about food shortage (Source: Dr. Mark Suh)

[BACKGROUND - Profile of land in DPRK]

80% is covered by mountainous areas. Annual average precipitation is about 1000mm and temperate mountain ecosystem is very fragile to be destroyed and degraded with a little human intervention.

Agricultural area covers 17% of the territorial land, which means it is only 0.07ha per person.

Severe drought is frequent phenomenon and occurs in spring season and heavy rain is concentrated in summer season. DPRK faces severe prolonged drought in last two decades. July and August is rainy season and flood is one of the main factors causing the soil erosion.

1. Main causes of Land Degradation

- Socio-economic development;
- Environmental factor (climate change);
- Population;
- External pressure;
- Unsustainable agriculture;
- Overgrazing; and

- Deforestation.

2. Prevailing Disasters DPRK is facing

Prolonged drought and continued natural disasters and economic difficulties bring about a decline in investment and environment sector, giving rise to some issues to resource management and sustainable development (Source: SOE 003/NCCE/UNEP/UNDP).

Population growth and the demand for food and firewood exert pressure on forest ecosystem of DPRK resulting in loss of habitats and frequent occurrence of disasters.

1) Forest Depletion

Forest covers about 73.2% of its territory. It is estimated that drought and noxious insect are key factors cause forest damage in past decade. Timber production and fuel wood consumption are the main causes to decrease forest stocks. Total firewood output was 3 million..m-3 in 1990 and it was increased to 7.2 million m-3 in 1996.

2) Deforestation

Deforestation and forest degradation are serious issues and capacity building to address them was recognized as a priority in national strategy against DLDD. Deforestation is defined as the main cause of land degradation, priority concerns are needed to forest rehabilitation and reforestation.
Prevent previously forest fire, which is a great threat to forests, is a prerequisite for successful reforestation and forest protection which is cross-cutting issue in environment-related programme, projects, initiatives and plans of the DPRK.

3) Forest Fires

Forest fire is the first and foremost concern for nature conservation in DPRK, and it has taken active measures to readjust and expand protected areas and prevent forests from forest fire, and defined reforestation and forest protection as priority target and, considering deforestation and forest degradation as a crucial problem, gave first importance on management of forests in national strategy to mitigate DLDD. Main Constraints to Control Forest Fire include:

- Lack of public awareness related to forest fire;
- Weak of legal capacity in forest supervision;
- Weak of technology, equipment, facilities and communication for forest fire monitoring;
- Lack of emergency responding capacity to forest fire; and
- Lack of technology to prevent forest fire spreading and rehabilitate burnt sites.

4) Damages caused by harmful forest insects

Combined with the impacts by climate change, the widespread occurrence of and damages by harmful forest insects have become increasing concern and another major cause of forest degradation in recent decades in DPRK.

Major harmful forest insects are, among others, the pine caterpillars (Dendrolimus specabilis, D. sibiricus) and Cecidomyia brachyntera that infest main domestic forest tree species such as pine trees (Pinus densiflora, P. koraiensis), and other evergreen and deciduous forest stands.

To curb the disastrous spread of these forest insects, DPRK has taken active measures to introduce biological control methods through Trichogramma parasitoid production, but rely still at large on the manual insect collection with public mobilization. Main constraints to control harmful forest insects are:

- Lack of management skill for healthy forests by establishing mixed forests and emergency responding capacity to forest insects;
- Weak of technology, equipment, facilities for survey, forecast, study and development for introduction of integrated forest pest management approaches/technology in forest management boards; and
- Lack of public awareness related to forest insect control.

5) Land Degradation

More than 80% of land area consists of mountainous terrain. Severe land degradation is closely associated with natural disasters (landslide, drought, flooding). It is reported that the inundation of arable land by flooding in 1995 inflicted damage estimated at US$925 million.
Conversion of forest land in hilly areas to cropping land was accelerated by population growth and infertility and un-productivity of land.
Acidification of arable land by fertilizer application brings about a decline both in soil fertility and crop output. Soil erosion caused by flooding, landslide and mining are key factors accelerating land degradation.

Figure 2. Prolonged droughts bring about food shortage (Source: Dr. Mark Suh)

6) Watershed Deterioration

Sloping land occupies large part of the watershed, especially, in mountainous areas and is basis for

development; as slops are ecologically vulnerable, it becomes a primary concern for soil protection in watershed management. Sloping land use tends to be inevitable in socio-economic development because of increasing growth of human population.
Deforestation, unsustainable cultivation and lack of land protection are main causes of land degradation.

7) Water Shortage

- Scarcity of water resource are becoming driving forces of DLDD Issues;
- Areas around drinking wells and natural runoff catchments are under heavy threats of dry-up due to concentrated consumption of water and livestock gathering;
- Mismanagement of water resource at upper stream and shortage of water supply at downstream, including expansion of irrigation agriculture and urbanization; and
- High livestock population brings about double or triple decrease of both surface and underground water.

8) Water Quality Degradation and untreated household sewage

Rainfall, rivers and underground water are the main sources. Roughly about 47.5 billion m^3. of water is used by industrial sector. Outdated treatment technology and intermittent operation of the facilities promote direct discharge of industrial wastewater, household sewages, untreated effluents into rivers.
Annual water consumption for human needs is about one billion cu. m^3., of which 63% comes from surface and 37% from underground.
Population growth is a key factor affecting water quality. Outdated treat technology and intermittent operation of the facilities promote direct discharge of industrial wastewater, untreated effluents into rivers.

9) Soil erosion

There are several types of soil erosion caused by water, including rain drops, surface water, side erosion of stream, and landslide. All these erosions are the consequences of deforestation and vegetation destruction, particularly in slopes and foothills.

3. Initiatives to Mitigate DLDD in DPRK

There is a variety of approaches, including traditional measures and modern solutions to rehabilitate land degradation and to combat desertification in DPRK. The followings are just to show some main initiatives DPRK taken in past years to control the land-related issues, including the legislation and policy development.

1) Stop Deforestation

- Multipurpose forest management to increase the multiple functions and services of forest ecosystems;
- Curb deforestation and rehabilitate the degraded forest lands;
- Improvement of productivity of forest lands; and
- Capacity enhancement of forest management planning.

2) Management of Fragile Ecosystems to Mitigate DLDD

- Integrated watershed management and agro-forestry practices;
- Establishment of drought resistant tree species and establishment of irrigation system;
- Introduction of drought resistant tree species and establishment of irrigation system;
- Establishment of protective forests in coastal and drought prone areas;
- Development and use of non-combustible renewable energy sources;
- Set up of Nature Preservation and Fragile Ecosystem Protective Areas;
- Build up of databases.

3) Promotion of sustainable agriculture and rural development

- The actions envisaged in the national agenda 21 couldn°Øt satisfactorily be brought into practice, because of the economic difficulties and repeated natural disasters in mid 1990s;
- National Capacity Building Action Plan for Implementation of global environmental Conventions was developed has set the following cross-cutting priority areas of capacity building:

  a. Improvement of national institutional framework for the implementation of Rio Conventions;
  b. Strengthening of international exchange and cooperation for the technical transfer in environmental field;
  c. Strengthening the capacity of integrated watershed management and its demonstration;
  d. Improvement of infrastructure for knowledge and information collection, dissemination and sharing in environmental field; and
  e. Training of experts and capacity building of re-education in the field of environment;
  f. Public awareness raising on Rio Conventions.

4) Capacity Building

- Demonstration of integrated, community-based land management and rational sustainable use of natural resources in rural areas;
- Strengthening of institutional capacity for the development and implementation of National Action Plan and its regular update in accordance with the UNCCD Requirements Capacity building for the establishment of integrated database and information sharing in relation to the land degradation;
- Technical transfer and demonstration of advanced sustainable farming methods including eco-farming to prevent degradation of agricultural lands while ensuring the safe and sustained agricultural production to meet the food demands;
- Establishment and operation of training/awareness center on land degradation and sustainable land management to promote public awareness and dissemination of advanced technologies;
- Demonstration of solving energy problems and improving livelihood in rural areas through introduction of new energy sources including solar and wind energies;
- Capacity-building for establishing early-warning systems and pre-responsive action plan to encounter with flood and drought.

5) Use and Management of Land Resources

- Establishment of land resources protection management center for the effective and sustainable

management of land resources;
- Consolidation of national institutional system for the comprehensive assessment and effective utilization of land resources;
- Strengthening of research and studies related to land resources;
- Improvement of public awareness, training and education on conservation of land resources and public participation including women and youth in the protective management of land resources;
- Establishment of regular communication and information sharing related to land management;
- Promotion of technical transfer and international cooperation.

6) Policy/plans on land management and prevention of land degradation

DPRK Cabinet has adopted in May 2003 the resolution on strengthening the management of mountains and rivers and is promoting its execution.

4. The main contents of the resolution are to:

- prevent the deforestation and forest degradation and realize the reforestation and greening of the whole country;
- improve the river and stream management;
- promote the public participation in land management activities;
- strengthen the scientific research and studies on mountains and river management as well as on forest sciences;
- improve the state leadership and reinforce the supervision and control on the land management practices.

1) Laws on Land Management

Land Law was adopted on April 29, 1977. The law stipulates a number of provisions regarding the protection, management and use of land resources, in particular, it specifies on:
- Survey and inventory of forest resources, rivers and streams;
- Management and procedures of their development;
- Land protection against environmental pollutions;
- Completion of irrigation system in agriculture;
- The general principles and procedures in development and use of land resources including road and industrial constructions and settlement area development;
- Integration of land development and protection into land development master plan and; public participation in land management activities

2) Law Enforcement and Legislation

Environmental Protection Law was adopted on April 9, 1986. It specifies on the basic principles of environmental protection, preservation and promotion of natural environment, environmental pollution and its control measures.

Land Development Planning Law was adopted on March 27, 2002 it describes about the provisions on the principles of land planning procedures and methodologies and stipulates that the land development

planning/activities should take into consideration the following principles:

- Preservation of existing arable land resources;
- Promotion of reforestation and stream/river management to protect the land resources;
- Avoidance of development of oversized urban areas;
- Consideration of local specific climate and natural conditions; and
- Prevention and management of degraded environmental damages.

Forest Law was adopted on December 11, 1992 and it provides general regulations on forest resources management. It stipulates that the forest lands should be managed based on forest development master plan. The law has classified the forest lands into five types:

- Special protection forests;
- Common protected forests;
- Timber production forests;
- Forests with economic value; and
- Firewood forests.

Agriculture Law was adopted on December 18, 1998 and it has the provisions on the diversified development of agriculture, completion of irrigation system and its management, protection of agricultural lands against natural disasters and on the prevention of land degradation.

Water Resources Law was adopted on June 18, 1997 and Law on Rivers and Streams was adopted on Nov 27, 2002. Water Resources Law deals with the survey, development, conservation and use of water resources. The River and Stream Law classifies the rivers and streams of DPRK into large, medium and small sized ones, stipulates regulations on river treatment, procedures and methodologies of river management. It addresses the issues of the construction, conservation, embankment and use of centrally and locally managed rivers and streams, the distribution system of responsibilities for managing rivers, identification of flood prone areas and urban and agricultural land protection projects to improve the water management in those areas.

As additional, DPRK has adopted several laws:

- Tideland Law;
- Meteorology Law;
- Environmental Impact Assessment Law; and
- Law on Pollution Control of Taedong River.

These laws are aimed to consolidate the legal environment supporting the prevention of land degradation. After ratification of UNCCD, DPRK has formulated and validated its NAP to combat land degradation. The NAP has set strategic orientation and focuses on the capacity building and demonstration in addressing the land degradation for the timeframe of 2006-2010.

3) DPRK's National Action Plan (NAP)

- DPRK has prepared the NAP to implement UNCCD and it was validated in 2006 and submitted to the Cabinet for its adoption.
- All relevant stakeholders were involved in the NAP since 2005 and made contribution to the consideration of its contents in national and sectoral development plans and their implementation.

- DPRK has yet to align its NAP by reflecting the new strategy of UNCCD; and
- In relation to UNCCD implementation, DPRK has organized a consultative process with the GEF and UNEP within the framework of GEF OP15.

4) Strategic Target of NAP

- Development and implementation of rationale and sustainable land use and management plan which harmoniously keeps the balance between forestry-agriculture (including livestock breeding)-water resources;
- Encouragement of public participation for enhancement of ecological, economic and social values of all land resources;
- Rehabilitation of degraded lands in combination with the sustainable rural development; and
- Managerial and technical capacity building for monitoring and assessment of land degradation and sustainable land management.

5) DPRK's National Coordination Body and National Focal Point

DPRK established National Coordinating Committee on Environment (NCCE) in 1994 to coordinate national activities and it is composed of:

- Ministry of Land and Environment Protection;
- Ministry of Agriculture;
- Ministry of Forest Industry,
- Ministry of City Management,
- Ministry of Electricity and Coal Mining Industry,
- Ministry of Road and Marine Transport; and
- Ministry of Fishery; and State Hydrometeorology Administration.

6) Financing mechanism to implement NAP

- The financial resources for UNCCD and NAP implementation will be raised from central and local budgets. In the past the activities to address the land degradation were financially supported largely by central budget while the local budgets at provincial and county levels also contributed.
- DPRK has set general turn-out campaign month for land management in spring and autumn every year and invested large amount of funds for the land management including reforestation and river/stream treatments.
- Regarding the local budget, the land management and planning agencies at provincial and county levels design their land management projects and finance them in a planned way.
- The international resources are yet to be sought for the implementation of the NAP for mitigating DLDD. The external pressure creates a bottleneck in smooth cooperation with international communities as well as bilateral cooperation and financial investment.

References

1. Agriculture Law, December 1998.

2. Environmental Protection Law, April 1986.

3. Forest Law, December 1992.

4. Land Development Planning Law March 2002.

5. Land Law, April 1977.

6. Law on Rivers and Streams, Nov 2002.

7. National Action Plan to Combat Desertification/Land degradation in Democratic People's Republic of Korea (2006-2010) the Ministry of Land and Environment Protection, June, 2006£¨Pyongyang, DPR Korea.

8. National Report on UNCCD Implementation in DPR KOREA, May 2006, Pyongyang, DPR Korea.

9. Water Resources Law, June 1997.

6. India: Rehabilitation of Degraded Lands

- Rajneesh Dube, Swayamprabha Das, and Vivek Saxena

[BACKGROUND]

The Earth Summit 1992 recognized to address issues of global environmental degradation, and its Agenda 21st Century, reflects a global consensus and political commitment at the highest level on development and environmental cooperation. The main policies and programmes of the Agenda 21st Century are in conformity to a number of traditional values inherent in the Indian Culture and also with all those values that are enshrined in the Indian Constitution. In India, innumerable initiatives were undertaken by the people in the past which not only demonstrate concern for the environment, but also the awareness about the need to balance this concern with livelihood resources. These tenets such as care, conservation and preservation of environmental resources are also reflected in the spirit of the Constitution of India. Over hundreds of years, the people of India have evolved time-tested mechanisms of conservation and prudent utilization of the livelihood resources.

1. Natural Resources

1) Forests

Forestry is an important part of land use. Forests occupy a recorded area of about 77.47 million ha constituting 23.6% of the total geographical area of the country. However, the actual forest cover is only 67.84 million ha out of which 28.78 million ha are open forests. 4.03 million ha of land areas is under scrub vegetation. Thus about 32.81 million ha of forest in the country are degraded or open. The forests range from tropical rainforest to dry thorn forests and to mountain temperate and alpine forests. There are four major forest types and 16 detailed forest sub-types in the country.

2) Deforestation

In India, the per capital availability of forest land is one of the lowest in the world, a meager 0.08 ha, against an average of 0.5 ha for developing countries and 0.64 ha for the world. The rate of deforestation in the country has been considerably reduced in the past. The average annual deforestation rate fell from about 1.3 million hectares during 1970's to 27,000 ha in 1980's, and to about 22,000 ha during the period from 1990-1995. In quantitative terms, however, extent of dense forest in almost all the major States has been reduced. On the other hand, during 1980-1990 period and also in subsequent years, there were afforestation efforts which added about one million ha annually to the plantation area. Thus, while the total area of natural forests of 55.12 million ha in 1980 reduced to 50.38 million ha by 1995, the total area of natural and plantation forests increased from 58.26 million ha in 1980 to 65.00 million ha in 1995.

2. Problem

India has an area of about 228.3 m ha (29.6% of total land area of 328 m ha) comprising arid (50.8 m ha), semi-arid (123.4 m ha) and dry sub-humid (54.1 m ha). India in rich in biodiversity; Eastern Himalayas

and Western Ghats are recognized internationally as two biodiversity hotspots. India's forests are classified into tropical, sub-tropical, temperate and alpine categories. Climate of the country is tropical monsoon and varies from 100 mm in arid areas to more than 3,600 mm in wet areas of North-Eastern States. Temperature varies from less than 10˚C during winter to 45˚C in summer. In arid and semi-arid regions, the temperature goes up to 45˚ to 48˚C.

Large areas are susceptible to water and wind erosion, salinisation, water-logging, drought and desertification etc. Land degradation is aggravated by high biotic pressure - human population (1,027 m) and livestock population (470 m). Biotic pressure, and erratic and uncertain amount of rainfall are the major causes behind desertification. The dryland regions are more susceptible to frequent droughts which accelerate the process of desertification.

3. Topography of India

The country can be classified into four broad geographical areas which include Northern Mountains comprising Great Himalayas (East-West); Indo-Gangetic Plains; the Thar Desert and the Southern (Deccan) Peninsular bounded by the Western and Eastern Ghats; and the coastal plains and Island Systems of Lakshadweep and Minicoy Islands in the Arabian Sea, and the Andaman and Nicobar Islands in the Bay of Bengal. 14 major river systems, besides a number of smaller water bodies, drain through the land mass of the country.

4. Climate

The general climate of the country is tropical monsoon, with an annual precipitation estimated at 1,200 mm. The distribution of the rainfall across the country varies from less than 100 mm in extreme arid areas of Western Rajasthan to greater than 3,600 mm in north-eastern States and 1,000 mm from east coast to 3,000 mm in the west coast.

Table 1. The rainfall and monsoon patterns in India

Season	Rainfall (%)	Rainwater availability (m ha m)
* Winter and pre-monsoon	16	64
South-West monsoon (June-September)	74	296
North-East monsoon (Oct.-Dec.)	10	40
Total for the year	100	400

Mean annual temperature across the country varies from less than 10˚C in the extreme north to more than 28˚C. During May-June, temperature reaches a peak of 40˚C to 45˚C. During July to August, temperature remains around 28˚C to 30˚C. With the withdrawal of monsoon in September, the day temperatures reach up to 40˚C during October. In winter, low temperatures with a mean of 14˚C remain in northern part and around 27˚C in southern part of the country. Most States experience temperature of

less than 10°C during January. Freezing temperatures are experienced in the Kashmir and parts of Himachal Pradesh. Ladakh region is the coldest region of the world in winter.

The relative humidity is lowest (20-40%) during summer in central and western parts of the country, and during monsoon it various from 50 to 80%. Solar radiation value varies between 400-500 cal per cm^2 per day. However, higher radiation values are recorded in May with a peak of 600-650 cal per cm^2 per day and with the advancement of monsoon it reduces to 300-350 cal per cm^2 per day.

5. Agriculture

Agriculture contributes 29.93% of India's GDP. Major part of agriculture is rainfed, extending to 89 m ha (61% of the net cultivated area of 123.5 m ha). A large percentage of cultivated areas growing coarse cereals (90%), pulses (81%), oil seeds (76%), cotton (65%) and rice (50%) is rainfed.

Expansion of irrigation has played an important role in the development of agriculture. Full irrigation potential of India has been estimated to be 139.5 m ha, comprising 58.5 m ha from major and medium schemes, 15 m ha from minor irrigation schemes and 40 m ha (revised to 66 m ha) from ground water exploitation. It is estimated that even after achieving the full irrigation potential, substantial part of the total cultivated area will remain rainfed.

6. Types of Land Degradation

Per capita land availability in India has declined from 0.89 ha (1951) to 0.3 ha in 2001. Per capita availability of agriculture land has declined from 0.48 ha (1951) to 0.14 ha in 2001. A per capita land resource is further exacerbated by degradation and desertification of land. About 107.43 m ha or 32.75% of the total geographical area of the country is affected by various forms and degree of land degradation.

Table 2. Types of degradation

Type of degradation	1990-99		2000-2003	
	million ha	% of total area	million ha	% of total area
Water erosion	107.12	61.7	57.15	17.42
Wind erosion	17.79	10.24	10.46	3.18
Ravines	3.97	2.28	2.67	0.81
Salt affected	7.61	4.38	6.32	1.92
Water logging	8.52	4.90	3.19	0.97
Mines and industrial waste	-	-	0.25	0.08
Shifting cultivation	4.91	2.82	2.37	0.72
Degraded forests	19.49	11.22	24.89	7.58
Special problems	2.73	1.57	0.11	0.30
Coastal sandy areas	1.46	0.84	-	-

(Source: Govt. of India, 1994, MoA 1985)

7. Rehabilitation of Degraded Lands

Various watershed development programmes have been initiated by Government of India for rehabilitation of degraded lands. Up to March 2005, an area of 28.533 million ha has been developed with an expenditure of Rs.14,577.32 crore[3].

The details are as follows:

Area treated up to 1999	- 21.07 million ha.
Area treated during 2002-2005	- 7.47 million ha.

It is estimated that about 12.00 million ha of degraded lands is likely to be treated during Tenth Plan period and about 76.50 million ha of degraded lands will remain to be treated in the beginning of Eleventh Five Year Plan.

[ACTIVITIES AND PROGRAMMES - PART 1]

1. Monitoring of the Scheme

There is a Standing Committee under the chairmanship of Additional Secretary, Ministry of Environment and Forest (MoEF) to review the programme on regional basis annually. At State level, the progress is monitored by project level implementation committee and State level implementation committee. The evaluation studies for 22 catchments have been evaluated by outside agencies like Administrative Staff College of India, Hyderabad, Agriculture Finance Corporation, New Delhi, Centre for Management and Development, New Delhi, Institute of Resource Development and Social Management, Hyderabad, Institute of Economic Growth, Delhi and National Remote Sensing Agency, Hyderabad.

The evaluation studies covering 22 catchments revealed that watershed interventions under the programme have proved effective as given below:

- Yield of agricultural crops increased from 2.7 to 76% in Matatila, Nizamsagar and Ukai catchments.
- Cropping intensity increased ranging from 85% to 115% in Matatila, Nizamsagar and Ukai catchments.
- Sediment production rate has been reduced ranging from 17% to 94% in Matatila, Nizamsagar and Ukai catchments.
- Runoff peak reduced from 46.6 to 1.6% in Sahibi catchment.

Due to ground water recharge, the water table in wells increased from 1 to 2.5 meter in Matatila, Nizamgarh and Ukai catchments. Employment generation was increased from 2.0 to 7.9 lakh man-days in Matatila, Nizamsagar and Ukai catchments. Since inception of programme and up to 2004-05, and area of 6.097 million ha has been treated with an expenditure of Rs. 1894.16 crores.

2. DPAP, DDP& IWDP: Watershed Development Programmes

A sizable proportion of the total land area of the country falls under arid, semi-arid and dry sub-humid categories and is either subject to desertification, or identified as drought prone watersheds. Ministry of Rural Development is implementing special area development programmes as instruments of poverty alleviation in drought prone areas, and desert and rainfed areas in a participatory mode. Following

[3] A unit in the Indian numbering system to denote ten million (10^7).

programmes of the Ministry of Rural Development are being implemented in partnership with State Governments.

- Drought Prone Areas Programme (DPAP)
- Desert Development Programme (DDP)
- Integrated Watershed Development Programme (IWDP)

Department of Land Resources (DOLR), Ministry of Rural Development has the mandate to develop degraded area of about 153 million hectares under these three programmes. These programmes aim to tackle: (i) continuous degradation of land, (ii) decreasing vegetative cover, (iii) soil erosion, (iv) depleting water resources, (v) decreasing productivity of crop (vi) livestock and human resources, (vii) and outmigration of both human and cattle populations in times of stress.

Guiding approach for DPAP, DDP and IWDP

- Development of lands, water and vegetative resources on watershed basis;
- Treatment of watershed to include all categories of lands including private, village commons, revenue and degraded forest lands;
- A micro-watershed with about 500 ha taken up as a basic unit for management and development with total watershed treatment approach;
- Planning and implementation of watershed development programme with the total participation of the beneficiaries through community based organizations for community empowerment;
- Women empowerment especially by creating alternative livelihood options;
- Developing sustainable production system, community based management of assets and equitable sharing thereof;
- Creating awareness including dissemination of information;
- State and district level committee to monitor the programmes with special emphasis on social audit;
- Capacity building and training at various levels of stakeholders; and
- Independent evaluation studies on regular basis.

Role of Non-Government organizations (NGOs): Watershed Development Programmes underline an active role for NGOs in order to ensure implementation of programmes in a participatory mode. The role of Panchayati Raj Institutions in watershed programmes has become pivotal in the implementation of developmental programmes at the grass root level.

3. Drought Prone Areas Programme (DPAP)

The Rural Works Programme (RWP) initiated in 1970-71 was redesigned as Drought Prone Areas Programme (DPAP) in 1973-74 to focus solely on problems of drought prone areas. Since the adoption of watershed approach in the year 1995-96 and till 2005-2006, 24,363 projects have been sanctioned to treat 12.2 million hectares of drought prone area. The Union Government sanctions new projects every year taking into consideration primarily the DPAP coverage in the States, performance of the on-going projects, socio-economic condition of the persons inhabiting the programme area, etc. During the Year 2005-06, 3,000 new watershed projects have been sanctioned under DPAP to treat an area of 1.5 m hectares at a total cost of about US$ 200 million over a period of fiver years.

Treatment of Area - The area treated under DPAP is given below:

(i) Under the Sectoral approach from inception till 31.3.1995: 5.7 million ha
(ii) Under the Watershed approach Since 1995-96 to 2004-05: about 5.8 million ha
Financial cost: The total committed outlay for these 24,363 projects (sanctioned from 1995-96 to 2004-05) was US$ 1,250 million out of which nearly 40% has been spent.

4. Desert Development Programme (DDP)

DDP was launched in 1977-78 to tackle special problems of desert areas. The basic objective of the programme is to minimize the adverse effect of drought, and to control desertification through rejuvenation of natural resource base of the identified desert areas. The programme also aims at promoting overall economic development and improving the socioeconomic conditions of the resource poor and disadvantaged sections of people inhabiting the programme areas. DDP is under implementation in 235 Blocks of 40 Districts of 7 States having coverage of about 45.7 m hectares.

Cost Norms and Funding Pattern: The Central share for treatment of areas under different types of eco-systems under DDP was as under up to March 31st 1999:

- Hot Arid Non Sandy Areas 75%
- Hot Arid Sandy Areas 100%
- Cold Arid Areas 100%

With effect from April 1st 1999, the programme is being funded on the basis of 75:25. Sharing pattern between Central and State Governments, from April 1st 1995 till March 31st 2000, the cost of each project ranged between Rs. 22.50 lakhs - a unit in the Indian numbering system to denote one hundred thousand - to Rs. 25 lakhs. With effect from April 1st 2000, a uniform rate of Rs. 30 lakh per project has been prescribed.

The Union Government sanctions new projects every year taking into consideration - primarily the DDP coverage in the States, performance of the on-going projects and socio-economic conditions of the people inhabiting the programme area, etc. During the year 2005-06, 2,000 new watershed projects have been sanctioned under DDP to treat an area of one million ha at a total cost of US$ 150 million over a period of five years.

Extent of area treated under DDP so far is given below:

- Inception point - March 31st 1995: 5.15 lakh ha
- April 1st 1995 - March 31st 2005: 29.30 lakh ha
- Total treated area: 29.45 lakh ha
- Financial cost: The total investment committed for 13,476 projects (sanctioned from 1995-96 to 2004-05) was about US$ 910 million, out of which, an amount of US$ 400 million has been spent.

5. Integrated Wasteland Development Programme (IWDP)

IWDP was launched in the year 1989-90 to develop the wastelands on watershed basis to strengthen the natural resource base, and to promote overall economic development of the resource poor and disadvantaged sections of people inhabiting the programme areas.

The programme has a treatable coverage of about 33 million hectares of wasteland. The IWDP is implemented in those degraded lands which are not identified under DPAP. The programme is being implemented in 403 districts of 28 States.

Since the adoption of watershed approach in the year 1995-96 and up to 2004-05, 885 projects have been sanctioned to treat 6.2 million ha of wasteland area. Financial cost: The total investment committed for these 885 projects (sanctioned from 1995- 96 to 2004-05) was about US$ 935 million. Out of this an amount of US$ 370 million has been spent.

6. Afforestation Programme

National Forestry Action Programme (NFAP) emphasizes to take immediate steps for sustainable development of forests. It aims to rehabilitate and increase the productivity of degraded forest, and also to increase the area under forest and tree cover to make it 33% of the total area of the country. The degraded/open forests are to be rehabilitated to take crown density above 40%, and the status of scrub forests is to be improved. According to NFAP, forest area of about 60 million ha will be brought under afforestation/plantation/regeneration in the next 20 years. This is intended to be achieved by:

(a) Improvement in forest cover density: about 31 million ha; and
(b) Plantation on non-forest and farmlands: about 29 million ha.

An area of about 64 million ha of the country is not available for plantation activity due to reasons of either being under habitation, industries, water bodies, snow etc.

[ACTIVITIES AND PROGRAMMES - PART 2]

1. Planning for Development - Eighth Five-Year Plan (1992-1997) & Tenth Five-Year Plan (2002-2007)

Planning in India is based on an interactive process involving interaction between the Central, the State and the local bodies. Multiple stakeholders participate in the planning process. At the national level, India's priorities are highlighted in the Five Year Plans. In Eighth-Five Year Plan (1992-1997), Planning Commission emphasized indicative planning to outline the priorities and encourage a higher growth rate from a centralized planning system.

The Ninth-Five Year Plan document also highlighted the same. The Tenth-Five Year Plan (2002-2007) which included the major thrust areas:

- Reduction of poverty ratio by 5% by 2007 and 15% by 2012;
- Providing gainful employment;
- All children in school by 2003, all children to complete 5 years of schooling by 2007;
- Reduction in gender gaps in literacy rates by at least 50% by 2007;
- Reduction in the decadal rate of population growth to 16.2% (2001 to 2011);
- Decrease in literacy rate to 75% during the plan period.
- Infant mortality rate to be reduced to 45 per 1000 live births by 2007 and 28 by 2012.

To prepare plans for various sectors, working groups and task forces are constituted involving participation, inter-alia, of civil society. These reports are taken into consideration by the Planning

Commission in consultation with Central Ministries and State Governments while formulating the Five-Year Plans. Areas identified and targets given in the Five-Year Plans become the basis for formulation of Annual Plans which set priorities for short-term development goals. These plans are implemented through decentralized and broad based government mechanism. A uniform pattern exists for devolution of responsibility between the Centre and the States on one hand, and the States and local bodies on the other.

2. National Conservation Strategy

The Earth Summit 1992 is widely regarded as being one of the most important global events to address issues relating to environmental degradation, inequities between nations, and possible strategies to protect the future of life on earth at international level. Principles 16 and 17 of Agenda 21st Century, conform to the framework of Government of India in its endeavor to seek a balance between conservation and development. Ministry of Environment and Forests, Govt. of India adopted the National Conservation Strategy and Policy Statement on Environment and Development in June 1992. The tradition of care, conservation and preservation of environmental resources is also reflected in the spirit of the Constitution of India, which has acted as the guiding inspiration of the nation for over half a century.

Ministry of Environment and Forests lays down the guidelines that help to weave environmental consideration into the fabric of the national planning and development processes. The conservation strategy is to serve as a management guide for integrating environmental concerns with development imperatives.

Thus the congruity of Agenda 21st Century objectives of sustainable development with India's own traditional values provided renewed thrust to several initiatives in the country. It also provided new direction in sectors, such as agriculture, irrigation, animal husbandry, forestry, energy (generation, use and conservation), industrial development, mining and quarrying, tourism, transportation and human settlements to ensure that conservation and enhancement of the environment are taken due care of while achieving sustainable development.

3. "Agenda 21" Century Implementation Plan

Sustainable development was accepted at the 1992 United Nations Conference on Environment and Development (UNCED) as a critical element in preserving the environment and promoting development and human welfare. In pursuance of this, country' specific programmes of action for channeling investing resources (both internal and external) into ecologically compatible projects and programmes are now incorporated into the Indian planning development process.

In the Government of India, the Ministry of Environment and Forest (MoEF) is the nodal agency for conducting the Environment Action Programme (EAP) exercise. MoEF constituted an EAP Implementation Committee comprising Ministries, Departments of the Government of India, Research Institute of excellence and NGOs concerned with different sectoral issues addressed in the EAP. After incorporating inter-ministerial suggestions, the draft EAP document was finalized in 1993. The goals of EAP are to improve the environmental services and to facilitate integration of environmental considerations into development programmes. People's participation at the grass root, local and

regional levels is also accepted as a key issue of the action plans. The Environmental Action Programm (EAP) process adopted a decentralized system of generating information and perspectives.

A great deal of progress has been achieved in the strengthening of organizations in the governmental, research and non-governmental sectors to pursue the programme under °∞Agenda 21°±. The stress, among other, on soil and water conservation and drought proofing and management of natural disasters in the Environmental Action Programme (EAP) is significant. Consequent to EAP, the priority areas are being monitored in terms of comprehensive Environmental Impact Assessment (EIA) framework and a scientific system of Natural Resource Accounting (NRA). Twenty-nine projects have been proposed to Global Environmental Facility (GEF) and Capacity 21 of UNDP to promote capacity building and generating environmental awareness (Government of India 1993). The Environmental Action Programme (EAP) is presently under comprehensive review both in the Governmental and Non-Governmental sectors. The results of these reviews would be significant for incorporating EAP in the future five-year plans.

4. National Plans or Strategies Available in the field of combating desertification developed prior to the Convention

Evolution of the programme:

Desertification and drought are common features of the arid and semi-arid regions. It is a continuous process of land degradation leading to desert like conditions. Sizable proportion of the total land area of the country falls under the arid, semi-arid and dry sub-humid categories and is either subject to desertification, identified as drought-prone or wastelands.

During 1951-52, Government of India appointed a committee to advise on development of the Rajasthan (Thar) Desert. To study various problems of the desert, a Desert Afforestation Station was established in Jodhpur. Later on, the studies at the station also included soil conservation programmes and as such its name was changed to Desert Afforestation and Soil Conservation Station (DA& SCS). Its mandate included conduct of basic and applied research in forestry, crop husbandry, and grassland development aiming to check wind erosion and aggravation of desert conditions. Subsequently in 1959, under UNESCO's Arid Zone project, the DA & SCS was reorganized and named, as Central Arid Zone Research Institute (CAZRI).

In 1960, Govt. of Rajasthan set up a State Land Utilization Committee which made recommendations on development of desert and semi-desert areas of the State. The Desert Development Board was constituted in 1966 under the chairmanship of Secretary, Ministry of Agriculture (MoA) comprising representatives of other central ministries and nominees of States like Rajasthan, Haryana and Gujarat. The Board was reconstituted with Minister of State (MoA) as its chairman and Secretary (MoA) as Vice Chairman. The Board recommended an integrated programme of pilot projects for desert development for inclusion in the Fourth-Five Year Plan (1969-1974). National Commission on Agriculture (NCA) made recommendations and the Desert Development Project (DDP) was started during 1977-78 in 20 districts.

Dryland farming projects initiated during Second-Five Year Plan (1956-61) were expanded in the Fourth-Five Year Plan (1969-1974). Suggestions were made during Fourth-Five Year Plan emphasizing that the amount spent by Government of India on relief in famine-affected areas was so deployed as to generate

more employment in rural sector in accordance with a pre-planned programme of rural works. Thus in 1970-71, rural works programme was formulated. In all, 54 districts including parts of 18 contiguous districts were identified as drought-prone areas for the purpose of Rural Works Programme. The Fourth Five-Year Plan mid-term appraisal redesigned the programme and named it as Drought-Prone Area Programme (DPAP). The Task Force headed by Dr. Minhas, Member, Planning Commission recommended integrated development of drought affected areas. Later, during Fifth-Five Year Plan (1974-79), restoration of ecological balance through integrated development on watershed basis became the goal. Subsequently, following changes were made:

- Dr. M. S. Swaminathan (1982) headed Task Force emphasized the importance of ecologically sustainability programmes of DPAP and DDP;
- Mid-term appraisal of the Seventh-Five Year Plan in 1988 considered the decisions taken by Central Sanctioning Committee during 1987 and spelt out drought proofing and control of desertification as the main objectives of DPAP and DDP;
- Technical Committee chaired by Professor Hanumantha Rao, former Member, Planning Commission recommended full involvement of beneficiaries in the watershed development planning as well as implementation of the works and sanctioning of works on the basis of the action plans prepared on watershed basis;
- In 2000, a common approach for watershed development was jointly formulated and adopted by Ministry of Agriculture (MoA) and Ministry of Rural Development (MoRD), and restructured NWDPRA providing for decentralization of procedures, flexibility in choice of technology and provision for active involvement of the watershed community in planning, was launched; and
- Various projects and programmes related to desertification control launched earlier were continued during Ninth Five-Year Plan.

The Mid-Term review of 10th Five Year Plan undertaken by the Planning Commission, recommended a number of measures to promote sustainable land management in the country.

Some of these are:

- Involvement of NGOs and corporate Sector in complementing the government efforts for the welfare of the disadvantaged groups;
- Suitable policy change in the area of management of common property resources to address the problem shortage of green fodder and grazing lands;
- Improvement in water use efficiency to bridge the gap between demand and supply;
- Development of a framework for conjunctive use of surface and ground water in watershed development project;
- Special Programme for dryland farming in arid and semi-arid areas of the country;
- Setting up of National Mission on Bamboo Technology and Trade cultivation, and National Mission on Bio-Diesel to promote bamboo plantation and Jatropha in the country; and
- Proposal to setup a National Rainfed Area Authority to address the problem of farmers in dryland areas.

5. Ministry of Environment and Forests (MoEF) Programmes Afforestation Prgrammes

(a) The Ministry of Environment and Forests (MoEF) in consultation with State Governments fixes targets for afforestation/tree planting activities annually. These afforestation activities are taken up under various schemes/projects of different Central Ministries/Departments and State Governments.

Important programmes of MoEF are given below:

- 20 point programme, NAEB/MoEF;
- National Afforatation Programme;
- Grant-in-Aid for Greening India; and
- Externally Assisted Forestry Projects.

(b) Programmes of other Ministries

- Integrated Wasteland Development Scheme;
- Desert Development Programme (DDP);
- Drought Prone Areas Programme (DPAP);
- Grants-in-Aid scheme of Ministry of Rural Areas and Employment;
- Programmes of the Department of Poverty Alleviation and Rural Employment;
- Soil Conservation, Watershed Management and other integrated programmes of the Department of Agriculture and Cooperation; and
- CAPARTAided watershed projects (A separate Department for Drinking Water has been created to make available potable drinking water to all villages during 2000-2005).

6. Ministry of Agriculture (MoA) programmes

(a) Indian Projects:

- Soil conservation for enhancing the productivity of degraded lands in the catchments of River Valley Project & Flood Prone River;
- Reclamation of Alkali Soils (RAS);
- Strengthening of State Land Use Board (SLUB);
- All India Soil and Land Use Survey (AIS & LUS) organization;
- Soil Conservation Training Centre, Damodar Valley Corporation, Hazaribagh, Jharkhand;
- National Land Use and Conservation Board (NLCB); and
- Watershed Development Project for Shifting Cultivation Area (WDPSCA).

(b) Externally aided projects:

- Indo-German Bilateral Project on Watershed Management;
- Sodic Land Reclamation Project (World Bank Assisted); and
- Indira Gandhi Nahar (Canal) Project (IGNP) (Japan Bank For International Cooperation assisted).

7. Other Schemes which are relevant in this context

- Jawahar Rozgar Yojana (JRY) for poverty alleviation and rural employment with focus on horticulture and watershed development;
- Integrated Watershed Management in the catchments of Flood Prone Rivers;
- Reclamation of special problem areas and improvement of productivity;
- Development and stabilization of ravines;
- Reclamation of mined areas, saline and alkaline areas, and waterlogged areas;
- Jawahar Gram Samridhi Yojana (JGSY). The programme is implemented by Gram Panchayat to enable village community to create community assets; and
- Desertification Status Mapping using satellite data has been taken up by Space Application Centre (ISRO).

- ISRO intends to: (a) establish Network for Desertification Monitoring and Assessment in India; (b) evolve and standardize procedure for desertification status mapping for both hot and cold deserts of the country and (c) identify various sub-programme areas where research and development effort is needed.

- The National Remote Sensing Agency (NRSA) with the cooperation of other agencies of the Department of Space (DoS) has taken up the following national programmes for long term drought mitigation:

(a) Drinking Water Technology Mission prepared ground water potential maps at district level, using multi-spectral satellite data;
(b) The integrated Mission for Sustainable Development of NRSA for combating drought has evolved action plans by integrating satellite data on watersheds with socio-economic data to provide action plans for development of food, fodder and water resources;
(c) Under irrigation management projects in selected basins, satellite data has been used for purposes such as proposed irrigation development, identification of causes for poor performance of distributaries and assessment of sediment in reservoirs; and
(d) NRSA is also developing land and water resource management maps and plans for 174 chronically drought affected districts in the country.

- The Swarnjayanti Gram Swarozgar Yojana (SGSY) for the rural areas, launched in 1999 is the single largest self-employment programme for the rural poor. Under the programme, it is proposed that 30% of the rural poor in each Block would be covered in the next five years.

- Swarn Jayanti Rojgar Yojna (SJRY) for the urban areas. Under the programme, there are two special schemes:

(a) The Urban Self Employment Programme (USEP); and
(b) The Urban Wage Employment Programme (UWEP).

Approximately, 6 million people benefitted from various schemes run under the programme.

7. Social Sector Programmes

National Social Assistance Programme (NSAP)-started on August 15, 1995, represents a significant step towards creation of social security net for vulnerable population. NSAP consists of three schemes:

1) National Old Age Pension Scheme (NOAPS);

(b) National Family Benefit Scheme (NFBS); and
(c) National Maternity Benefit Scheme (NMBS).

These schemes provide benefits in the form of old age pension to aged destitute, aid to the bereaved (poor) of its primary breadwinner and maternity aid to poor women, up to the first two live births.

2) Education Programmes: The Tenth Five Year Plan aims at providing one teacher for every group of 40

children for primary school/alternate schooling facility within 1 Km. of every habitation, provision of free text books to all SC/ST (vulnerable groups of society) children and girls at the primary and upper primary levels.

3) Health Programme: The Tenth Five Year Plan focusses on the re-organization and restructuring of existing health care infrastructure so that it serves populations residing in a well-defined geographical area.

4) Poverty alleviation: The Tenth Five Year Plan fixes targets to reduce the poverty ratio by 5 percent points by 2007 and 15 percent points by 2012.

The passage of the Constitution (73rd Amendment) Act, 1992 provides constitutional status to the Panchayati Raj Institutions (PRIs). Thus, PRIs at the district level (Zila Parishad), at intermediary (Mandal Panchayats) and village levels (Gram sabha/Panchayats) have been set up to accelerate the socio-economic development of the rural areas.

The following representative base now exits in India:
(a) Gram panchayats (Village councils) 2,27,698;
(b) Mandal Panchayats (Block councils) 5,906;
(c) Zila Parishad (District councils) 474;
(d) Number of elected representatives. 3.4 million; and
(e) Number of women representatives 1.13 million.

The Panchayati Raj System further strengthened with participatory approach in managing the livelihood resources by initiating following programmes. Joint Forest Management (JFM) became a system of managing forests as partnerships between forest department and local community. Under JFM, communities are assured of certain share of forest produce and income in return for taking the responsibility of protecting and managing the forests.

Following is the status of JFM in India:
(a) Implemented in 28 States of India;
(b) 99,868 JFM committees established;
(c) Covering 21.44 million hectares; and
(d) Equivalent to 28.17of the total forest area.

Participatory watershed Development: The watershed development is now planned, implemented, monitored and sustained by the watershed communities. Following are the salient features of this programme:
(a) Implemented through Watershed Community;
(b) Participatory approach;
(c) Demand driven watershed development plan prepared through PRA;
(d) Convergence of on going development programmes;
(e) Cost sharing by community;
(f) Linkages with credit institutions;
(g) Flexibility in technology; and
(h) Sustainable arrangements for post project maintenance.

From 1997 to 2002, under National Watershed Development Programme for Rainfed Areas (NWDPRA), an area of 2.216 million hectares was treated through participatory approach.

8. Monitoring of the scheme

There is a Standing Committee under the chairmanship of Additional Secretary MoEF to review the programme on regional basis annually. At State level, the progress is monitored by project level implementation committee and State level implementation committee. The evaluation studies for 22 catchments have been evaluated by outside agencies like Administrative Staff College of India, Hyderabad, Agriculture Finance corporation, New Delhi, Centre for Management and Development, New Delhi, Institute of Resource Development and Social Management, Hyderabad, Institute of Economic Growth, Delhi and National Remote Sensing Agency, Hyderabad.

The evaluation studies covering 22 catchments revealed that watershed interventions under the programme have proved effective as given below:

- Yield of agricultural crops increased from 2.7 to 76% in Matatila, Nizamsagar and Ukai catchments;
- Cropping intensity increased ranging from 85% to 115% in Matatila, Nizamsagar and Ukai catchments;
- Sediment production rate has been reduced ranging from 17% to 94% in Matatila, Nizamsagar and Ukai catchments;
- Runoff peak reduced from 46.6 to 1.6% in Sahibi cathment;
- Due to ground water recharge, the water table in wells increased from 1 to 2.5 meter in Matatila, Nizamgarh and Ukai catchments; and
- Employment generation was increased from 2.0 to 7.9 lakh man-days in Matatila, Nizamsagar and ukai catchments.

Since inception of programme and up to 2004-05, and area of 6.097 million ha has been treated with an expenditure of Rs. 1894.16 crores.

[SUBSTANTIAL EXAMPLES]

1. Reclamation of Alkali Soils

The programme was launched in Seventh Five Year Plan. This programme is now implemented through Macro management of Agriculture. The programme objectives are; (i) reclamation of the lands affected by alkalinity and improvement in land productivity by growing salt tolerant crops and horticulture plantations, (ii) increasing the production of fuelwood and fodder, (iii) improving capacity of extension workers and beneficiaries and (iv) generating employment opportunities.
About 70.00 lakh ha (7.00 million ha) area is affected by salt problem and out of this about 35.81 lakh ha area suffers from alkalinity in the country. Such Alkali affected areas are mainly located in 11 States:

The main components of the programme covered under the project are:

- Isolated approach: (i) survey, planning and awareness campaign and training of beneficiaries and staff (ii) formulation of water user group, site implementation committee, (iii) providing soil amenders.

- Projectized approach: (i) providing soil amenders, (ii) boring and installation of pump sets, (iii) providing inputs like seed, fertilizer, insecticides, pesticides, green manure seeds, (iv) plantation of fruit trees/fuelwood/fodder species and (v) maintenance of plantation area for three years.

The programme progress is reviewed in the meeting of Standing Committee (Government of India) besides periodic visit of regional, State and national level functionaries to project items. Positive impact of the scheme was observed in areas of Haryana and Uttar Pradesh; ph decreased from 9.4-10.5 to 8.9-9.2, organic carbon increased from 0.15 to 0.38%, paddy yield increased from 19 to 41 quintals per ha, 76% farmers' income increased and additional employment was created for them. Since inception and upto 2004-2005, an area of 6.59 lakh hectare has been reclaimed with expenditure of Rs. 96.64 crores.

2. Watershed Development Project for Shifting Cultivation Area

The project is continuing in seven North Eastern States, viz, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura. The objectives of the project are: (i) to protect the hill slopes of Jhum areas through soil and water conservation measures on watershed basis and to reduce further land degradation, (ii) encourage relocation of Jhumia families by providing developed productive land and improved cultivation packages, (iii) to improve the socioeconomic status of Jhumia families through household/land based activities, and (iv) to mitigate the ill effects of shifting cultivation by introducing appropriate land use as per land capability and improved technologies. The project is being implemented through government and non-government organizations, scientific and technical institutions in the watersheds where a minimum of 25% area is under shifting cultivation.

The programme implemented and evaluated in two States, viz, Nagaland and Tripura, revealed the following:

- 30% decrease in shifting cultivation area due to adoption of permanent/settled cultivation;
- About 27% Jhumias have abandoned Jhum practice;
- Sustainable increase in productivity of agriculture crops, horticulture crops, livestock, inland fisheries etc was observed;
- Overall income of Jhum families increase by 25%;
- Cropping intensity increase by 40%;
- Active participation and contribution of the watershed community for development of watershed was found effective; and
- Watershed Associations/Panchayats helped in promoting participatory approach.

Since inception and up to the end of 2004-05, an area of 3.18 lakh ha has been developed with an expenditure of Rs. 226.43 crores.

References

1. Ajai, Arya A. S., Dhinwa P. S., Pathan S. K. and Ganesh Raj K. Ajai, Arya A.S., Dhinwa P.S., Pathan S.K. and Ganesh Raj K. (2009). Desertification and land degradation status mapping of India, Space Applications Centre, Indian Space Research Organization, Ahmedabad, India.

2. Annual Report, 2008-09, Central Water Commission, Ministry of Water Resources, India.

3. Desertification & Land Degradation Atlas of India. 2007. Space Applications Centre, Indian Space Research Organisation (ISRO), Department of Space, Government of India.

4. India's Fourth National Report to UNCCD Secretariat: Performance Review and Assessment of Implementation System. 2010. Ministry of Environment and Forests, Government of India.

5. Indian State of Forest report 2009, Forest Survey of India, Ministry of Environment and Forest, India.

6. Nation Action Programme (NAP) to Combat Desertification in the context of United Nations Convention to Combat Desertification (UNCCD). (2001). Ministry of Environment & Forests, Government of India.

7. Rainfed Livelihoods--progress paradigm. NationalRainfed Area Authority (NRAA), Ministry of Agriculture, India (http://nraa.gov.in/RAINFEDLIVELIHOODSPROGRESSIVEPARADIGMS.pdf)

8. Seventeenth Indian Livestock Census, All India Sumamry Report, Department of Animal Husnbandry and Dairying, Ministry of Agriculture, New Delhi, January 2005.

9. Sinha R.K., Bhatia S., and Vishnoi R. (1997). Desertification Control and Rangeland Management in the Thar Desert of India, RALA REPORT NO. 200. India Gandhi Centre for Human Ecology, Environemnt and Population Studies, Rajasthan University, Jaipur, India.

7. Kazakhstan: Overcoming Constraints and Barriers to Implementation of Sustainable Land Management

- Bulat Bekniyaz

[BACKGROUND]

Land degradation in Kazakhstan renders serious social and economic impacts. The condition of the environment has direct impact on living standard and health of the population, especially on socially vulnerable segments of the population. Major impacts include: (i) decrease in productivity of agricultural crops as a result of arable lands degradation; (ii) decrease in efficiency of high risk for livestock production caused by steppe/desert steppe and pasture degradation and lack of emergency fodder; (iii) loss of the individual and national income generating capacity of wildlife management and fisheries in connection with population reduction of target species caused by over-harvesting and habitat destruction; (iv) deterioration of drinking water quality and resulting in health problems; (v) shortage of timber and non-timber forest products, especially for local vulnerable groups, and loss of environmental services from forests. The impacts of land degradation on rural populations increase their vulnerability and drive pressure to further exploit land resources for short-term production and benefit. At present the process of desertification is marked nearly in all administrative areas of Kazakhstan.

Prevention and where feasible reversal of land degradation plays an important role for Kazakhstan's sustainable development. About 43% of the overall population of roughly 15.1 million inhabitants are living in rural areas and the majority of them are dependent on incomes directly or indirectly related to the agrarian sector. The nominal cash incomes of rural citizens are about half of that of urban people. Thus the majority of rural people do not only rely on cash incomes from agricultural production, but also on in-kind income from household plots' and household flocks' as well as on utilization of natural resources as fish, game and fuel wood. Processes of land degradation and desertification negatively affect productivity and overall crop production, livestock and cattle-breeding productivity. The comparably severe social situation in rural areas is also indicated by the low standard and extent of social and technical infrastructure as well as limited access to secure drinking water.

Land degradation gives rise to a series of life-supporting problems of the affected lands. As an example, harmful influence on health and decrease in efficiency of cattle grazed on the degraded steppe/desert steppe and pastures, reduction of productivity, and also high vulnerability of agricultural cropping from a drought at not irrigated arable lands due to decrease of humus in the soil structure, the soil salinity leading to reduction of productivity of irrigated lands, degradation of wood resources that reduces an opportunity of stocking up of timber, fuel wood and other timber resources. On the other hand, land degradation has arisen due to irrational use of land resources by land users, as well as by large-scale changes, that are frequently out of the influence zone of direct land users. The total economic losses from direct and indirect impacts of land degradation in Kazakhstan are estimated in the amount of 93 billion Tenge (6,2 billion US Dollars).

1. Problems

The most serious problems of land degradation and Sustainable Land Management (SLM) identified in Kazakhstan include: (i) loss of soil fertility due to inappropriate land-use practices in rain-fed arable lands; (ii) inefficient water use, salinization and water logging of irrigated arable lands, caused by deteriorating irrigation and drainage infrastructure and management weaknesses; (iii) degradation of steppe/desert steppe and pasturelands caused by local overgrazing and underutilization of large pasture areas due to giving up of mobile grazing practices, local livestock concentration and catastrophic decline of wild ungulates' populations; (iv) forest degradation and deforestation caused by illegal logging and bushfires; (v) drying out of large areas of the Aral Sea and associated negative consequences; and (vi) local site pollution caused by industrial and military activities. These problems have in many cases impacts on ecosystem types of global importance and/or affect neighboring countries.

The determined problems have underlying causes in the constraints and barriers to SLM consisting of national policy, legal and institutional framework, economic incentives, knowledge and capacity of immediate land-users and responsible officials and in the current stage of monitoring and land management related research.

[ACTIVITIES AND PROGRAMMES]

Table 1. The list of activities and programmes

[SUBSTANTIAL EXAMPLES]

1. Achieved Coordination with Sub-regional and Regional Action Programs

Kazakhstan actively participates in development of Sub-Regional Action Program to Combat Desertification. Priority areas of sub-regional cooperation, and also areas of special interest for Kazakhstan in SRAP are (i) cooperation within the frames of monitoring systems, in particular on hydrological forecast, (ii) transboundary cooperation on water resources management, on irrigation and transboundary hydrological systems, as well as (iii) pastures management, in those cases where for mobile grazing transboundary cooperation is required. The Central Asia Countries initiatives on Land Management (CACILM) is the programme based on the Sub-regional Action Program (SRAP).

To assist the Central Asia (CA) countries in their efforts on implementation of the UNCCD, the Global Mechanism of UNCCD (GM) has defined the Strategic Partnership Application (SPA) of the UNCCD in the Central Asia Countries. The primary goals of the SPA are originally connected with development of coordinated, integrated and certain donor responses for CA Counties assistance in implementation of UNCCD. The SPA has supported the Central Asia Countries Initiative on Land Management (CACILM) at the Partnership Forum held in Tashkent, Uzbekistan, in June 2003. The forum participants (donors and representatives of the countries) have adopted the agreement to step forward: (i) to integrate basic issues of SLM both in the field of sustainable development planning, and into development frameworks of external cooperation of the countries-partners; (ii) to promote intersectoral coordination for harmonized operation of SLM initiatives; (iii) Strategy of resources mobilization to take advantage of the GEF financing programs to combat land degradation; and (iv) to establish in each country of the Central Asia the UNCCD National Working Group on partnership development for implementation of the UNCCD.

Table 1. The list of activities and programmes

#	Name	Implementation Timeframe	Goal/tasks/notes
1	Development Strategy <<Kazakhstan 2030>> Main body - Strategies "Ecology and Natural Resources - 2030",	Up to 2030	Creation of balanced interaction between society and the nature, facilitating environmentally friendly society.
2	Governmental Program of Republic of Kazakhstan	2003-2006	Population growth in all regions as a result of political stability, sustainable socio-economic development, economic and environmental security, decreased system risks, international cooperation.
3	Program for Small City Development/Urbanization	2004-2006	Facilitating economic, social and cultural development of small cities and creating adequate conditions for rural residents through eliminating social and economic disparity between rural and urban areas, increasing social and engineering infrastructure, using effective resettlement policies for rural residents; these programs solve one of the main UNCCD tasks - poverty alleviation and improvement of living standard of the population affected by land degradation and desertification.
4	Program for Rural Development	2004-2006	
5	Program <<Forests of Kazakhstan>>	2004-2006	Conservation, protection and rehabilitation of forests, their effective use and capacity building for further improvement of forest management and woodland increase
6	State Agricultural and Food Program	2003-2005	Ensuring food safety in Kazakhstan as a result of efficient agricultural sector and competitive agricultural production
7	Development of National Systems for Standardization and Certification	2004-2005	Facilitation of developing uniform criteria for monitoring of desertification.
8	Development of Etalon Base for Dimension Units	2004-2005	
9	<<Quality>> Program	2004-2006	
	Sustainable Supply of Quality Drinking Water for the Population and Development of Water Supply Facilities	2002-2010	Sustainable supply of quality drinking water for the population and development of water supply facilities. This program is related to UNCCD through improving living standards of the population affected by desertification.
10	Research Program <<Developing Information Infrastructure for Science and Techniques in the Republic of Kazakhstan>>	2004-2006	Development of system and efficient use of research institutes and enhancement of access to research among scholars and specialists working on desertification. It will create information base on effective approaches and elimination of desertification impacts.
11	Scientific and Technical Support for Strategic Sustainable Development of the Mountain and Metallurgical Complex	2004-2006	Facilitating sustainable development of mountain and metallurgical complex of the Republic of Kazakhstan through decreasing man caused impact on environment and improving technological update of production capacity for 2004-2006.
12	Employment Program	2005-2007	Activities to promote employment of the population; Support of the target groups; Informational support of the employment policy; Improvement of legal basis for employment policy
13	Poverty Alleviation in the Republic of Kazakhstan	2005-2007	Decreasing poverty level through the improvement of economic and social factors impacting living standards of the population
	State Support to Non-Governmental Organization	2003-2005	Establishes foundation for sustainable development of non-governmental organizations as part of the civil society to increase their roles in socially important problems including combating desertification

For this purpose consultations and workshops were held in Almaty, in February 2004, and Task Force Meetings in Almaty in August 2004, in Dushanbe in April 2005 and Almaty in June 2005.

The CACILM approach is to replace the non-coordinated interventions demanding approval and specific price preparation by the GEF program approach. The adoption of the suitable investment program through the SPA opens a way to the "qualified" individual interventions, at the same time, to create synergies and to reduce administrative costs. In the last quarter of 2003 the GEF Secretary has developed the Frame Initiative of Country Pilot Partnership for realization of the Operational Program on Sustainable Land Management (OP-15). The first region chosen by the GEF where Pilot Initiative will be carried out was the Central Asia considering the scales of land degradation and existence of SPA. Thus, the CACILM forms Multi-Country Partnership Frameworks and attracts financing from various sources, as in the form of grants and investments, including GEF grant resources.

The purpose of the program is to combat land degradation and improve living standard of rural population in the CA counties. The task is to organize donor and multi-country partnership of CACILM for development and operation of programming framework at national level with the purpose of introduction of effective and more integrated approaches to sustainable land management in the sub-region. The Multi-national approach to land degradation problem has a number of advantages such as participation of all donors and both the coordinated principles and approaches of their activity; coordination of National Action Programs, projects and activities, change of focusing from special projects to more integrated approaches in separate countries; development of the general frames of monitoring and assessment of activity directed on SLM; creation of the mechanism of knowledge, technologies and experience exchange at the regional level.

The CACILM Partnership among various countries is based on the presented National Programming Frameworks (NPF) of each country with primary goals: (i) To analyze the current situation of land management in regard to ecological and social conditions, current practices of land use and corresponding problems of degradation and stability, political, legal and institutional conditions and other related problems and; obstacles to sustainable land management; (ii) to analyze, compare and put forward priorities, potential options for improvement of sustainable land management and combating land degradation; and (iii) to develop the program for integration of sustainable land management into the process of development planning and budgetary processes, to identify the requirements under the priority investments, technical assistance and to provide effective mechanisms for wide participation of the interested parties in definition, development and realization of measures.

The CACILM promotes introduction of the 10-year program (2006-2016) on resources and activity mobilization through the NAP for (i) strengthening of political, legislative and institutional frameworks for creation of conditions promoting sustainable land management; (ii) increase of the capacity of key institutes responsible for planning and introduction of land interventions management and local societies directly exposed to land degradation; and (iii) improvement of land management and natural systems through the cumulative influence of corresponding favorable conditions and target project investments.

Proceeding from decisions and recommendations of the Sub-Regional Forum on Partnership Development in the middle of 2003: Confronting land degradation and poverty by strengthening UNCCD implementation, in Kazakhstan the working group on partnership development of implementation of the

UNCCD have been created which operates as a tool for interdepartmental coordination and intersectoral cooperation. It includes representatives of the Ministry of Foreign Affairs, Economy and Budget Planning, Agriculture (representatives of Committees of water resources and forestry and hunting), Agency of the Republic of Kazakhstan on Land Management, also representatives of NGOs and international organizations. The UNCCD National Coordinator is a supervising contact person and the head of the National Working Group. The National Working Group should become managing power at the stage of CACILM development (PDF B) in each country, consulting with ADB (as supervising agency for PDF B). The issues of regional cooperation on environmental protection and sustainable development with component issue of combating desertification serve a subject of regular consultations between five states of the Central Asia Sub-region.

References

Fourth National Report for Implementing the UNCCD, 2010.

8. Kiribati: Coping with Land Degradation on Small Pacific Islands

- Terrei Abete-Reema and Victor Squires

[BACKGROUND]

Geographic setting

Located in the Central Pacific Ocean, the nation of Kiribati comprises 33 atolls with a total land area of about 800 sq km. The country is divided into three groups of atolls namely; the Gilberts, Line and Phoenix. (See Figure 1.)

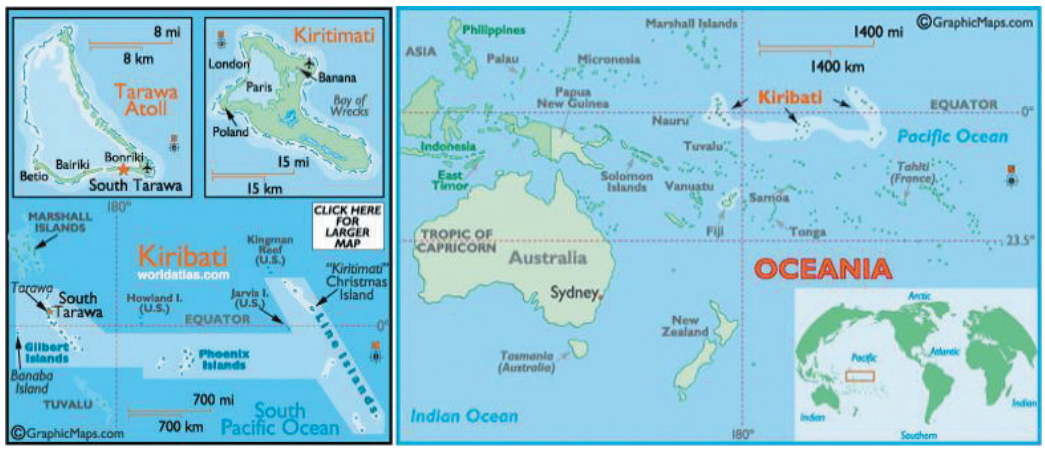


Figure 1. Map of Kiribati

With an Exclusive Economic Zone of 3.5 million sq km relative to the small land area one can only imagine the difficulties experienced by the government in managing a widely dispersed group of small islands in a vast ocean. The narrow strips of atolls have a maximum height of 3 to 4 m above mean sea level and a very thin layer of soil. These small and fragile strips of land play a very crucial role in sustaining the environment, people and economy of Kiribati. The thin layers of soils that carpet the land not only support the growth of the coconut trees, fruit trees, root crops and leafy vegetables but also protect the groundwater lens just metres below the land surface.

This Chapter focuses on the changes that have taken place in relation to causes and effects of land degradation and the response measures initiated by the people and government of the Republic of Kiribati, hereinafter referred to as Kiribati, to address the factors causing land degradation, their root causes and effects. It also highlights the areas of work that will need to be strengthened. This Chapter also outlines some emerging and potential opportunities to identify new partnerships, mobilize resources and make use of available and appropriate technologies and support from the scientific community.

Overview of the critical land degradation issues

During extensive consultations throughout the islands, communities were asked to identify environmental priorities. Seven out of the top ten priorities were concerned with access to freshwater, water quality and the protection of freshwater sources. Many of the freshwater problems arose because Kiribati had no wide-scale water resource policies or plans to draw on. Other priorities related to land degradation issues, coastal erosion and waste disposal.

The increasing threats to land degradation from, inter-alia, coastal erosion, poor waste management and pollution, rapid population growth in urban areas and economic development activities have not gone unnoticed and left unattended. The government and various national stakeholders have begun initiating strategies, plans and community-based activities to prevent the increase in land degradation and mitigate its effects. International donors and organizations through partnership arrangements, as well as Pacific regional organizations are supporting these efforts. It is recognized that an increased and sustained effort is needed if improvements are to be realized.

Excessive use of the thin layer of soil giving rise to decreased productivity of soil

Limited control over construction of buildings and sea-walls that change the coastal dynamics cause coastal erosion in certain areas. Increasing demand for burial sites and recreation sites are resulting in more clearing of land and loss of biodiversity.

Increasing population pressure on land due to urbanization

The most urgent case of population pressure on land is found on Tarawa atoll (see Figure 1.) where the seat of the government and main economic institutions and businesses are located. The population density in one of the most crowded places on Tarawa is considered to be higher than Tokyo in Japan. The rapid rise in the population is due mainly to the influx of people to Tarawa from the outer islands seeking employment, medical care, business opportunities and the lure of a modern township. This high population density from rapid urbanization is placing extreme pressures on the land in various ways. Very high exploitation of the terrestrial and marine biodiversity causing a marked decrease in the

available supply of fuel wood, food crops, marine resources.

Inappropriate disposal of solid waste and pollutants

The growth of populations, business activities and increasing reliance on imported items is having its toll on the atolls' environments. Improper dumping of solid waste, littering and careless disposal of pollutants is posing a serious health risk to the atolls inhabitants. Toxic leachate from rubbish heaps and dumps as well as the careless spillage of oil and toxic pollutants are finding their way down to the water lens. Improper disposal of medical waste on land is also experienced on Tarawa especially, where lots of used needles, sharps, chemical containers and so forth have been found at sites and reported many occasions to the Environment Office.

Increasing amounts of liquid waste

Wastes pollute the land surface, water lens and surrounding marine environment and also create a dangerous health risk to people.

For many years, there were many concerns expressed over water quality, particularly lagoon and ground water in Tarawa. The cholera outbreak in 1977 and subsequent investigations showed that groundwater, near-shore lagoon water and shellfish from the lagoon were all contaminated by micro-organisms. To date, inappropriate waste disposal on the island of Tarawa, the capital island, is the long standing problem. After gaining independence in 1977 rapid urbanization and high population growth have exacerbated the problems. Agricultural and industrial activities pose significant contaminants at many sites. For example, the ground water around the area near the powerhouse in Betio proved to be contaminated with hydrocarbons due to the dumping of waste oil and diesel near the premises. This water can no longer be used to meet subsistence food production needs.

Increasing rate of coastal erosion due to the effects of wave action

Kiribati people have observed over the years that the sea level is rising and areas of coastal land are increasingly being eroded into the sea. This phenomenon has given rise to an increase in the number of sea walls constructed around Tarawa atolls coastline as people try to save their precious coastal areas. Coastal erosion also gradually removes coconuts and other important trees that people rely on for food and income. In a setting where the islands are only about 20-50 meters wide in many places, such a phenomenon is looked upon with great concern by the inhabitants.

Given the country's very vulnerable situation any measures taken by the people and government of Kiribati to combat land degradation will also need to be linked to measures to adapt to the effects of climate change. Harmonizing these strategies and actions will be a challenge.

Extent of vulnerability to the effects of climate change and human activities

Increasing sea levels will give rise to greater loss of land and terrestrial biodiversity and will have a profound impact on people's way of life. Coupled with the effect on land quality due to increasing populations, it is not difficult to see that serious preventative measures need to be taken now to ensure that the productivity of the land is maintained to support the environment and people's livelihoods.

Most of the atolls and islands of Kiribati stand less than six metres above mean sea level, which means they will be partly inundated if sea levels rise to the extent predicted in climate change forecasts.

Increasing sea levels will give rise to greater loss of land and terrestrial biodiversity and will have a profound impact on people's way of life. Coupled with the effect on land quality due to increasing populations, it is not difficult to see that serious preventative measures need to be taken now to ensure that the productivity of the land is maintained to support the environment and people's livelihoods.

Because of its vulnerability, Kiribati was one of the first countries in the world to be selected under the Global Environmental Facility Strategic Priority on Adaptation. This project provides adaptation strategies for countries at risk from climate change. The Kiribati Adaptation Program is part of the GEF/World Bank's regional commitment to supporting Pacific Island countries in their efforts to prepare themselves for the impact of climate change and the growing threats from natural hazards, such as cyclones, tsunamis, earthquakes and other events.

The adaptation program is focusing on the country's most vulnerable sectors in the most populous areas. That includes improving water supply management in and around the capital, Tarawa; coastal management protection measures such as mangrove re-plantation and protection of public infrastructure; strengthening laws to reduce coastal erosion; and population settlement planning to reduce the risks of injury and loss of life.

The National Water Resource Policy and Implementation Plans have recently been implemented. Both policy and plan will improve the welfare and livelihood of the people of Kiribati despite the threats of climate variability and change. The responses required to protect human life and property from sea level rise fall broadly into three categories: retreat, accommodation and protection.

- Retreat involves no effort to protect the land from the sea. The coastal zone is abandoned and ecosystems shift landward. This choice can be motivated by excessive economic or environmental impacts of protection. In the extreme case, an entire area may be abandoned. In Kiribati, where some atolls are only a few hundred metres wide this is not an option.
- Accommodation implies that people continue to use the land at risk but do not attempt to prevent the land from being flooded. This option includes erecting emergency flood shelters, elevating buildings on piles, converting agriculture to fish farming, or growing flood or salt tolerant crops.
- Protection involves hard structures such as sea walls and dikes, as well as soft solutions such as dunes and vegetation, to protect the land from the sea so that existing land uses can continue.

The appropriate mechanism for implementation depends on the particular response. Assuming that land for settlement is available, retreat can be implemented through anticipatory land use regulations, building codes, or economic incentives. Accommodation may evolve without governmental action, but could be assisted by strengthening flood preparation and flood insurance programmes. Protection can be implemented by the authorities currently responsible for water resources and coastal protection.

[ACTIVITIES AND PROGRAMMES]

Activities/strategies to enhance capacity to address land degradation

There is a need to enhance the capacity of relevant resource people to address land degradation by; enhancing the capacity to develop holistic legislation to address land degradation and its causes; enhancing enforcement capacity to regulate and control land degradation; enhancing Public awareness capacity of authorities on causes of land degradation; improving capacity of local authorities especially Island councils in waste management (contributing to land degradation). The government through relevant projects is continuously trying to improve the capacity of resource people in these areas.

Capacity needs at the grassroots/community level in achieving the outputs of any sustainable land management (SLM) strategy. There are capacity needs at the grassroots or community level that need to

be improved in order to achieve the expected outputs of SLM as set out in the NAP. These are the capacity building or community training and awareness for church groups; community based organizations; village groups such as women, youth, old men associations; the enhancement of community voices in addressing land degradation through radio programmes; enhancement of authorities to mainstream environment legislations and SLM principles to support community based initiatives to combat land degradation, especially in times of emergency such as severe erosion, this means there needs to be a legislation flexible in emergency situations to help combat land degradation; enhancement of the capacity of authorities to incorporate into planning and policies, for instance there should be community based initiatives in addressing land degradation issues to encourage the ownership of strategies to combat land degradation; capacity building at the individual level in areas of combating land degradation, especially those in leadership roles; awareness on land degradation terminologies so that terminologies on land degradation issues are standardized; capacity building on public awareness methodologies or techniques.

Coupled with the demand for action on the ground, the government of Kiribati and its national partners are also under pressure to address a host of international and regional conventions, strategies and agendas. All these are placing strain on the country's limited resources and calls for a capacity needs assessment to be undertaken to identify priority capacity needs that can be addressed through various interventions.

There are projects underway that are directly or indirectly related to the UNCCD these range from projects focused on SLM. An ADB study on mainstreaming environment into national decision making processes; sustainable agriculture project, organic farming project; Global Programme of Action of the Marine Environment from land-based activities and so on.

Progress in measures to mitigate the effects of drought

- Strengthening early warning systems and monitoring and assessing the effects of drought.

To date there is a need to strengthen the Meteorological Office in Kiribati early warning systems and assessments. Monitoring of weather conditions is carried out by the Meteorological Division with surface and upper air observing stations in Tarawa, and limited surface observing capabilities are maintained on Butaritari, Banaba, Beru, Arorae, Kanton, Kiritimati, and Tabuaeran. The sites were selected possibly to meet the need for civil aviation, but now with greater need to understand climate change. The Meteorological Division needs to establish more observing stations. The arrangement for reporting rainfall only from the other atolls is not satisfactorily carried out. The Meteorological Division has benefited from limited technical and technological cooperation through some work programmes of the WMO, and through regional and bilateral initiatives.

At the same time there may be an opportunity to strengthen systematic observation systems under the GEF enabling activity - Second National Communication for the UNFCCC and with support from the Pacific Sub-Regional Office of the World Meteorological Organization.

Water conservation, protection and harvest

Through proper conservation of freshwater, protection of water from land based contamination, improved and increased storage and harvest management systems freshwater scarcity could also be

eased. A UNCCD project proposal to restore up to 6 water cistern tanks redundant from the colonial times, on South Tarawa is an effort to assist part of the water problem to mitigate water shortage by increasing water storage by 1494 cubic meters. The restoration will cost US$90.000 to conduct within two years and the outcome should benefit approximately 8% more of the population, around the target communities in Betio, Bikenibeu and Bairiki which are the major towns of the capital faced with major water scarcity problems.

Constraints and challenges anticipated in implementation of the NAP

- Achieving an integrated and coordinated approach to addressing land degradation

The initial stage for implementing the production of the NAP was to set up a National Coordinating Committee that comprised by concerned stakeholders including the National Planning Office, Agriculture Department, Lands Department, ECD and the Public Works Department. After that a comprehensive Stakeholders committee was set up that comprised of most line of government ministries, NGOs, youth, church group as already indicated earlier in this report. Coordinating committee and stakeholders meeting is one way of achieving the integrated and coordinated approach toward sustainable land management. However the main constraint of this approach especially at the ministerial level is the political pressure and power that may hinders proper environmental considerations in any decision making and when a particular ministry is mandated to carry out political directives for political interests. PWD usually present lots of contributions in coordinating activities for NAP but it is always the main contributor to land degradation. This is due to the political pressure that drives their immediate activities in terms of advancing economic development and physical infrastructures at a given timeframe.

Given the country's very vulnerable situation any measures taken by the people and government of Kiribati to combat land degradation will also need to be linked to measures to adapt to the effects of climate change. Harmonizing these strategies and actions will be a challenge.

References

Fourth National Report for Implementing the UNCCD, 2010.

9. Kuwait: Controlling Land Degradation Using Environmentally Friendly Materials

- Salah Mudh'hi Fahed Al-Mudh'hi and Farah A. Ibrahim

[BACKGROUND]

The harsh environmental conditions (including drought) besides the degradation of natural resources due to human pressure are major impediments for the real development of the terrestrial environment of Kuwait. These two major elements represent serious threat to national economy and quality of life. Challenges facing the real development of the terrestrial environment of Kuwait are diversified. Reversing the processes of land degradation through serious and sustainable control measures, as well as appropriate land use planning are the most significant challenges. Realizing the seriousness and complexity of the land degradation processes and hazards of drought, a package of preventive and remedial measures should be adopted to reverse land degradation and minimize the effects of drought in Kuwait .In the current study, special emphasis will be given to "Best Management Practices (BMP)" that are used frequently to control land degradation and to manage the hazards of drought. These practices range from appropriate utilization of the natural environment to the establishment of integrated systems for controlling land degradation and shifting sands.

The main objective of this study is to develop measure to stabilize the shifting sands and mobile sandy bodies using inexpensive and environmentally friendly materials. These materials include a wide range of plant cuttings reaching about 10 elements. These include leaves, fruit bunches and fibers of date palms, dead tree branches and grasses. In addition, ecomat, which is an environmentally friendly material made up of 100% natural oil palm residues, will be used for sand stabilization. Previous experience indicates that plant debris especially ecomat, leaves of date palms and tree branches, if properly applied, are very effective in the immediate control of sand movement.

Almost all of the development sectors in the Kuwaiti Desert are suffering from encroaching sands. In the agricultural sector, 66.6% of the farms and 100% of the animal production facilities are affected by sand encroachment. In the public works sector, at least six desert highways representing 85% of total highways are influenced by shifting sands. Some of these highways are very severely affected by shifting sands and sand encroachments, e.g., Wafra-Mina Abdallah, Kabd, and Al Salmi Highways.
In the defense sector, 100% of the airbases and 50% of the military camps are suffering from serious sand encroachment problems. Ali Al-Salem and Ahmad Al-Jaber Airbases are severely affected by shifting sands. In the oil development sector, 43% of the oil fields are subject to shifting sands. Managish and Wafra oil fields are examples of severely affected oil fields. Gathering centers, wellheads, roads and flow lines are the main elements affected by shifting sands in KOC operational areas.

In Kuwait, sustainable action plan to control wind erosion and sand encroachment problems is not applied. Development sectors, e.g., oil, defense, public works, agricultural, etc. deal with the problem, in their affected sites, without any coordination among each other. The approach of the development sectors in controlling drift sands depends in almost, if not all cases, on the periodical removal of the

accumulated sand. The removed sands are dropped in open desert areas. Dropping of drift sands in open desert areas causes a lot of problems as they blow up by strong winds and re-shift and then attack new areas.

[ACTIVITIES AND PROGRAMMES]

1. Shifting Sands in Kuwait

Recent mapping of areas affected by shifting sands using Arc GIS 9.2 indicates that Al Atraf-Kabd area (about 1,475 km^2) is severely encroached by mobile sands. In this area at least 11 strategic facilities including airbases, military camps and highways are threatened by shifting sands.

In Al Atraf-Kabd (Total area 1,475 km^2) the following facilities are severely attacked by sands

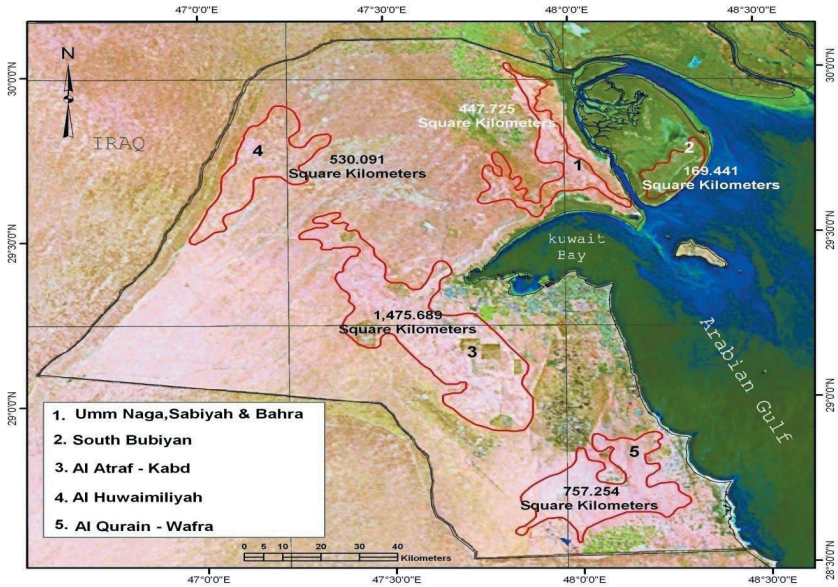


Figure 1. Areas Affected by Mobile Sand (Socio-economic Approach)

- Ali Al Salem Air Base;
- Kabd animal production;
- Kabd Road (Road 604);
- 6th Ring Road (NW Al Jahra);
- KISR Experimental Station;
- Kabd Transmission Station;
- Military Camp (B.35 Armor);
- Umm Al Qawati ammunition store;
- Al Mutlaa water tankers;
- Al Mutlaa Transmission Station; and
- Ahmad Al Jaber Air Base.

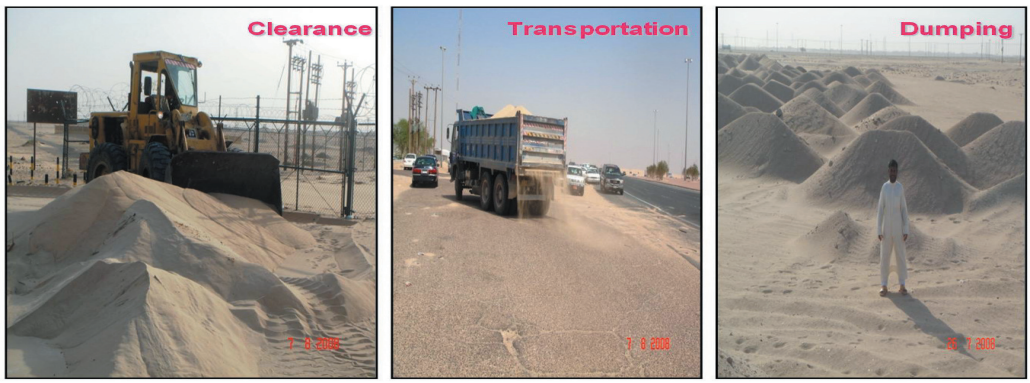


Figure 2, 3 and 4. Cycle of Sand Clearance, Transportation & Dumping (CTD) in open desert areas, Al Mutlaa site, August 2008.

2. Environmentally Friendly Materials

Mechanical stabilization of mobile sands using environmentally friendly materials is the main approach of this study. These materials are differentiated as processed and raw. The processed materials include ecomat and erosion control blankets (coir product). While leaves of date palms, dead desert grasses, tree branches and others constitute the raw materials. Generally, these materials are applied successfully to control soil erosion and sand encroachment problems at several areas in the world including Kuwait. The cost of these materials is very low in comparison to their environmental benefits and their immediate effect on sand stabilization.

Ecomat is environmentally friendly mulching mat, fully biodegradable, made up from 100% natural oil palm residues. These residues supply nutrients to both the soil and the plants. The ecomat contains elements e.g., K (Potassium), Mg (Magnesium) and N (Nitrogen), which enhance soil quality and plant growth. Ecomat was successively tested in Burgan oil field, Kabd and at Al-Liyah India Kuwait. Figure 5 and 6 show some applications of ecomat in Kuwait.

Figure 5 and 6. Using ecomat in stabilization of mobile sand body at KOC (Arabian Scientific Consultancy Center, Kuwait) November, 2006.

Figure 7. Soil Stabilization using environmentally friendly materials (Case of al Liyah)

3. Coir mats

Coir mats are 100% biodegradable mulching blankets made up of coir products. These mats are fast binders of soil. They provide excellent medium for quick vegetation and holding the seeds and saplings in place. The mats are excellent for air and water permeability. This product was tested at Burgan oil field. Figure 7 below, shows rolls of coir mats.

Figure 8. Using different parts of palm leaves in sand stabilization at Al-Liyah area, August 2006

Cuttings of date's palms including leaves (fronds), fruit bunch and fibers are used on a large scale for stabilization of mobile sands in several areas in Kuwait and other countries (e.g., Saudi Arabia, UAE, Libya and Egypt). Each part of the cuttings has its own application. For example, the leaves are used for mulching, low wind breaking and checkerboards (Figure 8 & 9).

Figure 9. Application of plant residues (mainly palm leaves) in different designs to control shifting sands in arid regions

Figure 10. Plate huge amounts of Plant residues, Wafra Agricultural area, November 2010

4. Environmental Advantages of Plant Residues

- Biodegradable;
- Environmentally/ecologically friendly;
- Very cheap and available in huge amounts;
- Light, simple and highly flexible, which makes them easily portable and efficient for workers to apply (user friendly);

- Helping to retain moisture and reducing evaporation of water from subsoil;
- Enhancement of soil quality, plant growth and wildlife development;
- Durable and long lasting; and
- Immediate stabilization and control of mobile sands.

5. Soil conservation

Field measurements indicate that moisture storage in the 0-60cm soil profile of the treated soils (mulched) was about 2.5 times greater than that of untreated soil .The soil moisture of mulched soils was 16.2%, while that of un-mulched soils was 6.7 %.

6. Development of fauna

Field measurements indicate that rodent burrows were about 6 times higher in treated soils (mulched) in comparison to control (un-treated soils). Benefits of Fauna include: soil aeration, organic enrichment & seed dissemination. Huge amounts of plant residues are produced from Wafra, Abdaly and Kabd Agricultural areas. These residues include palm fronds. The majorities of plant residues are dumped and seed dissemination and burnt.

There are many benefits of environmentally friendly materials, include:

Figure 11. Burning plant residues, Wafra Agricultural area, November 2010

Table 1. Approximate cost of transportation & spreading of environmentally friendly materials: KD 17,000/month

Item	Cost (KD)	Remarks
Transportation	8,000	8 trucks
Labour (drivers & field operators)	6,000	8 drivers 24 field operators
Technicians	3,000	6 technical staff (500 KD/person)

Table 2. Cost of stabilization of 1m of soil using different material (min. 1000m)

Material	Cost (KD)
Local plant residues & waste	0.3-0.5 (source: Misak 2006)
Metal grid (1m spacing)	2.67 (source: A. Ramadan, 2007)
Metal grid (2m spacing)	1.5 (Source: A. Ramadan, 2007)
Ecomat (Malaysian)	0.5-0.6 (Source: ASCC, 2006)

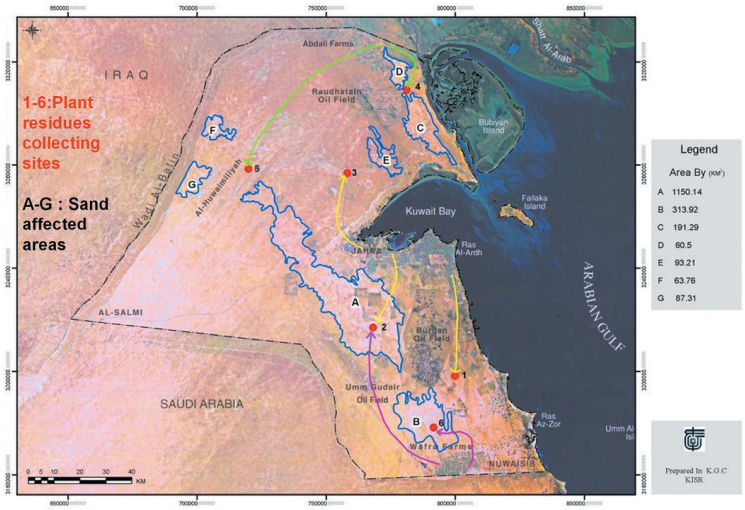


Figure 12. Stabilization of shifting sandy bodies using greenery residues of Abdaly, Kabd, Wafra and Urban areas in Kuwait

Recommendations

- Prohibit dumping or burning plant debris (tree trimmings, palm fronds, grass clippings & others). Recycle these materials as sand stabilizers are recommended.
- Adoption of a long-term program for collection and recycling of plant debris.
- Formulate a committee from EPA, KISR, Kuwait Municipality & other concerned organizations to evaluate the concept of recycling plant materials for land degradation control.

[SUBSTANTIAL EXAMPLES]

Environmental rehabilitation study of the quarries in the state of Kuwait[4]

1. Introduction

The rapid urbanization in Kuwait since 1960s has resulted in an unprecedented demand for sand and gravel to support construction activities. This demand has led to the extensive exploitation of aggregate deposits in certain parts of the country, which in turn has caused a severe negative impact on the natural

[4] Note this work is reported by Kuwait Kuwait Institute for Scientific Research Environment Public Authority based on field work conducted September 2003 - August 2008.

ecosystems. Therefore, the study was proposed to delineate the abandoned gravel and sand quarry sites over the desert of Kuwait, investigate the optimum and most effective approach to rehabilitate the desert environment degraded due to quarrying activities, and draw long-term action plan for the restoration of the entire areas damaged in the Kuwait desert.

2. Method

The rehabilitation of the desert environment damaged by the quarrying activities is the core of this five-year study sponsored by the Council of Ministers, State of Kuwait. The study had been conducted under multi-methodology approach that covers most aspects related to rehabilitation of desert ecosystem. The main outlines of the study include damage assessment of the quarries areas in Kuwait, measuring the size of the damaged areas using the remote sensing images and review of the different stages that led to official banning of quarry activities.

- The soil survey and the examination of the damages to the structure of the surface soil were commenced including assessment of physical and chemical properties. The overall objective of the revegetation task was to rehabilitate areas damaged by quarrying using an integrated approach involving sand control, soil moisture conservation and improvement in vegetation and wildlife habitats. An accurate assessment of current status of land and biological resources in the affected areas is a key to the development of environmentally sound rehabilitation plans and conduct of the environmental impact assessment. Therefore, the overall objective of this study was addressed through three sub-projects, namely: a) assessment of the current status of soil, vegetation and wildlife resources; b) revegetation of degraded quarry sites using native plants; and c) revegetation with naturalized exotic plants

- Seed collection is the first necessary step in the approach to restoration and rehabilitation of desert ecosystem, which include monitoring and then collecting the germplasm from similar desert ecosystems that have not been overgrazed or extinct. It is essential for this study to be executed to prioritize the species for each ecosystem and topography, and then increase the seed harvest. It is also necessary to make selection for cultivars within species that are more drought and heat tolerant. Thus the project is divided into many sub-projects including seed collection from native plant population, seed handling and cleaning and seed storage at KISR seed bank holdings unit.

- Revegetation of degraded land in the quarry site at Liyah and transplantation of selected native plants were the core activity in the study project. A large scale experiment was initiated involving different furrowing techniques and seeding approaches with key native species. Six plots, each 50 x 25 m were selected in a completely barren, heavily compacted site. These plots were arranged along a single straight line, 300 m in length, aligned at a right angle to the north-west prevailing wind direction. Twenty four furrows were created along the line of plots with 3 different machines: plots 1 and 2 with a camel pitter, plots 3 and 4 with a contour seeder and plots 5 and 6 with a ripper. A premixed species were used in the experiment, which include 5 perennial dwarf shrubs, 4 perennial grasses and 3 annual grasses.

- Wildlife assessments, reintroduction and monitoring task consisted of four distinct phases, namely: Phase I: Assessment; Phase II: Planning (master plan development); Phase III: Integration of Programs: (implementation of the master plan); and Phase IV: Monitoring of Ecosystem Health.

- Aeolian process and sand stabilization and control focused on field and laboratory methods applied on monitoring, evaluating and stabilization of surface sands on the degraded land using different methods and measurements and analysis of rainfalls during the last season.

3. Findings

The study had achieved in significant degree many positive and promising findings toward a complete understanding of the desert behavior once given the chance to rebuild its natural rehabilitation system.

It has been indicated that the total area of gravel quarries in Kuwait is about 38,294 ha (2.29% of total land area of Kuwait), about 85% of these quarries are located in the Northwestern part of Kuwait (Jal Liyah to Umm Al Madafae area). In this study, the environmental damages which resulted from gravel quarrying are classified into immediate and long-term damages. The immediate damages include as such: destruction of vegetation cover, soil compaction, increase of sand and dust emissions into air and development of shifting sand bodies. While the long-term damages include, sandy degradation of surface hydrological conditions, depletion of soil moisture and in turn, deterioration of vegetation, soil crusting and sealing, and increase of groundwater salinity in case of exposing groundwater bodies during excavation processes.

It has been clearly verified that certain sections of the Kuwait desert have the potential for self-recovery, providing adequate protection afforded from detrimental activities such as overgrazing, camping, off-road driving, etc. In other sections, recovery can be accelerated by minimal human intervention, such as the planting of dominant species. Where degradation is particularly severe, more substantial measures, including mechanical soil treatments, may be required. The extremely positive results of this study are documented by a substantial increase in vegetation cover, a marked increase in plant diversity and a gradual recovery of mammals, reptiles, birds and invertebrates. Moreover, the area has become an important stop off area for birds during the migration season

4. Conclusion

The study concludes that by developing a wise management program, the other degraded quarry sites in Northern Kuwait can be vastly improved by relatively inexpensive means. In the simplest case, this merely entails controlling access to the area and the use of its resources. Human intervention can also improve the regeneration process at severely damaged sites. However, it is important to realize that biological recovery in degraded deserts is a lengthy process. The study is therefore recommending a coherent long-term restoration program to cover all quarry sites in Northern Kuwait, equivalent to 3% of the total area of the country. The restored areas can be used for a variety of environmentally sustainable purposes, including biodiversity conservation, desert ecotourism and education. This program will also have a number of important social-economic benefits, including helping reduce wind-borne dust, and will also underline Kuwait's commitment to combating desertification and protecting its natural heritage.

5. Applications

Five years have lapsed since this study commenced, and it has been clearly shown that efforts to restore highly degraded ecosystems of the Kuwait desert in the Liyah quarry site are beginning to show considerable success. It is important to stress three important points: the quarry sites were subjected to

massive disruption and impacts, thus complicating restoration measures; virtually no information was previously available on how to restore such highly degraded sites; and restoration of such highly degraded sites entails a long-term commitment, measured in decades rather than years. The work so far carried out has involved a substantial amount of learning, and it is vital that this learning process, in the form of applied scientific research, continues if restoration activities are to be extended.

A number of important lesson have been learnt from the project, and the results have allowed the project team to propose more general recommendations towards applied restoration efforts of the entire quarries in Kuwait that include:

- An effective management system should be implemented for areas to be restored in order to prevent unauthorized access, grazing and hunting throughout the year;
- Facilities in the Liyah quarry site for native seed and plant production need to be established so that a source of suitable species is available to support revegetation efforts in the other quarry sites;
- Future activities to revegetate the area should focus on sites that are already showing positive signs of natural revegetation and have the potential to deliver promising results in the short to medium term;
- Future restoration efforts should focus on the reestablishment of dominant native plant species that have already showed encouraging results; and
- Restoration of the desert environment requires a long-term commitment of at least 10 -20 years. It is therefore strongly recommended that an independent body be responsible for drawing up and executing the long-term restoration program.

Figure 13. Refilling of gravel quarries at Liyah site

Figure 14. The quarrying companies showing the separation and grinding facilities

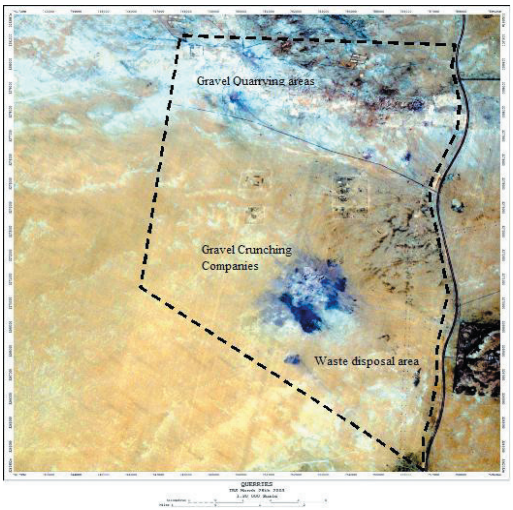


Figure 15. IRS Satellite image of Liyah quarry area on March 28, 2003

Figure 16. Seed handling and cleaning at KISR laboratories

Figure 17. Rehabilitated Rhanterium epapposum community occur in the Eastern section of the Quarry site

Figure 18. Nest with eggs of Greater hoopoe lark

Figure 19. Hoopoe lark hatchlings

Figure 20. Growth of plant in shed house

References

1. Alhajraf, S.,. Al-Enezi, A., AL-Dousari, A.M., Brown, G and Delima, E. 2008. Environmental rehabilitation study of the quarries in the State of Kuwait, Al-Liyah. EC006C, Final report, Kuwait Institute for Scientific Research, KISR9475.

2. Arabian Scientific Consultancy Center (ASCC), 2008. Protection of pipelines against shifting sands in west Kuwait (pilot site).

3. Arabian Scientific Consultancy Center (ASCC), August 2006. Management of the Spirit of the Desert (Burgan oil Field), First Progress Report.

4. Khalaf, F.I. and Al-Ajmi, D. Aeolian processes and sand encroachment problems in Geomorphology 6: 111-134; 1993.

5. Misak, R. 2008. Managing the hazards of shifting sands in the terrestrial environment of Kuwait. First Regional Conference on Geoinformatics. Kuwait, 24-26, November, 2008.

10. Lao PDR: Conservation Agriculture in Practice

- Oloth Sengtaheuanghoung and Saysamone Phothisat

[BACKGROUND]

Activities in the field of Conservation Agriculture (CA) have been conducted from 2003 to 2009 by PCADR (funded by AFD, French GEF and Ministry of Foreign Affairs, France) under the umbrella of the Ministry of Agriculture and Forestry of Lao PDR. Several components have been implemented under this programme as the Lao National Agro-Ecology Programme (PRONAE) resulting from a partnership between NAFRI and CIRAD and the Rural Development Project of the four southern districts of Xayabury Province (PASS). More recently, MAF, with the support of the French Agency for Develoment, has implemented the Sectoral Programme on Agro-Ecology (PROSA). Main objective of PROSA is to define a national strategy for the dissemination of CA in the Lao PDR including different stakeholders (educational sector, policy-makers at central and provincial levels, representatives from farmer groups, research and extension service agencies, private sector).

1. Priority Targets

Preservation of natural resources is the first priority. Maintaining and enhancing productivity of the soil and preservation of natural resources is crucial for long-term improvement of low-income holders' conditions and poverty alleviation (National Growth and Poverty Eradication Strategy). The main environmental and socio-economic objective will thus be to develop technical alternatives that shall enable the preservation of renewable but not inexhaustible natural resources such as soil and water, and to promote sustainable agriculture that is socially acceptable, economically profitable and environmentally sound. First of all the activities should move to restore and preserve the physical, chemical and biological fertility of the soil used in agriculture, which constitute much of the natural heritage of Laos.

Soil management is the principal integrating topic for all development activities linked to agriculture, livestock, forestry, fishing, preservation of infrastructure, water quality and the quality of life. Conservation agriculture based on the techniques of direct seeding and plant covers is thus proposed. Centering the approach on soil capital also makes it possible to maintain enough diversity to allow interesting ecosystem properties to emerge, notably with regards to the natural functions of bio-geochemical regulatory cycles. Thus, it enables the project to meet the environmental issues through:

- Promotion of technologies that can increase the productivity and socio-economic capacities of farming systems without negative effects related to land use, water use, chemical fertilizers or pesticides;
- Promotion of technologies that can assist the careful and environmentally responsible development of the ecosystem services of natural systems whose primary production functions are not fully exploited (e.g. the Plain of Jars);
- Promotion of technologies that increase energy efficiency, reducing greenhouse gas emissions and increasing carbon sequestration

In addition to the promotion of sustainable agriculture, this approach also allows the creation of global and local environmental public goods (GPG and LEPG), which for the moment have no monetary value. The concept of Payment for Environmental Services (PES) provided to society is appropriate here

2. Approach through a global system

The system approach, designed to progressively transfer skills to the local authorities, research and development agencies and private operators, is organized around two principles: To develop a repeatable global solution to the constant need for information from all development practitioners, in order to improve and update in 'real time' the technological, methodological and organizational methodologies to keep it in line with the evolving biophysical, socio-economic and political context, and with demand. Constant evaluation at each stage will allow real time adjustment of activities and reorientation of programmes, and so optimize the use of all resources.

To develop an integrating approach that unites research, extension, training and all processes involved with creating a structure and taking policy and financial decisions from the very start of the project and throughout its cycle. This will require links with all actors in rural development: farmers, extension agents, trainers, researchers, the private and banking sectors, and political and financial decision makers.

The solution lies in an integrating and iterative process based on components designed to fulfill activities of Diagnosis, Set-up & Trials, Training, Monitoring & Evaluation, Creating an enabling environment and Extension. Each participant will thus be somehow involved in every project activity. Such involvement is essential to the success of this global system solution. The single most important objective in each component is the constant safeguarding of the human, economic, cultural, technical and natural environments.

The farmer groups approach is used to facilitate regular technical support and exchange with families (creation of structures) concerning the production system that will be developed. The approach must be flexible, evolving according to results and indicators, and able to structure and adapt groups of producers towards service activities (e.g. supply, credit, and collection).

3. A farmer-group based approach

A holistic approach, based on a permanent link between research and development, has been implemented by the Lao National Agro-Ecology Programme (PRONAE - PCADR, NAFRI), the Rural Development Project of the four southern districts of Xayabury Province (PASS - PCADR, LCG), and the Sector-based Programme on Agroecology (PROSA, MAF), in partnership with the Department of Agriculture and Forestry of Xayabury and Xieng Khouang Provinces. Five interdependent components describe this holistic approach: the first component is based on local knowledge and initial assessment to characterize biophysical conditions, farming systems and the socio-economic situation. The second component based on reference data acquisition (65 ha in Xayabury and Xieng Khouang) is implemented through demonstration sites. A broad range of options is developed and will allow farmers to adjust their systems in line with changing market demands (continual diversification and adjustment of system).

4. Institutional tools for the promotion of Conservation Agriculture

The National Agro-ecology Programme (PRONAE) and the Southern Xayabury Application Point (PASS) of the Capitalization and Rural Development Support Programme (PCADR), have developed an approach in Xayabury and Xieng Khouang Provinces that relies on directsowing mulch-based cropping systems (DMC). This approach has provided relevant alternatives to traditional agricultural practices, which can no longer ensure the foundations of sustainable agriculture. In view of the results obtained, both of socio-economic or environmental, the Council of Ministers authorized the Ministry of Agriculture and Forestry (MAF) to promote these techniques throughout the country, and called for this approach to be programmed into university and school courses. It is in that context that the Sector-based Agro-ecology Programme (PROSA) is aimed to define and implement a national strategy for the dissemination of Conservation Agriculture based on agro-ecological techniques (DMC).

5. Direct Seeding Mulch-Based Cropping Systems

Farming systems throughout the Lao PDR have changed drastically over the last 15 years due to a range of factors. In some areas where market forces are prevalent, shifting cultivation systems have given way to more conventional high-input agricultural systems. In other remote areas, the traditional system with long rotations has been put under pressure primarily due to modification of land access and growing population pressure. In Southern Xayabury in the Mekong Corridor, where there is access to the Thai market, land preparation has become based on burning residues and ploughing on steep slopes. Because of the environmental and financial costs of land preparation, farmers are shifting to herbicides, which lead to chemical pollution, while crop residues and weed mulch are usually burned, thereby increasing mineral losses and erosion on un-vegetated soil. In mountainous areas such as Xieng Khouang Province, the rationale of shifting cultivation is collapsing as farmers use land for longer periods

6. Principles of direct-seeding mulch-based cropping system

This chapter gives an overview of the holistic research approach implemented by NAFRI and CIRAD and the principles of direct seeding mulch-based cropping (DMC) system. Conventional agriculture and intensification of shifting cultivation are now being questioned, as they seem unable to face the main challenges of food safety, soil and water conservation, environmental protection and cost reduction. A holistic approach has been developed and managed by farmers, researchers and extension agents, whose aim is to propose agro-ecological systems that are compatible with farmers' strategies and conditions and which can be reproduced inexpensively on a large scale. Agro-ecology is the understanding of dynamics and functions of agro-ecosystems, including all physical, socioeconomic environments. Direct seeding mulch-based cropping (DMC) system, replicating functions of forest ecosystem, are one of the components of agro-ecology strategy. The main principle of these systems is that the soil is no longer deteriorated under series pressures.

7. Assessment

Poverty alleviation is strongly dependent on soil and natural resources access and preservation. Swidden cultivation is one of the best examples of farmer ecological strategy: with a mosaic of sites under fallow and some in cropping, soil potential is maintained and biodiversity (source of gathering and hunting,

medicinal plants, firewood) is optimized by smallholders.

However, over the past fifteen years, farming systems have changed drastically in the Lao PDR, with swidden systems giving way to more modern agricultural technologies in many areas. In Southern Xayabury (the Mekong Corridor), with agricultural intensification, rotational cultivation systems and fallow periods are disappearing, being progressively replaced by a 'resource-mining' agriculture that has serious social and environmental costs, including increased soil erosion (leading to destruction of roads and paddy fields), loss of soil fertility, and chemical pollution of the environment. In the uplands, intensification of swidden cultivation, with longer periods of cropping and more frequent return to a given field, is now being questioned as it seems unable to face the main challenges of food safety, soil and water conservation and environmental protection. In many countries, including the Lao P.D.R, the rationale of slash-and-burn collapses under changes in social conditions (growing population density), modification of land access and increasing pressure on farming system.

Knowledge of farming system is a key to rational generation of technologies. Our research priorities are based on agricultural aspects, socio-economic needs and environmental conditions of farmers. Initial assessment of the situation has been carried-out at different levels in order to integrate all aspects of smallholders' strategies and environmental conditions.

[B. ACTIVITIES AND PROGRAMMES]

1. Xayabury

Since the 1990s, traditional farming system in Southern Xayabury Province has changed drastically through extensive agricultural development based on cash crops such as maize, rice-bean (Vigna umbellata), peanuts, Job's tears (Coix lacryma Jobi), sesame and black cowpea (Vigna unguiculata). This development is mainly the result of technology transfer from Thailand (inputs, heavy mechanization and technical skills), along with increased local financial capacity and market accessibility. In response to Thai market demand and due to the low labour requirements of the crop, maize mono-cropping now dominates production in the area. Land preparation, based on ploughing steep slopes, has allowed maize cultivation across large upland fields. This development, along with land allocation and growing population density, is leading to dwindling fallow periods. Despite very good soils and high potential for agricultural development, arable land can be quickly degraded, in such case, negative social and economic effects occurred consequently.

2. Xieng Khouang

A survey of 73 households was conducted in three districts of Xieng Khouang Province, Lao PDR, revealed that rice importance still prevails in remote areas with limited access. Farming system in such areas is still based on food security and self-sufficiency, and rice crops remain the cornerstone of household production strategies. However, the emergence of new economic opportunities such as (i) better road access to markets and, (ii) increasing local and regional urban consumption, have also slightly modified these traditional schemes and encouraged the emergence of non-rice based farming systems in the province.

3. Cropping system and technologies

Agronomics and socio-economic diagnosis provides a basis for modelling cropping systems and their components. Related to the initial assessment, long-term experimental units, which are representatives of the biophysical (integrating soil, slope and climate) and farming systems diversities, are set up in order to carry out DMC systems and technologies. A range of cropping systems is generated, integrating local species (as rice bean in the South of Xayabury) as a first step. Each cropping sequence, and each year of the sequence, is represented under no-till and tillage (used as a reference) practices. Cropping systems comprise three major components:

- Soil management and land preparation through either conventional land preparation (slash-and-burn, ploughing) or through direct seeding (mulching, use of crop residues and cover crop);
- Crop management (rotation, association or crop sequence in the same season; sowing date and plant density). In DMC systems, efficient crop management can reduce weeds and pest pressure and maintain the main functions as close as possible to the natural ecosystem; and
- Thematic adjustment (cultivar, fertilizer). Soil and crops management, cultivars and others inputs and natural conditions can be cross-linked to obtain a set of highly varied conditions.

4. Livestock interactions

Managing the interface between animal and crop components is crucial to the success of these systems. Overgrazing of cover crop or crop residues during the dry season may leave too little mulch for sowing of the following wet season crop, thereby affecting the main functions of the DMC systems. Specific forage use and control of wild-fires on the landscape unit must be defined by farmers during the dry season.

1) Direct Seeding mulch-Based Cropping Systems

The Plain of Jars is acid and infertile savannah grassland covering an area of about 60,000 ha in the western region of Xieng Khouang Province, Northeast Lao PDR. In this ecology, farming systems are mainly based on lowland rice cultivation and extensive livestock production. An increase in rice production and intensification of the livestock industry are two key components in the Lao Government's Poverty Alleviation Strategy for this area. The main agronomic constraints for developing crops and forage systems are related to serious unfavourable soil chemical characteristics. Low pH, along with nutrients deficiencies (in nitrogen, phosphorus, potassium, calcium and magnesium) and high levels of aluminium saturation probably have a negative effect on the growth of upland crops, as well as many pasture species. Moreover, severe phosphorus deficiency generates animal health problems. Since 2004, the Lao National Agro- Ecology Programme (PRONAE) has been working on innovative farming systems.

2) Improving the lives of low-income holders

In the four southern districts of Sayaboury Province, farmers' livelihoods are primarily depending on rainfed maize cultivation. On average, maize production contributes to 66% of farmers' annual incomes. That contribution even reaches 80% in Paklay District. The current farming systems - based on intensive mono-cropping and mining practices - involve high production costs and engender a rapid decline in agricultural yields. In order to remedy this situation and improve farmers' livelihoods, the Ministry of Agriculture and Forestry of the Lao PDR launched the PASS-PCADR project with financial support from

AFD. The main objectives of this project are related to: (i) soil and environmental conservation, (ii) the improvement and diversification of farmers' incomes, and (iii) the improvement of agricultural marketing. Alongside DMC extension activities, PASS-PCADR is working to improve smallholder pig raising systems.

References

Fourth National Report for Implementing the UNCCD, 2010.

11. Mongolia: Working with Land Users to Arrest and Reverse Desertification

- Banzaragch Tsesed

[BACKGROUND]

Mongolia is a landlocked and mountainous country in Northeast Asia Sub-region. It is also the world's second-largest landlocked country after Kazakhstan. The country contains very little arable land, as much of its area is covered by steppes, with mountains to the north and west and the Gobi Desert to the south. Approximately 30% of the population is nomadic or semi-nomadic. Due to the distance from the sea, the climate is continental.

Table 1. Country data

Country data	
Total land area in 1996 (thousand ha)	156,650
Total forest area in 1995 (thousand ha) /% of total land	9,406/6.0
Natural forests in 1995 (thousand ha)	9,406
Total change in forest cover in 1990-95 (million ha)/annual change (%)	0
Population in 1997 (millions)/Annual rate of change in 1995-2000 (%)	2.6/2.1
Rural population in 1997 (%)	38.1
GNP per person in 1995 (US$)	310

(Source: FAO - State of the World's Forest 1999)

Causes of desertification

As stated in the United Nations Convention to Combat Desertification (UNCCD), the Rio Declaration on Environment and Development, Agenda 21, June 1992, desertification is defined as: "land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variation and human activities". Under the above criteria, 90% of lands in Mongolia, which have been used for steppe/desert steppe and rangelands for livestock i.e. sheep, goats, cattle, horses, and camels, are vulnerable to desertification.

It has been assessed that the major causes of desertification in Mongolia are:

- The climatologically factor. Scientists claim that drought is a cyclical phenomenon, but its duration may have become longer and more severe. Strong winds are also one of the major causes of desertification.

- The anthropogenic factor. Several factors have been identified, including overgrazing and other human activities associated with livestock grazing; intentional burning; and rodent and insect attacks.

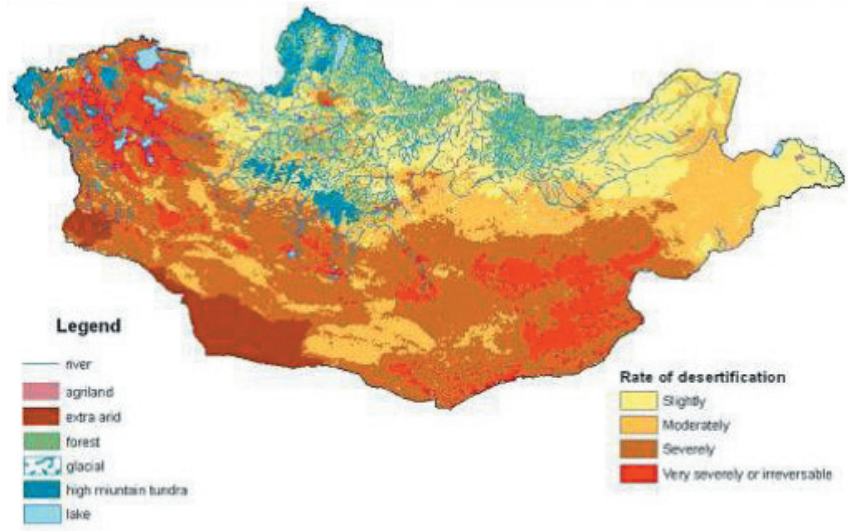


Figure 1. Extent and location of desertification in Mongolia in 2006

[ACTIVITIES AND PROGRAMMES]

Mongolia has signed the "UN Convention to Combat Desertification" in 1996 and ratified it in 1997. The Government of Mongolia approved National Action Plan to Combat Desertification by its Resolution 193 in 1996. Although adoption of the National Action Plan is only one among all required measures, which need to be taken, it however, is a clear example of government's special attention to desertification problems.

1. Activities completed and planned

No.	Name of Projects	Projects scale	Project framework	Time	Parties	Total budget, 0,000 US dollars
1	Prevention of Sand and Dust Storm in Northeast Asia, master plan for regional monitoring**	Regional	Sand and Dust Storm monitoring	2003-2005	ADB Government of Japan, GEF	1000.0
2	Conservation of Bio Diversity of Eastern Mongolia, to support sustainable livelihood development*	National	Conservation of BioDiversity of, to support sustainable livelihood development	1998-2005	GEF UNDP	6174.0
3	Conservation of Ecosystem of Great Gobi and its umbrella species *	National	Conservation Bio Diversity	2000/ 2003-2007	GEF UNDP	25.0/979.0
4	Combat Desertification by Improving Pastoral Management*	National	Combat desertification	2000-2003	GTZ German Technical Cooperation	580.0

No.	Name of Projects	Projects scale	Project framework	Time	Parties	Total budget, 0,000 US dollars
5	Combating Desertification in Asia*	Regional	Implement the NAP to Combat desertification	2000-	ADB UNCCD Secretariat	450.0
6	Rural Poverty Alleviation Project *	National	Combat desertification, Poverty Alleviation	2003-2010	IFAD Government of Mongolia	19700.0
7	Sustainable Pasture Management *	National	Mitigation of desertification	2002-2007	UNDP Government of Netherlands	3300.0
8	Keep Mongolia Green **	National	Pasture degradation, Rehabilitation of affected by Desertification	2004-2009	International Rotary Organization Government of Mongolia	100.0
9	Combat Desertification through Sustainable Land Management **	National	Combat desertification National capacity building	2006-2009	GEF	PDF
10	National Geo-information Centre for Natural Resource Management **	National	To establish Natural resources database & metadata base	2006-2010	Government of Netherlands and Government of Mongolia	330.0
11	"Mongolian Pasture - Green Gold" **	National	Combat desertification	2004-2007	Swiss Development Cooperation agency	6600.0
12	To Combat Desertification with Joint Participatory Efforts at the "Zamiin-Uud" Soum, Dornogobi Province, Plantation and Irrigation of Affected Areas	Local	Local capacity building	2003-2005	UNCCD Secretariat	50.0

** "Social and Ecological Vulnerability Report, Mongolia Human Security".*

*** International Cooperation Department, Ministry of Nature, Environment and Tourism.*

2. Recent Activities

The Gobi Desert Region, occupying 41.3% or 647.0 thousand hectares of Mongolia's land territory, is threatened by desertification. Mongolia has already concluded seven intergovernmental and over twenty inter-ministerial agreements with neighboring and other countries to protect the environment. Many of these agreements have important provisions for mutual cooperation in combating desertification. Since 1990, there are 14 projects being implemented with total costs of US $ 24.6 million with assistance of international donor community. As an example of cooperative activity, Korea Green Promotion Agency supports the Desertification Campaign in Mongolia. The Government of the Republic of Korea has launched a campaign in Mongolia in 2006 to reduce dust and sandstorms disasters in the sub-region. The campaign titled Greenbelt Plantation Project is an initiative by the Korea Forest Service to plant some 1.5 million trees in Mongolia to slow down desertification spread. Governmental departments of both Republic of Korea and Mongolia have recently launched a US$9.5 million program to combat desertification and prevent land degradation in Ulaanbaatar. The tree planting program is an outcome of

the Agreement on Environment Protection issues by Mongolia and the Republic of Korea. Roughly, ten varieties of trees were selected and planted, including some desert shrubs, have been replanted in desert areas to control further degradation.

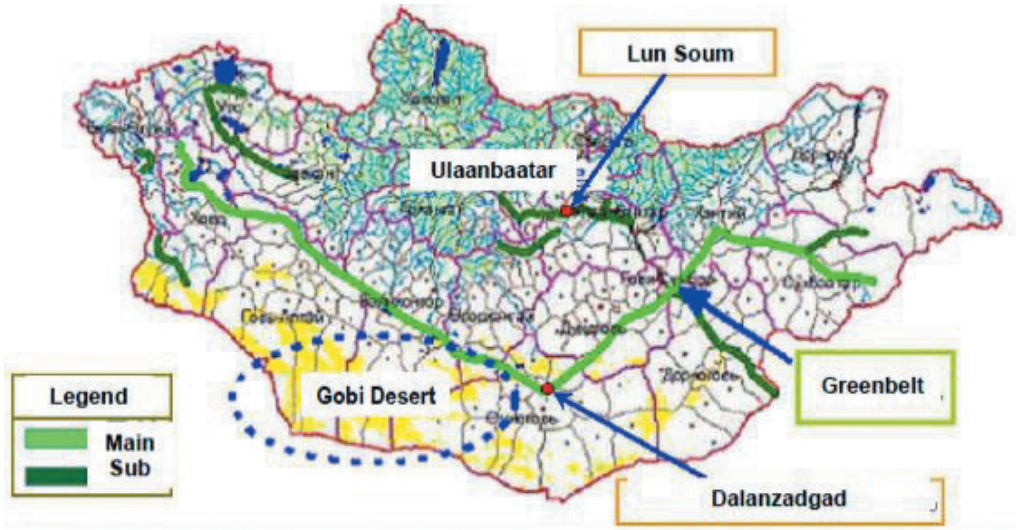


Figure 2. 3,000ha plantation (Feb. 16th, 2007, about 9.5 Million USD) Dalanzadgad, Lun Soum
(Source: Korea Forest Service 2009)

3. Some Achievements made

Desertification Research field:

- Methodology is completed;
- Capacity building in academic and research sector; and
- Desertification assessment at local, provincial and national scale.

Legislation and Policy field:

- National Program to Combat Desertification and Other Legislation on Natural Resource Combating Desertification field;
- Conducting experiments and pilot/demonstration projects; and
- International Cooperative Projects implemented at provincial and local level.

Figure 3. Umnugobi Aimag, Moltsong Els, General view.
(Source: Seminar on Combating Desertification-- Batkhuu Province in Mongolia)

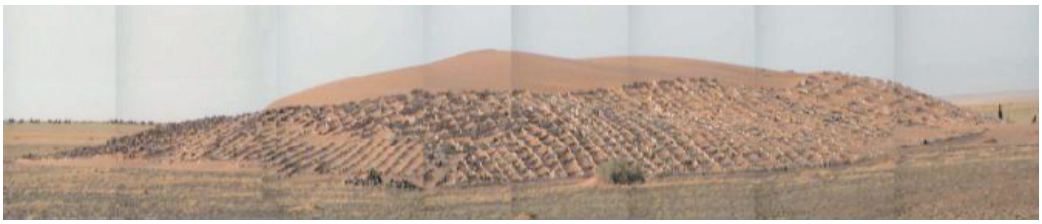


Figure 4. Mechanical-biological protection experimental site for sand stabilization - Umnugobi Aimage, Moltsog Els. (Source: Seminar on Combating Desertification-- Batkhuu Province in Mongolia)

4. Combating Desertification Experimental Method

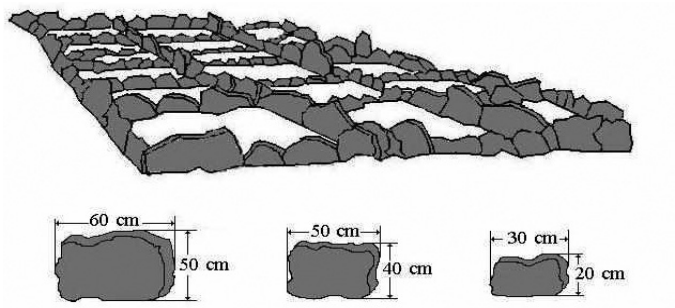


Figure 5. Mechanical barriers

Figure 6, 7, and 8. 1x1 m sized frames; 2x2 m sized frames and 3x3 m sized frames

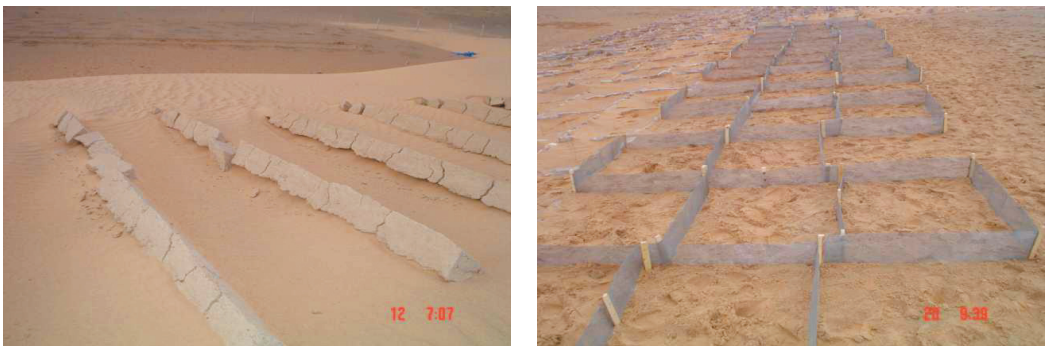


Figure 9 and 10. Clay barrier and Net checkerboard

Figure 11. A transplanted tree

[SUBSTANTIAL EXAMPLES]

A. Case Study 1 - Fostering the Sustainable Livelihoods of Herders in Mongolia via Collective Action

Recent poverty trends show that in rural areas between 2002/03 and 2007/08, the per capita index increased by 7 percent from 42.7 percent to 49.7 percent, meaning that half of the rural population is now living in poverty. This rise in poverty is particularly disturbing as these years correspond with one of the greatest growth spurts in the world economy and with rapid economic growth within Mongolia itself (Poverty Profile in Mongolia, NSO, 2009). In light of the alarming poverty trends and the global downturn, it is therefore particularly urgent to reintroduce a sustainable livestock herding system in Mongolia.

The Green Gold Pasture Ecosystem Management Project (Green Gold) has been supporting herders since 2004 in developing community-based steppe/desert steppe and grassland management activities, preparing winter and spring fodder, improving animal productivity and initiating alternative-income-generation activities. Green Gold is experimenting with an intensive approach to the organization of herders into rangeland management and user groups that is embedded into local government structures. Herder families traditionally using the same rangeland form a Pasture-user group (PUG) that is based on territorial boundaries, which are defined in a deliberative process involving the concerned herders and are validated by the Soum (village and community) administrative.

The membership of residents in PUG area is mandatory in order to avoid conflicts between members and non-members that would weaken the PUG's rangeland management capacity. PUGs are not collectives, they are autonomous organizations aimed at jointly developing, enforcing and monitoring pasture-management plans (PMPs) for their respective territories. PUGs are supported by local government, and for the time being through technical advice and the co-financing of pasture management related projects provided through Green Gold. The assumption of Green Gold is that PUGs will learn through the implementation of increasingly complex pasture-management activities that

require collective action until they are able to address the most demanding task of adapting the number of animals to the carrying capacity of their pastureland. At the Soum level, PUGs are federated into associations of pasture user groups (APUGs). APUGs are NGOs with a small permanent staff and a secretariat that support PUGs through technical assistance and should guarantee the PUGs' survival beyond the duration of the Green Gold project.

Livestock herding in Mongolia accounts for 20.6 percent of GNP and almost 40 percent of employment. It is practiced in a variety of systems, ranging from nomadic to semi-nomadic livestock herding in all ecological zones from the desert to the more fertile forest steppe. With the advent of industrial development and urbanization after the Second World War, the share of the economically active population in the rural economy progressively declined. However, this trend was reversed after the transition from a centralized socialist system to a market economy in the early 1990s. The transition to a market economy provoked an economic crisis and massive levels of unemployment due to the downscaling of the state. Many urban residents therefore moved to rural areas and took up herding as a survival strategy.

At the same time, the collectives were abolished and livestock were privatized. Because the collectives played an important social-welfare role for the rural population, their disappearance resulted in a deterioration of social and livestock services and increased poverty to a level that has not since declined. Not only did the collectives provide social services and technical assistance, they also formed the core institutional mechanism for the governance of nomadic pastoralism. The collectives managed land allocations and seasonal rotations. With this management institution gone, replaced by a newly introduced constitutional freedom of movement which was not granted during socialism, herders became free to move anywhere, thus transforming the herding system from a controlled pasture system to an open-access system.

While subsequent legislation has attempted to provide a regulatory framework for pastureland use, with management powers vested in the Aimag, soum and Bag governments, these efforts have to date proven ineffective and insufficient for re-regulating pastureland use. Today, we observe the twin crises of pastureland degradation and rural poverty in Mongolia (Mongolian Society for Range Management, 2009). Ground measures of species diversity and ground-cover density that have been conducted since 1960s indicate a clear linear trend of pasture degradation since that time. At the same time, an equally linear trend of increasing temperatures all over Mongolia is observable.

Therefore, there are two very likely causes for the observed pasture degradation: climate change and the failure of pastureland-management regulatory institutions in the 1990s. However, the current data do not allow for a clear separation of the effects of climate change and institutional failure in relation to pastureland health, but it is assumed that they reinforce each other. This study tries to assess the collective learning capacity of the PUGs that is a necessary precondition for fostering sustainable livelihoods. More specifically, the study is aimed to enable the collective-action-based system of PUGs to (1) make a significant contribution to sustainable livelihoods through improved pasture and animal productivity; and (2) to provide an alternative to the ineffective regulatory framework for sustainable pastureland management.

In order to answer these two core questions, qualitative case studies were conducted in six regions that differed in respect to their ecological and economic properties, and included four of Mongolia's five agro-

ecological zones. Qualitative interviews were conducted in 22 Soums to investigate herders' perceptions of pasture degradation and its causes, the difficulties of setting up and running organizations for collective action for managing pastures and seasonal shifting grazing, and productivity-enhancing activities that required either collective action for implementation or could be implemented individually.

The study also investigated the degree to which collective organizations satisfied the conditions for effective functioning and sustainability that had been defined by a group of experts. In addition, the herders' expectations were assessed in relation to: (a) the influence of the pasture-user system on seasonal rotations, inter-annual and emergency migrations; and (b) the capacity of this system to limit livestock population in the future. Green Gold is not the only programme in Mongolia supporting herders in creating formal membership organizations for collaborative pasture management and livelihood improvement.

However, other projects use a different approach to community development that builds on ad hoc herder groups (HGs) with voluntary membership based on a common interest. The herder group approach is not a singular and coherent system. Members of HGs work together for income-generation and pasture and livestock improvement. As opposed to PUGs, HGs' territorial base is less strong as they do not cover entire administrative areas and only sometimes have pasture leasehold agreements with the Soum administrative. The Soums where HGs operate also prepare PMPs, but these are initiated by the Soum administration and its officials, who also take the lead in terms of implementation responsibilities.

In order to assess the performance of the PUG design, HGs are compared in this study with PUGs in terms of the criteria mentioned above. Interviews with herders and other stakeholders have revealed that PUGs have the capacity to successfully organize herders to plan and implement pasture management and seasonal shifting plans in the equilibrium pasture-management zones, and perhaps in the mixed zone of the central steppe (see Appendix A I. for definitions). HGs, on the other hand, have shown little such capacity, primarily because they do not have control over a territory to the same extent as PUGs. Strong facilitation by a dedicated support organization, like the APUG in each Soum, appears to be necessary to enable the PUGs to perform these tasks on a sustainable basis.

Government support and good leadership are also necessary for sustainability and effective performance. In the desert steppe, where the disequilibrium system prevails and seasonal shifting are vast and irregular, the PUG system does not appear to fulfill the needs of herders. They do not see it as an appropriate response to declining pasture productivity. Indeed, neither science nor herder perceptions suggest that pasture degradation in disequilibrium systems has been caused by livestock density and other management factors. The same applies to a greater extent to the desert zone, which we did not study.

The more intensive PUG system may also have an advantage in performing productivity-oriented activities that either do or do not require collective action. That may be a consequence of the presence of a dedicated support organization and/or may reflect the greater ability of the larger PUGs to motivate and manage such activities. Similarly, the PUGs, after some time of operation, fulfill the conditions for sustainability better than the HGs, which often become inactive after project support completion. It has to be noted that the PUG system is in development and every PUG therefore still enjoys project support. Hence, no direct comparison between HGs and PUGs without project support is possible.

Nevertheless, the PUG system is built around a supporting APUG that will continue beyond the project, thus fulfilling a crucial function for sustainability that is lacking for HGs. At present, the capacity to deal with weather-related risks such as drought seems to be weak in the more peripheral regions of Mongolia. For instance, in the mountain zone, efforts to destock before winter after a dry summer, during which livestock did not gain a significant amount of weight, ended in a price collapse due to a market oversupply. This price collapse occurred across the nation and affected herders' decision-making on destocking throughout the country, beyond those areas that were initially affected.

As meat prices dropped below a threshold, herders did not continue to destock and thus entered winter with an oversized and undernourished animal population, which led to many fatalities in winter and the loss of offspring in spring. On the other hand, herders in proximity to large urban markets are better able to protect themselves against potential livestock loss during hard winters. They buy fodder for winter and sell their animals on the high-price spring market. The respondents noticed that the style of herding had changed in the past decade, with seasonal shifting being increasingly directed by water scarcity rather than rotational grazing. Free shifting facilitated by a flat topography in the desert steppe has become a problem and challenges collective-action initiatives in this zone.

This shows that the drawing of boundaries and enforcement is greatly facilitated by topography and equilibrium conditions that reduce the need for inter-annual migrations. The strategy for facilitating collective action in the steppe should be rethought and measures devised to reduce the problem of the seasonal shifting of herders from the outside via greater collaboration with Soum and Aimag administrative. The challenge in the desert steppe or desert is even greater, and may lead to the development of organizational models that are quite different from those of other areas. In areas where herd size and herd composition are a cause of degradation, herders clearly perceive the number of goats and the overall number of animals to be the prime causes of pasture degradation.

Interestingly, however, there is little correspondence between herders' assessment of pasture health and scientific degradation assessments. In some seriously degraded areas, herders perceived the level of degradation to be moderate, and vice versa. The incongruence of scientific pasture health assessment and herders' perception needs to be further investigated. For instance, evidence from Southern Africa suggests a relatively good match between pastoralists' perceptions and botanical assessments (Wesuls and Lang, 2010). PUGs and HGs appear to face a number of functionality challenges. Analysis of the interviews shows that it is easy to establish a HG or a PUG; however skeptical herders may not initially participate in PUGs. Successfully running a herder organization is more challenging. HGs often suffer from inactivity, and their activities often break down after the supporting project is terminated without having left behind a functioning supporting NGO. HGs also often suffer from conflicts between members and non-members over pasture entitlements and the sharing of benefits. HGs seem to be less sustainable than PUGs; however this finding should be interpreted with care given the young age of most organizations. Both types of groups appear to depend on a facilitating organization that assists with mobilization, planning and technical assistance.

Common challenges facing the sustainability of both HGs and PUGs are financial sustainability, clear relations with non-members and marketing. Sustainability seems to be enhanced by strong leadership from a supporting NGO and a good working relationship with the Soum administration. Also, longer-established organizations appear to be operating more efficiently. After sufficient sensitization and a strong organizational effort, herders in many areas appear to be willing to consider limiting the number

of livestock if the productivity improvements resulting from the PUG do not bring livestock numbers into line with carrying capacities. This study therefore identifies four main findings.

Firstly, an ecological zone with its topographical specificities has an influence on social organization. The desert steppe is much more challenging for collective action than the forest steppe and the mountains, with the steppe somewhere in between. Social and spatial boundaries are less evident and more difficult to create. Secondly, pasture management and the control of seasonal shifting can only be achieved through territory-based organizations and in close collaboration with local government. Thirdly, collective action requires the assistance of a supporting organization such as a facilitating NGO. HGs that did not benefit from such support after the completion of project activities became inactive. How to make such a system permanent will be an initial challenge for the projects, but ultimately the government will have to find a solution. Finally, there are encouraging signs that given time and sufficient sensitization, and with the support of local government institutions, herders may be willing to limit herd sizes if they receive support for increasing livestock and protecting pasture.

The Pasture-User Group System

Herder families traditionally using the same pastures form a pasture-user group (PUG) that is based on territorial boundaries, which are defined in a deliberative process involving the concerned herders and are validated by the Soum administrative. The membership of residents in a PUG area is mandatory in order to avoid conflicts between members and non-members that would weaken the PUG's pasture-management capacity. PUGs are not collectives; they are autonomous organizations aimed at jointly developing, enforcing and monitoring PMPs for their respective territories. They can also facilitate and negotiate seasonal and permanent shiftings in and out of their areas. PUGs are supported by local government, and for the time being through technical advice and the co-financing of pasture-management-related projects provided through Green Gold. The assumption of Green Gold is that PUGs will learn through the implementation of increasingly complex pasture-management activities that require collective actions of increasing complexity until they are able to address the most demanding task of adapting the number of animals to the carrying capacity of their pastureland.

Associations of Pasture-User Groups (APUGs)

At the Soum level, PUGs are federated into associations of pasture-user groups (APUGs). APUGs are NGOs with a small permanent staff and a secretariat that support PUGs through technical assistance and should guarantee the PUGs' survival beyond the duration of the Green Gold project. APUGs play an important role in interacting with the Soum administrative and assisting PUGs in the negotiation of seasonal shifitngs beyond a PUG's territory or an administrative boundary as necessitated by bad weather. APUGs can also federate at the Aimag or national levels. The roles of local and central governmental services include: in order to strengthen the PUG system to function effectively, close collaboration between PUGs, APUGs and local governmental institutions and central governmental services at the Soum level are necessary. While herders themselves define the territorial boundaries of PUGs, it is the Soum khural (the elected citizens' assembly) that validates them. PUGs' PMPs require endorsement by the Soum governor. Soum administrations also play a role in coordinating otor movements in collaboration with the protected areas administration. Furthermore, PUGs benefit from such governmental services at the Soum level as technical assistance provided by the land officer and agricultural extension officer. The Soum administrative is the only body that can allocate right, and thus

only it can take ultimate responsibility for the enforcement of rights and management plans.

The Longer-Term Vision for the PUG System

The PUG system is based on the assumption that PUGs, supported by a favorable legal environment and with the help of local authorities, technicians and non-governmental facilitating service providers, will be able to gradually introduce sustainable pasture-management practices and develop the productivity of the pastureland and their herds. More specifically, PUGs:

- Are allocated use and possession rights to pasture/rangeland;
- Regulate and facilitate seasonal rotations and inter-annual shiftings;
- Apply various technical solutions and investments for sustainable pasture management;
- Ensure respect for reserve pastures (otor), jointly agreed upon with local governments;
- Foster a gender balance and the equitable sharing of development benefits;
- Prevent and resolve conflicts;
- Facilitate economic diversification and value chain activities; and
- Where necessary, regulate the number of animals in line with the carrying capacity.

Conditions for the Success and Sustainability of PUGs and APUGs

In order for PUGs and APUGs to successfully carry out their functions, including developing, managing and enforcing PMPs and making collective investments in pasture and herd productivity, a number of institutional and organizational factors need to be in place. During brainstorming sessions on project experiences with the MSRM and its experts and other relevant authorities, the study identified the following sustainability criteria, which are explored:

1) Functions: PUGs need to be empowered with relevant and appropriate functions.
2) Constitution: PUGs must have a good constitution and bylaws.
3) Relations between members and non-members of PUGs must be clearly spelled out in order to avoid conflicts.
4) Enforcement: PUGs must be able to enforce and receive support from local authorities for enforcing collective decisions regarding pasture management.
5) Accountability of the leaders of the organizations to their members for plans and activities.
6) Accountability of the leaders of the organizations to their members in relation to financial matters.
7) Leadership: They require good leadership and democratic mechanisms for renewing leadership.
8) Capacity: They need to improve their capacities via training and learning by doing.
9) Financial sustainability: PUGs need financial resources in order to undertake group projects. Financial sustainability must first of all be based on their own revenue sources, which they decide upon and implement. For most of their projects, co-financing from the government or other sources is necessary. It is also beneficial to develop a revolving fund that can finance small individual and group projects.
10) Head office: In order to become a functioning organization, an APUG needs to own and operate an office.
11) Operational manual: Such a document summarizes the institutional set-up of the PUGs and APUGs, their functions, planning, decision-making, financing and implementation mechanisms, relationships to government, facilitators and donors, accountability mechanisms, etc. It is a living document that

can be periodically revised.

12) Sharing of benefits: All members of the organization must benefit from the organization. The basic principles of equity and fairness must be followed in relation to the distribution of benefits. These principles should be stated in the constitution and bylaws.
13) Political backing: They need to have strong relationships with, and backing from, local and cetral governments.
14) Political influence: such as having herders elected to soum and aimag assemblies.

Challenges to the Pasture-User Group System: the Implications of Vegetation Dynamics for Community Organization

The experiences of Green Gold and UNDP's Sustainable Land Management project have shown that community-led efforts to develop HGs have been successful in the mountains, forest steppe and steppe regions of Mongolia. In these regions, vegetation dynamics are either in equilibrium or mixed equilibrium-disequilibrium systems, rather than the disequilibrium pasture systems of the desert and desert steppe. Put simply, an equilibrium model of rangeland vegetation dynamics is characterized by climatic conditions that allow for regular patterns of vegetation growth with little variation between years.

B. Case Study 2 - Herders' Communal Work Revives Degraded Pastureland

In 2010, herder communities involved in UNDP's "Sustainable Land Management for Combating Desertification" project harvested high yields of hay, which was the result of several years of effort to improve the soil condition in their localities, representing arid and semi-arid regions.

Baruunbayan-Ulaan soum in Uvurkhangai province fenced 12 hectares in 2009, irrigated and applied organic fertilizer to support growth, thus creating high-yield hayfields. In 1940-2007 the average annual air temperature in Mongolia rose by 2.1°C due to climate change effects, while annual precipitation decreased in most areas, resulting in intensification of droughts. According to the definition provided in the UNCCD, 90 percent of Mongolia's landmass is highly vulnerable to desertification and land degradation, and 72 percent is affected by desertification to a certain degree.

Mongolia is located in arid and semi-arid zone of continental Asia, characterized by hot and dry summers, low soil fertility and scarce vegetation cover dominated by few species. Nomadic herders rear sheep, goats, cattle, horses, and camels as their main source of income. They often faced by insufficiency of hay and fodder in winter and spring seasons, which is a main obstacle in sustainable livestock husbandry. In recent years, herders have become less mobile, leading to overgrazing hindering plant seed maturation, which in turn leaves pastureland barren and prone to wind and water erosion.

Herders of "Bayantuhumiin Uguuj Horsho" group are encouraged by their results to make their desert area green. Before the start of SLM project, 70% of Baruunbayan-Ulaan soum in Uvurkhangai province was degraded with increased sand invasions, the main reason of which was unsustainable use of pasture exceeding the carrying capacity. "New generation" of herders have a poor knowledge about pasture use, and have limited experience in haymaking and pasture rotation and fencing to support the natural regeneration.

The UNDP project provided support in forming of herder groups and a series of training opportunities with field demonstrations on pasture management, hayfield fencing, soil quality improvement and maintenance techniques, and methods of planting Alfa-Alfa and barley. In 2009, the training courses organized by UNDP project enrolled over 2600 participants, 60% of which were women. After the training, with the project support herder communities fenced of 12 hectares of pasture in the Taats river valley in 2009. The UNDP project also provided technical assistance in restoring old water ditches and establishing a borehole well to be used in case of severe water shortage. The plot was used by a former state collective farm to grow barley and haymaking over 20 years ago. However, due to difficulties of irrigation caused by continuous declining of water level, herders have slowly abandoned the crop farming.

In 2009, under the technical guidance of the UNDP project, "Bayantuhumiin Uguuj Horshoo" herder group planted Alfa-Alfa in 2.2 ha, barley in 1 ha, and 10 ha of land was used for hay-making. Due to their collaborative efforts to maintain hayfields, fencing and improved irrigation, herders were able to once again harvest crops and prepare their own hay for the winter. The herder community harvested 2.5 tons of Alfa-Alfa, 2 tons of barley and 80 tons of hay that fully meet their need.

The herders who worked on the hayfield established a formal herder group involving 10 households and 23 members in 2010. The group leader Mr. D.Tumurchudur says, "We worked as one to rest our field from livestock, irrigated and used organic fertilizers, which rewarded us with good amount of hay. Because of hay reserved, we did not lose a single lamb in the past severe winter. Neighboring herders now come to us to learn from our experience".

He also stated that herders can harvest five times more hay from one hectare by merely supporting natural regeneration. Initially, the herders were pessimistic about planting new crops. However, after seeing the first results, the community was very much inspired. Herder group women made barley flour and besides using the flour for household needs, the excess was sold on the provincial market generating a revenue of MNT500, 000 (approx. US$385). The herder group won the first place by participating in the brand product fair of Uvurkhangai province.

Following the experience of "Bayantuhumiin Uguuj" herder group, 5 new groups with 43 households were established in 2010, all working on soil improvement and pasture management. With the UNDP support, the herders have created value-addition to and alternate income opportunities aside from the livestock husbandry through small-scale vegetable farming, diversified diary and wool products.

With UNDP's support, the annual soum-wide pasture/land management plan is developed and implemented with the herder community participation, which will be the basis for achieving significant reduction of degraded land towards the end of the project. The UNDP-supported herder groups pioneered reviving a collective action for pasture management and prevention of land degradation.

[SUMMARY]

These activities were quite successful. Drought resistant, highly precocious types Darkhan 106, Darkhan 141, in case of irrigation plant species resistant to drought Darkhan 133 have been grown through the selection methods. The World Bank project "Sustainable livelihoods" has developed a map for pasture management of 142 counties in 8 provinces, schemes and handed over to the local authorities to use for

pasture management and nature restoration activities. Pasture irrigation system, water resources have been studied by in cooperation of JICA in 3 stages, state budget annually allocates some funding for water well erection, restoration of water wells. The foundation to support small and medium enterprises have been established within the project "Support to the development of small and medium enterprises." Competition for manually operated water well has been announced with prize fund of 19.3 million in order to upgrade the water facilities in the rural areas with low water resources, as a result of these initiative more than 350 wells have been erected in 2005. 120,087 seedlings of trees and bushes have been planted in 353.5 ha with irrigation system in 14 sites of 13 provinces the "Green Belt program" program only for the first year of the implementation.

References

1. Asia and The Pacific national forest programs UPDATE 34. December 2000. Food and Agriculture Organization of the United Nations.

2. Gov't to Launch Anti-Dust Planting Project in Mongolia. December 2007. Chosunilbo news 6/11/2007

3. International Forest Cooperation Projects. June 2009. International Cooperation Division of Korea Forest Service.

4. MONGOLIA National Report to CRIC5. June 2005. Ulaanbaatar.

5. MONGOLIA: STATE OF THE ENVIRONMENT 2002. 2002.

6. Seminar Batkhuu State of Desertification and Combating Desertification Trails in Mongolia. 2009. Korea Green Promotion Agency.

7. State of Desertification and Combating Desertification Trials in Mongolia. 2007. Korea Green Promotion Agency.

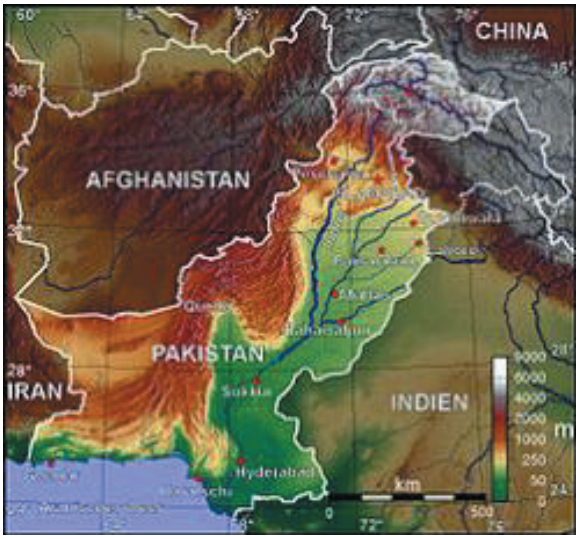
8. Unasylva 218, Vol. 55. 2004.

12. Pakistan: Land and Water Management Interventions

- Amjad Tahir Virk and Syed Mahmood Nas

[BACKGROUND]

1. Geography

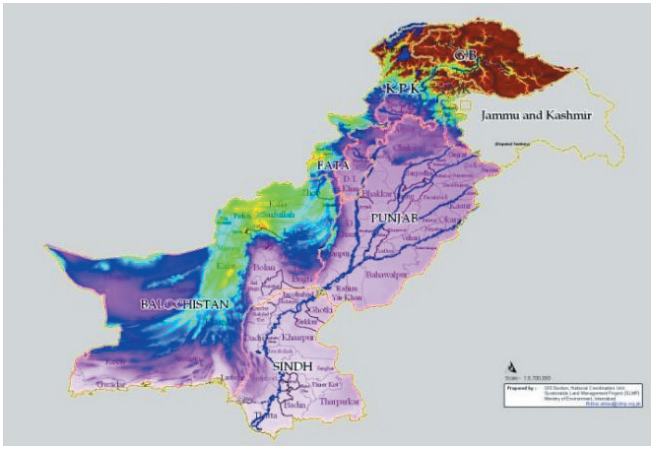


Pakistan lies between 24° - 37° North latitude and 61° - 75° East longitude in South Asia, bordering Arabian Sea in the South, India in the East, Iran and Afghanistan in the West and China in the North. The total area of Pakistan is 864685.93 km^2. The country has highly variable topography, climate and culture. Three major mountains range namely Hindu Kush, Karakoram and Himalaya lay in the north followed by plateaus, plains and coastal areas. The climatic variability is expressed by humid zones in the north-east to hyper-arid in the south-west and west.

The country's high mountains comprise of 2,400 km long belt of Himalayan, Hindu-Kush and Karakoram ranges. Gilgit-Baltistan spread over an area of 72,496 km^2 amidst towering snow-clad peaks with heights varying from 1,000 meters to over 8,000 meters above the sea level. The snow and glaciers in the northern high mountains are the major source of irrigation water in the Indus plains. Some of the lower mountain ranges in the north-east receive high monsoon rainfall in summer and snow precipitation during winter.

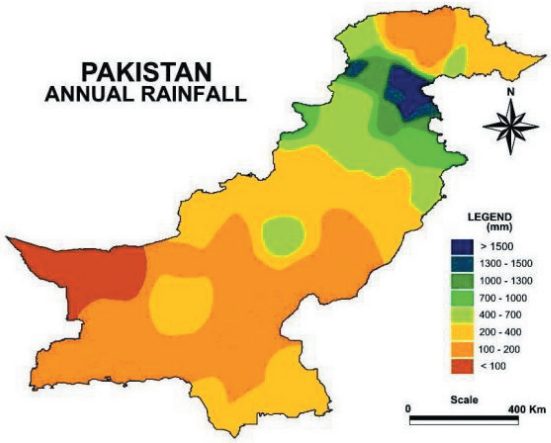
The main rivers are the Indus (2,749 kilometers within Pakistan) and its tributaries: the Chenab (731 km), Ravi (681 km), Jhelum (611 km), and Sutlej (531 km). The navigable portions of these rivers are generally small and unconnected due to seasonal variations in water flows and the presence of substantial irrigation structure

2. Administrative Units



Administratively Pakistan is divided into four provinces and federal territories. The provinces include Balochistan, Khyber Pukhtoonkhwa (KPK), Punjab, and Sindh. Besides, there are Federally Administered Tribal Areas, Gilgit- Baltistan, Azad Jammu & Kashmir, and Islamabad Capital Territory. The provinces are divided into districts which in turn are subdivided into tehsils.

3. Climate



Most of Pakistan has a generally dry climate and receives less than 250 millimeters of rainfall annually. The northern and southern zones have noticeable climatic differences. The average annual temperature is around 27˚C, but temperatures vary with elevation from -30˚C to -10˚C during the coldest months in mountainous and northern areas to 50˚C in the warmest months in parts of Punjab, Sindh, and Balochistan. Mid December to March is dry and cool, while April to June is hot with 25 to 50 percent relative humidity. July to September is the wet monsoon season, while October-November is the dry post-monsoon season.

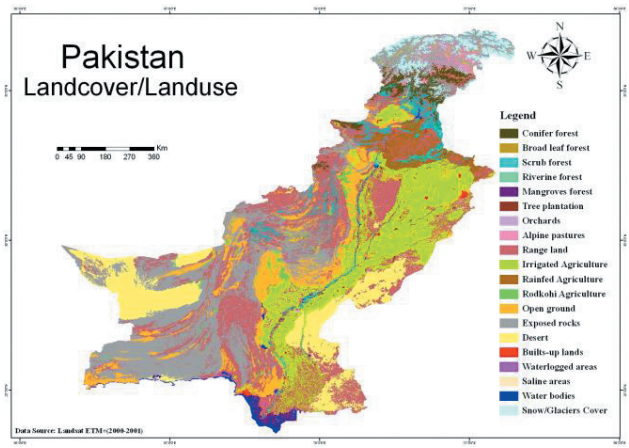
4. Land Cover/Land Use

Land cover and land use classification of Pakistan developed from Land Sat ETM image data is shown in table below:

Table 1. Pakistan: Land cover/Land use (000, hectares)

S. No	Land use/land cover	Balochistan	Sindh	KPK	Punjab	Pakistan	%
1	Forest	508.1	848.3	2311.9	855.1	4523.4	5.4
2	Rangeland	9255.8	3961.1	3848.7	5385.7	22451.3	26.9
3	Agricultural land	822.2	4465.0	1174.1	10143.4	16604.7	19.9
4	Open Ground/ fallow	4494.7	911.5	1290.5	1618.8	8315.5	10.0
5	Exposed rocks	16425.1	201.4	3451.1	318.4	20396.0	24.5
6	Desert	3189.4	3140.8	-	1796.9	8127.1	9.7
7	Built- up area/land	6.7	90.2	26.4	196.6	319.9	0.4
8	Waterlogged and saline land	15.2	294.3	0.2	130.4	440.1	0.5
9	Water bodies	1.8	178.9	57.1	179.8	417.6	0.5
10	Snow/Glaciers	-	-	1829.6	-	1829.6	2.2
	Total	34719.0	14091.4	13989.7	20625.1	83425.2	100.0

(Source: Landuse Atlas of Pakistan, Ministry of Environment)



Forest cover including scrub, riverain, mangroves, and irrigated plantations cover about 5 percent of the

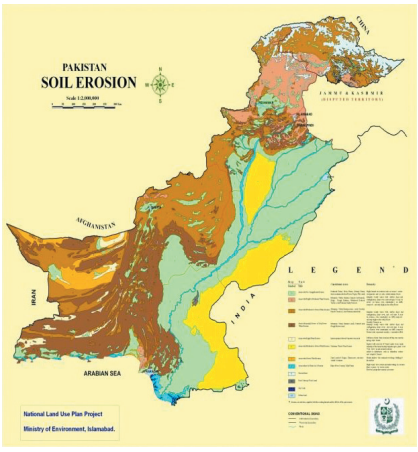
country. Agricultural land including irrigated, rainfed and rodkohi constitutes about 20 percent. It does not include the fallow land which has been covered under open-space/ground class (covering about 10% area of country). Rangelands cover around 27 percent areas, while rocky outcrops occupied another quarter of the country. The snow and glacier cover was recorded about 2 percent. Deserts occupy about 10 percent of the area. Other uses, including waterlogged and saline lands, water bodies and human settlements cover a little more than one percent of the country. Land use patterns in the country are evolved over centuries and are influenced by environmental and physical factors such as landform, soil, climate, water availability etc. Human factors such as population growth, economic forces, local customs also influence the landuse patterns. The interprovincial landuse variations clearly depict the influence of these factors. For example, KPK and Gilgit-Baltistan regions are mainly hilly areas and high mountains with relatively more snow fall and rain shower as compared to other provinces. For these reasons KPK also has higher forest cover (about 17%) as compared to Punjab (4%), Balochistan (1.5%) and Sindh (6%). On the other hand, Balochistan has more areas classified as rangelands, while 50% of lands in Punjab and 33% in Sindh are predominantly agricultural.

5. Soil Types

A large variety of soils are found in Pakistan, which vary significantly in kind and distribution. This entails adopting different approaches to optimally and sustainably use this resource. Although the country's soil resources are vast, good quality soils that form prime agricultural land are limited. Pakistan has to rely on the existing soil resources and protect prime agricultural lands from misuse that may lead to land degradation and food insecurity. Optimal use of soil resources of the country will not only ensure basic human needs such as food, fiber, and shelter, but also improve the overall environmental conditions.

Soil genesis is an interactive process involving: climate, living organisms, relief, parent soil material, water (both surface and sub-surface), human activities, and time. A change in any of these variables triggers different soil formation producing varied soil characteristics. Pakistan has a highly diverse landscape and environment that have given rise to a wide variety of soils, which are to be protected for the well being of its people and economic development of the country.

6. Desertification Related Problems



There are number of driving forces that contribute to depletion of land and water resources of Pakistan. Some of the key drivers/causes of land degradation are briefly described here:

1) Soil Erosion

Soil erosion process is classified into two categories - 'Geological' and 'Accelerated'. The former operates under natural conditions and is mainly responsible for evolution of the natural landscapes. The latter is induced mainly because of disturbance of natural landscapes mainly through human activities and is generally more rapid as compared with the natural processes.

While geologic processes continue to operate all over Pakistan, extensive areas in the country are prone to 'accelerated' erosion by water and wind to various degrees as shown in the Soil Erosion map of the country. Water erosion mainly affects the sloping/ elevated terrain characterized as highlands. Various types of water erosion - sheet, rill, gully, etc. - are manifested in different parts of the country. Erosion by wind, on the other hand, is a characteristic of drylands having loose soil, bare sands or finer materials exposed to strong air currents. Vast sandy deserts of Cholistan, Thal, Chagai and Kharan are suffering from wind erosion problems. Hyper arid silty or finer valley floors/terraces of western Balochistan are also subject to massive wind erosion.

Erosion by major streams and rivers along their courses, sea intrusion, and by glacier melting areas is also noteworthy in Pakistan. These types of erosion are geological in nature, operating in undisturbed natural environment. These are slow but progressive and need to be addressed to assess their adverse environmental impacts. Area affected by the intensity of wind and water erosions and their percentage coverage at two different times is shown in the tables below, which indicates trends in soil erosion:

Table 2. Area Affected by Wind Erosion in Pakistan

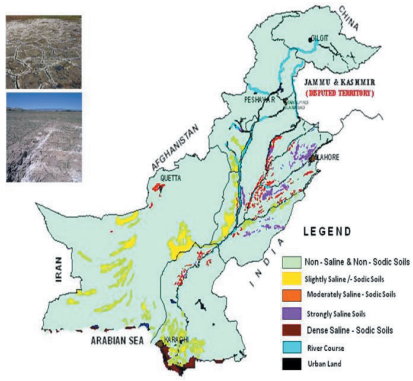
Intensity of Erosion (Class)	1998 Area (Mha)	2007 Area (Mha)
Slight to Moderate Erosion	2.595	1.29
Moderate to Severe Erosion	0.496	9.456
Severe to Very severe Erosion	1.668	2.282
Total	4.759	13.028

Table 3. Area Affected by Water Erosion in Pakistan

Intensity of Erosion (Class)	1998 Area (Mha)	2007 Area (Mha)
Slight to Moderate Erosion	3.979	5.165
Moderate to Severe Erosion	3.581	20.003
Severe to Very severe Erosion	3.745	17.677
Bank Erosion	-	2.282
Total	11.305	45.127

2) Soil Salinity and Sodicity

Saline soil is characterized by the presence of excess of soluble salts that interfere with the growth of most crops and plants. The amount of salts is determined by measuring electrical conductivity (EC) of saturation extract of the soil, expressed in deci-siemens/meters (dS/m), or millimhos/centimeter (mmhos/cm). The following classes of salinity are commonly observed in many parts of the country.

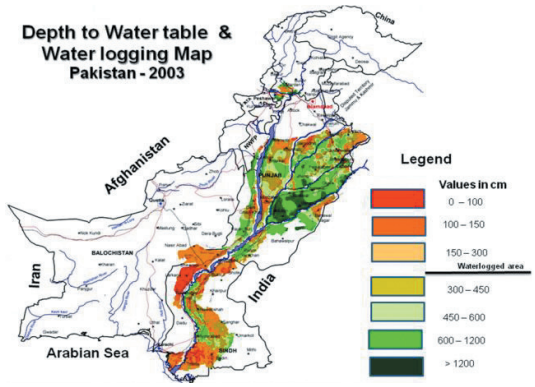


Class Electrical Conductivity (dS/m or mmhos/cm)

Non saline	0 - 2
Very slightly saline	2 - 4
Slightly saline	4 - 8
Moderately saline	8 - 16
Strongly saline	> 16

The salinity and sodicity map produced by the Soil Survey of Pakistan shows a number of categories salinity and sodicity based upon the kind as well as the severity of the problem. The information presented is based upon data generated through standard reconnaissance soil /land resource surveys using 1:40,000/1:50,000 scale maps.

3) Water Logging



Pakistan has Asia's largest canal irrigation system. The mismanagement of this system created water logging problems in many parts of the country that forced the government to take remedial measures. Since 1912, efforts have been made to tackle the problems. But it was only in 1953-54 that detailed mapping of soil and land use of the Indus plain was carried out under the Colombo Plan. Unlike inundation canals where water was available only during rainy seasons, the introduction of perennial canals made water available throughout the year. As a result, the water seeped to the subsurface from the unlined canals and irrigated fields. This constant supply of water was more than the rate of evapotranspiration. This resulted into extensive water-logging in irrigated ecosystem. In fact poor management of available irrigation water both at the system and farm level is contributing to water-logging. As a result, about 1.57 million ha of arable land is affected by water-logging.

4) Deforestation

Pakistan falls among those countries where deforestation rate is very high and natural forests are disappearing at rate of 27,000 ha per year further aggravating the land degradation process. Most of the trees removed are consumed as fuel wood, while the rest is used as timber. In addition, 150,000 ha of forest lands have been converted into non-forestry purposes. The excessive deforestation is causing severe soil erosion and flood damages, thus speeding-up the process of land degradation.

5) Over-grazing

Around 40% of the country is classified as rangelands, which provide livelihood directly to 15 million people. About 50% of these rangelands are bad degraded affecting local livelihoods and increasing rural poverty. Over-grazing reduces ecosystem functions and services as well as range productivity, because of removal of vegetative cover, soil compaction, and exposure of top soil to wind and water erosion. Degradation of rangelands also decreases dryland's natural resilience to climate variability.

7. Natural Vegetation and Extent of Desertification

Vegetation cover over most of Pakistan is scarce and there is considerable season variation in vegetation cover. The vegetation cover and productivity of land is reflected by Normalized Difference Vegetation Index (NDVI). The Pakistan Meteorological Department has published high resolution NDVI maps of Pakistan derived from SPOT data for general use by a large number of stakeholders. Mean monthly NDVI for the months of April (spring), August (monsoon), and October (autumn) and its interpretation as vegetation cover are given in the following maps:

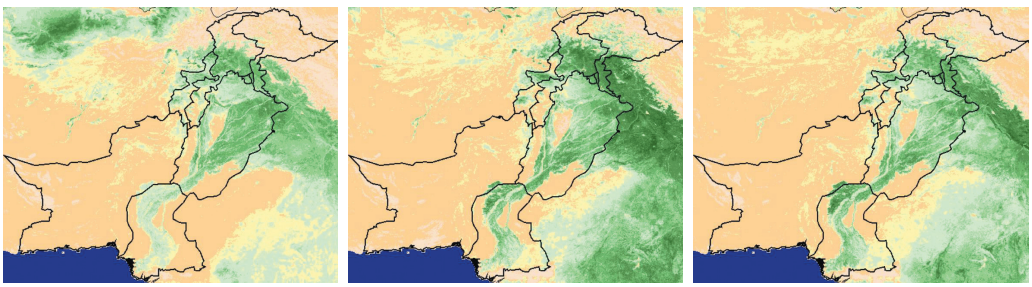


Figure 1. Mean monthly NDVI for the months of April (spring), August (monsoon), and October (autumn)

Deep green areas represent highly dense vegetation that exists in irrigated Indus Basin and sub-Himalyan northern tracts. Light green color shows sparse vegetation whereas yellow and brownish colors represent areas devoid of vegetation cover. It is evident that most parts of Balochistan, southern parts of Punjab (Cholistan) and eastern parts (Thar Desert) of Sindh have very little vegetation cover. High NDVI is along the Indus River is the legacy of irrigation water that supports agriculture.

8. Number of Acts and Laws Passed Relating to the UNCCD

1) Pakistan Environmental Protection Act 1997: The Act and Regulations thereof empower the Pakistan Environmental Protection Agencies to review Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA). The Act and its regulations bind all agencies and individuals to conduct detailed IEE/EIA under the prescribed procedures before commencing any land-based development project or intervention.

2) Forest Act 1927: The Act contains provisions for declaration of forests, and protection of forest produce. Forest Act 1927 applies to State-owned Reserved Forests, Protected Forests, Communal Forests and Privately-owned lands managed by the Forest Departments for the sake of land rehabilitation.

3) Land Revenue Act 1963: The Act specifies the procedures for demarcation of arable, rainfed and wastelands and collection of revenue on the basis of land productivity classification.

4) Provincial Wildlife Acts: Although the focus of provincial wildlife laws are threatened wildlife species, yet they speak specifically on protection of wildlife habitats and ecosystem as a whole. Under the wildlife legislation, Pakistan has declared 19 national parks and more than wildlife sanctuaries and reserves which contribute to controlling land degradation and desertification.

5) Punjab Forest Act, 1999: This Act governs forest resources management, transit of forest produce, sale of timber, firewood, protection and conservation of land and natural resources. The Act has provisions for joint forest management and participation stakeholders, management of public, communal, and private forests, environmental and biodiversity concerns, wildlife and ecosystem management.

[SUBSTANTIAL EXAMPLES]

A. Case Study 1 - Strengthening Traditional Rud Kohi (Hill Torrent) Water Management System in Dera Ismail Khan, Pakistan

1. Background

Rud Kohi is the local term for Hill Torrent water management system, a form of centuries old traditional practice of diverting and spreading water from hill torrents to crop fields in the piedmonts of mountain ranges. In Pakistan the system exists in all the four provinces but the largest tract under this system lies in Dera Ismail Khan (D. I. Khan) District, which represents the southernmost part of Khyber-Pukhtoonkhwa province of Pakistan. In D. I. Khan the system existed prior to 1900. It was formally recognized and brought under the regulations, when land settlement and water rights were established

by the British Government.

The system is important not only as the primitive old surviving systems, but also from the fact that it provides livelihood to more than 30,000 households of the poor farming communities. These communities depend on their livelihood primarily on this system. The hill torrents are the only source of water in this arid tract. The poor farmers with low investment capacity usually are not able to manage and harvest the water from hill torrents coming from the Suleiman Mountain Range mainly because of the coarse rainfall pattern in the catchment areas. There are either heavy flash floods or prolonged droughts, and the climate change is equally playing its role in this equation. The deforestation in the catchment area no doubt also is another important factor. In monsoon season, the flood water usually becomes un-manageable destroying the earthen water control structures and conveyance system. The farmers spend their hard earned income almost every year to re-construct their water diversion dikes and field embankments. The average village cost for these repairs stands at about Rs. 86,000 (US$1000) per year. Despite all these hardships faced by the poor farming community, the area has received little outside help. In fact, it is not on the development agenda of the province.

2. Landscape and Landuse

The Rud Kohi system in Dera Ismail Khan and adjoining Tank area depends upon 5 major streams, namely Gomal Zam, Draban Zam, Tank Zam, Chodwan Zam and Sheikh Haider Zam. In D. I. Khan, the tract between Suleiman Mountain Range and River Indus consists of piedmonts which are cut across by these streams originating in the mountains. The soil in these piedmonts is fertile and consists of sandy and clayey loam. Most of this area comes under arid and semi arid tropical climate with extreme temperatures in summer and short rainfall season. Only a part of the area falls under the Rud Kohi irrigation system, while the remaining major chunk is mainly rainfed area. The perennial water (Kala Pani) and flood waters from hill torrents coming down from the Suleiman mountain range is diverted for the crop field surrounded by earthen embankments. Rod Kohi water is available in spring and monsoon seasons only when farmers filled their crop fields with water. In fact, the water for irrigation is available only once in 6 months. The Rud Kohi system is very fragile and it causes severe water erosion because of flash floods and weak controlling structures. In addition, the entire cropping pattern depends upon quantity of rain water that has high degree of uncertainty. The system totally depends upon rains in the catchment area of torrents. The area out of the reach of Rod Kohi water is extremely dry and usually suffers from acute water shortage even for drinking purposes.

3. Socio-economic Set-up

This case study focuses only on the area under Sheikh Haider Zam comprising of 10 villages namely Zarkani, Kot Sultan, Gara Madda, Gara Mastan, Gara Mahmood, Gara Khan, Gandi Ashiq, Gara Mouladad, Khowar and Sagu. Total population of these villages is about 23000 people. Majority of the community depends on agriculture, livestock and daily wages. Land holding is very small and farmers are landowners and tenants or share croppers. Annual household income of majority of the community is less than Rs.80,000 (US$950).

Out of 3235Households (HH), only 115 have more than 200 acres of land, and these are mostly absentee landholders settled in urban areas. About 1600 HHs have between 50 - 60 acres land-holding while 1170 HHs have less than 10 acres of land holding. Remaining households are landless working either as

tenants or for daily wages.

The various sects in the community live in harmony. It is, however, during the hill torrent season that conflicts arise among adjoining communities over distribution of Rud Kohi water. In years when floods are low, the farmers of downstream villages face conflicts with up-stream villages as each village wants to have bigger share in the flood water. The water is used to irrigate fields on both sides of the main dike, the communities on downstream break dikes themselves to get water for their fields at the cost of farmers on upstream, thus giving rise to serious conflicts, which sometimes end up to loss of human lives.

4. Community Mobilization

Prior to undertaking the field interventions, a campaign of social mobilization was carried out by the Implementing Partner (IP) of the SLMP, the VDO. The VDO actively engaged the community members through focused dialogue for sustainable management of their land and water resources. The process resulted in following arrangements:

1) Organization of each village community into Community Based Organization (CBO) representing each and every cast and clan of the village. The village communities agreed in these meetings that they have to address land degradation and Rud Kohi water management problems through technically viable interventions acceptable to the community and the Project team. They were prepared to cooperate with the project for undertaking field interventions and contributing community's share either in kind or cash.

2) Each CBO selected a sub-committee comprising of 5 members for implementing and monitoring of the field interventions. The committee includes 3 members from the community and one each from the IP and technical line department. Beside this sub-committee, every member of the CBOs was actively involved and encouraged to monitor and supervise the implementation of field interventions.

3) For Operation and Maintenance (O&M) Arrangements another subcommittee was established by each CBO. The role of this committee was to collect contribution for O&M for any damages to structure in future.

5. Sustainable Land and Water Management Interventions (SLWMI)

Finding solutions to the problems in management of land and water resources of Rud Kohi area were the community led ventures supported under the Sustainable Land Management Project (SLMP) funded by the Global Environment Facility (GEF), United Nations Development Programme (UNDP) and the Government of Pakistan (GoP). The farmer community of the area was very active in identifying their problems and providing their experienced inputs for finding solutions to these problems. The experienced farmers with the technical support from government line departments and facilitation from a local NGO the VEER Development Organization (VDO) designed a package of interventions mainly aimed at soil and water conservation, and promoting sustainable land use in the area. The package consisted of the following interventions, which have been completed with financial support from the SLMP and technical assistance by the VDO and line departments:

1) Channeling Rud Water: The perennial and Rud water coming out of the Sheikh Haider Zam was not properly channeled toward main Ruds. It used to scatter on the graveled stream or flow under the gravels having little use for the villages. The Project sponsored construction of a channel to CBO of the Zarkani Village. Due to this new water channel, the perennial water reached to three additional villages and hundreds of acres of barren land have been brought under cultivation.

2) Gated Structure: Construction of gated structures on tributaries of main Rud/water channels control flood water in heavy flood season would prevent the breaking of dike and thus save heavy costs involved in re-constructing the dikes. The project supported construction of 4-gated structures in four villages, Gara Madda, Gara Khan, Gandi Ashiq and Sagu.

3) Farm Inlet Structures: Construction of water inlet structures at farm water entry points. These inlets are used to control flow of water into farm fields. Farmers close these inlets when the field is filled out. These structures prevent overflow of water in to fields and consequent breaking of earthen embankments around the farm. This used to cause damage in the absence of inlets not only to the this field, but also downstream fields coming in the way of water flow producing huge gullies in the loose soil. In total 30 inlet structures were constructed by the community in nine project villages.

Figure 2 and 3. Gated structure along the main channel & Inlet structure on farm

4) De-siltation of Tributaries: Water channels carrying Rud Kohi flood water were de-silted by removing sediments and gravel. This material was used to strengthen the dike (bunds) for controlling down-flow of flood water. A total of six 6 dikes (bunds) were constructed.

5) Dry-Afforestation: Plantation has been done along the main water channels and on the inner side of earthen dikes to re-enforce dikes against water force during heavy floods. So far, plantation up to 5 avenue kilometers on both sides of bunds has been completed. Similarly, it is mandatory for the community and farmers to plant trees of native species on both sides of the gated and inlet structures.

6) Farmers Nurseries:Promotion of farmer nurseries as a source of supplying saplings of native trees for raising plantations along the field embankments and as a source of income to farmers. A total of 9 farmer nurseries with 50,000 plants each of native tree species have been established.

7) Rud Kohi Water Management Fund: The 3 villages in middle section of the Rud Kohi area of the Sheikh Haider Zam expressed their interest in establishing and managing a community level revolving fund namely "Rud Kohi Water Management Fund" to cover the future costs in strengthening their Rud Kohi water control structures. The fund will have contributions from the SLMP and 3 villages, where villagers have agreed to contribute 50% of the total capital cost of the fund in cash. This fund once established will be the first of its kind in Rud Kohi Areas of Pakistan and will help in ensuring the sustainability of the above-mentioned interventions.

Figure 4 and 5. Re-enforcement of farmland dikes & Farmer's Nursery

The Partners in SLM

The sustainable land and water management interventions in Rud Kohi area were joint initiatives of the local communities, SLMP, its Implementing Partner, and government line agencies. The role of each partner is briefly described below:

1) The Community: The role of community as lead player and as beneficiary was very important. The community took keen interest in not only identifying problems and solutions, but also contributed in cash and kind for each activity, and assumed responsibility for taking care of the field interventions in the future by creating Rud Kohi Water Management Fund for operational and maintenance costs of the Rud Kohi System. The community shared 20-25% cost in each activity either in cash or in kind and thus showed their sense of responsibility and ownership.

2) The SLMP: The SLMP provided financial support and technical backstopping for the whole pilot project in Sheikh Haider Zam area. These pilot interventions have achieved land mark results for on-the-ground implementation of the UNCCD and enhancing livelihoods of local communities affected by Desertification, Land Degradation and Drought (DLDD).

3) The Implementing Partner: The VEER Development Organization (VDO) played an important role as Implementing Parner of the SLMP by undertaking baseline surveys, social mobilization, capacity building of CBOs and liaisoning between the community, SLMP, and government line departments. The VDO used its established roots in the local community and the trust this organization maintains with the villager to steer a working relationship necessary for undertaking field interventions.

4) The Government Line Agencies: The district level government departments provided technical expertise for undertaking field activities. The Forest, Agriculture, Livestock, and Revenue Departments played their parts for the successful implementation of the pilot interventions. A District Level Coordination Forum was pivotal in bringing all the stakeholders to same platform of exchange and planning of the project activities.

The Outcomes

The outcomes of the land and water management interventions included:

1) There is an agricultural land of about 4000-5000 acres down the point of construction of the gated control structures, which was properly and sufficiently irrigated after the construction work in first flood season in 2010. This would happen each year till the structure is in place.

2) The interventions saved hard earned money of the poor farmers, which was spent annually before each flood season to re-construct the earthen dikes on Rud Tributaries. The average amount spent by each village annually was calculated as Rs. 80,000 (US$950). Now, the villager will save this money.

3) The interventions benefited most of the farming households in terms of more food production and cash savings. The assessment in Sagu Village indicated that each farming household produced crops of worth Rs. 250,000 (US$2900).

4) Land value has been increased substantially, especially in upper Rud Kohi areas where availability of perennial water has been increased. Outsiders are now purchasing land in these areas for agriculture purpose.

5) With the construction of the permanent structures, the conflicts among communities have been reduced because of the availability of more water for irrigation.

6) The interventions have resulted in conservation of soil and water resources that was usually lost to the rivers and streams during heavy floods.

7) Because of irrigation of their field, the community saved their income by not migrating to other villages for labour during the harvesting season.

8) Livestock is the main source of income for the farmers and compared to previous years they saved their livestock because of availability of more fodders.

Benefits to Environment and DLDD

As the area is prone to severe droughts, and when floods come the farmers cannot intercept the water due to inferior/weak infrastructure. This leads to drought like conditions. However, after improvement in Rud Kohi water system farmers irrigated their additional lands and minimized the risk of soil erosion as well as stopped further land degradation.
The system also provides a strategy for local farmers to adapt themselves for possible risks posed by the climate change. Future weather prediction shows that the flash floods and drought would become more frequent in the area as a result of rapidly changing climatic conditions.

Replicability of the Interventions

Spate Irrigation Project of Pakistan Agriculture Research Council has replicated some of the above described interventions in the area at further critical points. There is need to replicate the best practices and lessons learned on all critical sites Rod Kohi Water Management System in the adjacent Zams and other Rud Kohi Areas in Pakistan to benefit more and more farmers from these interventions. The results and achievements made through the pilot activities also need to be widely published for the benefit of the farmers outside the district and the KPK Province.

References

Fourth National Report for Implementing the UNCCD, 2010.

13. Philippines: A Vegetable Agroforestry System in Practice

- Silvino Q. Tejada and Kim Tae-eun

[BACKGROUND]

The Philippines is a country made up of islands, some large and some small. Most have steeply sloping land that was cleared of forest to become cropland - principally for food crops. Over time, soil loss and nutrient depletion have reduced the productivity of the land. Innovative approaches that provide soil protection and improve both livelihoods and human nutrition have been trailed. This chapter summarizes the results of some of them.

1. Vegetables and Agro-forestry system in Lantapan, Bukidnon

The Municipality of Lantapan is located in the Mt.Kitangald Range Natural Park in Philippines. Several streams and rivers flow from this biodiversity-rich mountain range, which runs into a network of irrigation canals for rice production, and ultimately drains into a reservoir used for hydro-electric power generation.
In 1999, conservation farming launched through more than 1,000 farmers adopting soil and water conservation technologies. By 2002, 11% of the total farmed area applied conservation technologies. Nevertheless, conflict between the adoption ceiling and the proliferation of banana frequently occurred. Additionally, tensions among stakeholders heightened regarding to competing water use.

2. Short description of the best practices

The incentive-based policy program for Sustainable farming System (SFS) in Lantapan is the Local Government's strategy to encourage farmers to adopt sustainable farming practices not only for private benefit but for the greater public good - under this program, such efforts are to be recognized, supported, rewarded and compensated. Incentive categories include input subsidies for crop production and NRM-based livelihood, extension support, subsidized crop insurance, micro-financing, infrastructure, awards and recognition, and marketing support. It does not only provide incentive support to adopt and invest on sustainable land use to improve farmers' livelihoods, but also maintain environmental services (ES) and contribute climate change adaptation and mitigation

The program, rather than being a 'dole out' system, is a viable approach to agricultural development because it encourages cooperation and investments in sustainable agriculture by smallholders. As such, it builds social capital among farmers, as well as the institutional capacity of the local government to broker between local communities and external potential ES buyers.

Vegetable-Agroforestry System (VAF) is a viable farming system that integrates vegetables in tree-based systems. VAF system provides multiple benefits, including provision of micro-nutrients to the diet of rural communities, enhancement of on-farm agro-diversity and environmental sustainability. It also improves the provision of environmental services, particularly carbon sequestration that mitigates global warming. Based on the experiment results, the best VAF system can increase vegetable production from 20-100%.

If properly integrated with vegetables, trees can provide the following benefits:

- Improve farm's productivity by serving as windbreaks and improving micro-climate;
- Increase the income of farmers due to agro-diversity;
- Maintain soil organic matters due to litter fall and decayed roots; and
- Reduce soil erosion as contour hedges, especially in sloping farms.

3. Main problems addressed by the practice

1) Lack of a programmatic approach. The Dole-out system provides projects to local communities, with no clear condition between them and the local government. This often results to minimum impacts in the absence of conditions and requirements.
2) Poor monitoring of farmers' land use systems, whose practices and land use decisions affect the condition of our resource. With the program, the provision of incentives is targeted to farmers who have done positive to protect the natural resources and sustain ES.
3) Poor agricultural extension system. The policy improves the system because extentionists are required to communicate with the farming communities to ensure 'appropriate' incentives are given to 'real' adopters. As such, incentives provided are site-specific and beneficiary-targeted, hence provides more chances of success.
4) The presence of multi-national companies has enriched the rural cash economy, but their unintended effects have pushed smallholders in less productive and fragile areas.

4. Outline specific land degradation problems addressed by the best practice

Soil erosion is a major constraint to sustaining vegetable production on sloping lands in Southeast Asia. Degradation of land resources, where the livelihood of farming communities depends on soil is a serious problem. In tree depleted landscapes with poor soils and risk-prone environments, vegetable farming systems based on monoculture are not sustainable, but integrating trees, and contour hedges to control soil erosion, increase income of farmers, and improve farm environmental services (ES) particularly on carbon sequestration, offer better prospects and a viable option for smallholders. Soil erosion, soil infertility, poor tree cover, and poor farm productivity are major barriers. Integration of trees into intensive vegetable farming systems with minimal negative interaction can increase productivity, profitability, nutrient use efficiency and ES. With VAF, tree cover is increased, which sequester carbon caused by polluters, while cooler climate is maintained.

[ACTIVITIES AND PROGRAMMES]

1. Brief description of main activities, by objective

Objective 1 - To provide incentives to deserving farmers and farmer organizations for adopting or having adopted sustainable farming practices

- To mobilize local resources to provide incentives, and link with external agencies that can potentially provide additional resources or assistance.
- To disseminate the program to all farming communities, and all other stakeholders to gain support.
- To maintain an updated database of farmers adopting specific technologies or farmer organizations implementing agriculture/environment-related activities at the community level.
- To provide incentives to deserving farmers and farmer organizations for adopting or investing on SFS.

Objective 2 - To promote capacity building at the Municipal Agriculture Office-level to implement the SFS incentive-based policy

- To provide continuous training program to Agricultural Technologists (ATs).

Objective 3 - To develop economically viable and ecologically sound integrated vegetable-agroforestry (VAF) systems to increase farm productivity and income through reliable supply of product and reduce vulnerability and risks

In collaboration with the World Agroforestry Centre (ICRAF-Philippines) and SSFWM (Small-Scale Farmers both Women and Men) the following four steps were taken:

- Assess adoption of VAF system in the site.
- Conduct researcher-managed trials on vegetable-tree-crop interactions.
- Conduct researcher-managed and farmer-managed trials on low-cost drip irrigation system.
- Introduce improved high yielding or indigenous vegetable germplasm in a VAF system.

Table 1.List of farming technologies adopted by farmers in Lantapan, Bukidnon (2007)

	Sustainable farming practices	Specific technology
1	Organic Farming Technology	Vermi Compoesting/Culture, Bio-N Naiture Farming Technology System (NFTS)
2	Integrated Crop Management (ICM)	Bio-fumigation, Integrated Pest Management (iPM) Soil Testing (Use of STK) ,Crop rotation
3	Agroforestry	Vegetable-Agroforestry (VAF) production system
4	Diversified Farming	Multiple cropping , Inter-cropping
5	Sloping Agricultural Land Technology (SALT)	Contour plowing, Contour hedgerow Any contour barriers, SALT 1,2,3, and 4 (including Livestock)
6	Soil and Water Conservation (SWC)	Mulching, Cover cropping, Minimum tillage, Drip irrigation
7	Farm Waste Management	Recycling, Composting, Segregation (Liquid and solid)
8	Farm Forestry	Diversification of tree species (Exotic, indigenous, and fruits)
9	Clean Energy	Briquette production (Using nice hull, charcoal, farm waste)
10	Indigenous Knowledge System	Indigenous vegetables and medicinal plants Indigenous pest management
11	Community-wide Clean and Green Projects	Riparian improvement, Water quality monitoring, Community three parks.

2. Contribution to impact

1) On-site impacts

Production or productivity
The economic benefits of the program come from improved agricultural production in Lantapan due to: 1) increased yields; 2) greater cropping productivity; 3) diversification into high-valued crops; and 4) adoption of various agroforestry systems, and other technologies specified (but not limited) in Table 1.

Socio-economic level (including cultural level)
Formation of new farmer groups and strengthening of existing farmer organizations (e.g. Landcare, ATSAL, PAGLAMBU, Tigbantay Wahig, etc.) that are rewarded led to the following benefits: 1) greater responsiveness (receptiveness) to various VAF-related programs and projects; 2) wider scope of SFS Incentive-based Program with more new VAF-related programs and projects; 3) more efficient and effective distribution of assistance; and 4) more encouragement for other non-practicing farmers to adopt SFS. This hopefully will lead to the improvement of farmers' lives and livelihoods, as well as the landscapes.

Environmental level
The program yields environmental benefits due to adoption of various SFS technologies. Apart from environmental protection and sustained provision of ES, specific environment benefits include: 1) improved soil fertility; 2) increased tree cover; 3) improved agrodiversity and biodiversity; and 4) ensured water supply and quality. Improved vegetation in Lantapan also improves micro-climate, and adapts to the impacts of climate change to the agriculture and forestry sectors.

Other
The institutional changes within the LGU, particularly MAO, also provides important benefits, including: 1) more sustainable VAF-related projects on ground reaching the majority of the poor in the uplands; 2) improved monitoring and evaluation of LGU's agricultural programs; and 3) agricultural service delivery that is more responsive to farmers' needs.

2) Adoption and replicability

With more farmers adopting and investing on SFS, provision of ES is sustained for other beneficiaries. For example, water coming from the Manupali watershed is sustained for the multi-national companies, irrigation farmers, hydro-power company among others downstream to use. Tree cover is increased, through reforestation and agroforestry activities, which sequester carbon caused by polluters. Lantapan serves as effective corridor to MKRNP, which is the habitat of diverse flora and fauna (biodiversity). Increasing number of mountaineers and bird watchers come to the park to enjoy its rich biodiversity and natural beauty.

3) The three main conditions that led to the success practice/technology

- Receptive local government: They are willing to try new approaches to achieve their goals.
- Conditions: The program requires co-investment from the farming communities and the local

government - the farmers adopt SFS while the local government provides incentives equitable to their investments.

Three main conditions that led to the success of VAF:
a. Adoption of VAF system has socio-economic and environmental benefits.
b. VAF system is based on existing agroforestry system in the site. ICRAF just put science into it to maximize benefits and enhance knowledge.
c. VAF system, as an agroforestry system, is considered as effective adaptation measure to climate change.

- Realistic: The farming communities and the local government recognize the importance of protecting their resources because they both have stakes to these, as well as other ES beneficiaries downstream.

4) Lessons learned

- Human Resources aspect: building social capital at different levels is a key element to successfully implement the program, trust is very important between farming communities and the local government.
- Financial aspect: partnership is very important in resource mobilization.
- Technical aspect: promotion of simple, low-cost and culturally-sensitive technologies.

With more farmers adopting and investing on VAF, provision of ES is sustained for other beneficiaries. For example, reduced soil erosion in sloping farms will spare irrigation canals and hydropower's reservoir from siltation and sedimentation problems. This means that sufficient water from upper ridges of Manupali watershed is now available for use by downstream users such as multi-national companies, irrigation farmers, and the hydro-power company

[SUBSTANTIAL EXAMPLES]

A. Case study 1 - Small Farm Reservoirs (SFRs) to mitigate the impacts of drought in Bingawan, Ililo, Philippines

1. Context

Background: Being an agricultural community, adequate supply of irrigation water is very vital for the lives of Bingawanons. However, way back in1990s, due to its location irrigation support facility in the Municipality was very limited. Only the two (2) creeks, a Small Water Impounding Project (SWIP) constructed by the Bureau of Soils and Water Management in Poblacion and the Community Irrigation Project (CIP) in Brgy. Ngingi-an served as sources of irrigation water for the farmers. This situation led to the construction of Small farm Reservoirs in different areas of Bingawan.

2. Short description of the proven practice

Small Farm Reservoir is small earth dam structure designed for storage of rainwater and runoff to serve a single rain-fed farm. It is applicable in numerous farm sites with rolling and undulating lands. Size of a Small Farm Reservoir ranges from an area 400 sq.m. to 2,000 sq.m. and has an embankment of 4 meters

above ground level. Construction could either be done using heavy equipment like pay loader, bulldozer, backhoe or manual using spade, hoe and other construction materials. Irrigation is done using PVC siphon or pumps. Small Farm Reservoir (SFR) is suitable in areas with rolling and undulating lands. The upstream portion consists of the watershed area; the mid-stream portion consists of the reservoir area, embankment and other appurtenances; and the downstream area as farmland or service area.

"Small Farm Reservoir" as a practice promotes diversified farming technology. Among the major components of this project are management of watershed area and service area, development of reservoir area, trainings and seminars and dispersal of ducks, vegetable seeds and fingerlings (tilapia and hito). In an SFR, a farmer could culture fish in the reservoir, plant/produce vegetables using stored water for watering, raise poultry/ducks and livestock and use water to irrigate the farm lands. By doing so, aside from rice farming, farmers could also earn additional income by selling some of their produce. It is also a form of savings for the family because aside from having a free, fresh, healthy and nutritious food, it also lessens likelihood of sickness. In addition, rain water collected add-up to a cooler environment in the surrounding area.

Small Farm Reservoir (SFR) promotes diversified farming and encourages maximum utilization of resources. The area can be used for various purposes to include culture of fish, vegetable production, and raising of poultry and livestock. It is also a measure for adaptation to climate change/global warming.

3. Main problems addressed by the best practice

Insufficient supply of water to irrigate farm lands, low income of farmers due to low production, dependency of farmers on rice production as their source of livelihood, adaptation to climate change.

4. Specific land degradation problems addressed by the best practice

Small Farm Reservoirs (SFRs) can contribute in preventing soil erosion in sloping and rolling areas. As they collect and store rainwater and runoff it could reduce the volume and eroding power of runoff within a sub-basin. They also capture eroded materials and thus contribute in minimizing siltation of low-lying areas and waterways.

5. Objectives of the practice

1) To transform and develop a small Municipality like Bingawan, Iloilo into a self-reliant, self-sufficient and productive community by year 2010.
2) To reconstruct and rehabilitate 100 units Small Farm Reservoir (SFR) in the Municipality of Bingawan, Iloilo, gaining economic benefits for production and resource conservation.
3) To maximize the utilization of water in the SFR using modern farming systems and techniques as medium in providing technological transfer and information dissemination.
4) To develop a workable linkages among partner agencies, institutions, farmers and private sector as to link services and resources for community development potentials.

6. Activities - Brief description of main activities, by objective

Objective 1.

Develop organizational and management capabilities among farmers through conduct of consultation focus group discussion, workshop, seminars, meetings and classes to farmer and their organization.

Objective 2.
1) Conduct of field visit and survey by the LGU on the best possible SFR sites.
2) Rehabilitation and construction of SFR. Inclusion of the project in the Development Plan of the LGU.

Objective 3.
Dispersal of ducks, vegetable seeds, fingerlings (tilapia and hito), certified palay seeds.

Objective 4.
Close coordination with other lead support agencies' extension workers to effect concerted efforts in project implementation.

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

The federation and council organized the farmers and identified farmer-beneficiaries and farm sites for the possible rehabilitation and construction of SFR. Agricultural technologies and inputs are introduced to these farmers through the organization and maintenance of SFR which are being done by the recipients.

8. Contribution to impact

1) Production or productivity

- Source of irrigation water that saves crops during unexpected drought periods.
- Diversified farming and maximum utilization of resources.

2) Socio-economic level (including cultural level)

- Additional income of farmers from production of fish, vegetables, poultry, and livestock.
- Savings for the family (free source of healthy and nutritious food and lesser tendency of sickness).

3) Environmental level, it:

- Promotes protection of permanent vegetation in the watershed and contributes in maintaining cooler environment;
- Promotes biodiversity;
- Minimizes surface run-off; and
- Provides fresher and cheaper supply of vegetables in the market.

4) Adoption and replicability

- Three main conditions that led to the success practice/technology
  a. Strong support of the LGU
  b. Open-mindedness and willingness to adapt technological transfer by the farmers

c. Support from other agencies

5) Lessons learned

- Related to human resources: Good coordination with relevant government agencies was a key to the success of the initiative.
- Related to financial aspects: Potential of the SFR to support diversified farming should be maximized, and strong financial support not only for LGU but other agencies concerned.
- Related to technical aspects: SFR should be strategically located in sloping and undulating areas with more trees above for water catchment.

B. Case study 2 - Sloping Agricultural Land Technology (SALT), Mindanao Baptist, Philippines

1. Context - Short description of the practices

Sloping Agricultural Land Technology (SALT) was developed by the Mindanao Baptist Rural Development Center and is being adapted by MRDP2-NRM in many of its agro-forestry sub-projects in the SLM sector. SALT is a technology package of soil conservation and food production that integrates several soil conservation measures. Basically, the SALT method involves planting field crops and perennial crops in bands 3-5 m wide between double rows of nitrogen-fixing shrubs and trees planted along contour. These minimize soil erosion and maintain the fertility of the soil. SALT helps considerably in the establishment of a stable ecosystem. The double hedgerows of leguminous shrubs or trees prevent soil erosion. Their branches are cut every 30-45 days and incorporated back into the soil to improve its fertility. The crop provides permanent vegetative cover which aids the conservation of soil and water. The legumes and perennial crops maintain soil and air temperature at levels favorable for the better growth of different agricultural crops.

Aside from its soil and water conservation effect and of ensuring sustainable source of food to smallholder farmers, SALT is also seen to be an effective paradigm shift from the traditional destructive farming practices (e.g., "kaingin" system or swidden cultivation) of upland farmers and forest migrants to more sustainable farming systems in the uplands. "Kaingin system is observed to be one of the major factors influencing soil erosion in the uplands and siltation of lowland areas in most of the project sites of MRDP2-NRM and GEF sites. If this SALT technology will be widely adapted by majority of upland farmers - particularly the beneficiary - communities and people's organization (PO) partners, this can drastically reduce siltation in downstream areas and coastal waters. In a short period of time, the technology can improve soil and water quality and the rejuvenation of our forests (re-greening effects).

Technically, SALT is a contour farming system. The method involves the planting of field crops in bands 3-5 meter wide between double rows of nitrogen-fixing shrubs and trees planted along the contour. These minimize soil erosion and maintain the fertility of the soils. Field crops include legumes, cereals, and vegetables, while the main perennial crops are cacao, coffee, banana, citrus, other fruit trees and forest trees. SALT helps considerably in the establishment of a stable ecosystem. The double hedgerows of leguminous shrubs or trees prevent soil erosion. Their branches are cut every 30-45 days and incorporated back into the soil to its fertility. The crop provides permanent vegetative cover which aids the conservation of both soil and water. The legumes and perennial crops maintain soil and air

temperature at levels favorable for better growth of different agricultural crops. The recommended hedgerows species used in SALT are Flemingia macrophylla, Desmodium rensoni, Gliricidia sepium, Leucaena diversofilia, and Calliandra calothyrsus.

2. Technical specifications of the technology-if any

First contour lines are established by using an A-Frame, a simple device for laying out contour lines across the slope. It is made of a carpenter level and three wooden or bamboo poles nailed or tied together in the shape of a capital letter A with a base of about 90 cm wide. The carpenter's level is mounted at the cross bar. The contour lines are spaced 4-5 meters apart.

3. Main problems addressed by the best practice

- Rampant "kaingin" or swidden cultivation in the uplands particularly in forest and forestlands. Along with timber poaching and illegal logging, "kaingin" is one of the major issues that contribute to soil erosion and land degradation in the uplands;
- Declining upland farm productivity because of top soil removal and soil fertility loss;
- Massive siltation in downstream and coastal waters as influenced by unsustainable land use; and
- Declining forest cover because of timber poaching, "kaingin", and illegal logging in forests and forestlands.

4. Outline specific land degradation problems addressed by the best practice

- Excessive run-off during rainy season;
- Top soil removal and soil fertility loss due to the effects of burning and sub-soiling in the practice of "kaingin" or swidden cultivation; and
- Soil erosion.

5. Specify the objectives of the proven practice

- To provide smallholder farmers in the uplands a model that would eventually shift their traditional/destructive farming practices into more sustainable systems;
- To control and minimize excessive runoff, adequately protect soil against erosion and help restore soil structure and fertility;
- To introduce a replicable sustainable farming system that could address the problems of land degradation in short time possible; and
- To contribute in the re-greening of the uplands.

6. Activities - by objective

Objective 1. To provide smallholders farmers in the uplands a model that would eventually shift their traditional/destructive farming practices:

- Awareness and advocacy campaign
- Capacity building
- Resources mobilization

Objective 2. To control and minimize excessive runoff, adequately protect soil against erosion and help restore soil structure and fertility:

- Cleaning/weeding of project sites
- Contour establishment using A-frame; staking
- Land preparation
- Planting of hedgerow crop and alley crops

Objective 3. To introduce a replicable and sustainable farming system that could address the problems of land degradation in short time possible:

- Techno demo establishment
- Capacity building, awareness and advocacy campaign
- Organization of famers field visit in the techno demonstration sites
- Production of popular knowledge products in local dialects

Objective 4. To contribute in the re-greening of the uplands.

- Replication and expansion of the technology in other upland areas
- Provision of technical assistance and support

1) One-meter strips along the contour lines are plowed and harrowed to prepare for planting. Stakes which were driven while using the A-Frame serves as guide during plowing.
2) Along each prepared contour line, two furrows are laid. With a distance of 12 cm between hills, two to three seeds are planted per hill which serves as hedgerows. Hedgerow species are Flemingia macrophylla (syn.congestal), Desmodium rensonii, Calliandra calothyrsus, Gliricidia sepium, Leucaena diversofilia, and L. leucocephala.
3) The space between rows of nitrogen-fixing trees on which the crops to be planted is called a strip or alley. Cultivation is done on alternate strips (i.e., 2, 4, 6 and so on) to prevent erosion as unplowed strips hold the soil in place.
4) Permanent crops such as coffee, cacao, banana, and others of the same height may be planted when the nitrogen fixing species are sown. Permanent crops are planted every third strip. Tall crops are planted at the bottom of the farm while the short ones are planted at the top.
5) Short and medium-term income producing crops (e.g. pineapple, ginger, taro, peanut) are planted between strips of permanent crops.
6) Every 30 to 45 days, the growing hedgerows are cut to a height of 1.0 to 1.5 m from the ground with the cut leaves and twigs to be piled on the soil around the crops.
7) Crop rotation is practiced by planting cereals such as corn and upland rice, tubers and other crops where legumes were previously planted.
8) Green terraces are built by piling organic materials such as straw, stalks, twigs, branches and leaves at the base of the rows of nitrogen fixing trees.

7. Contribution to impact

1) Production or productivity

- Increase production capacity of farm per unit area because of multi-cropping and optimization of areas for crop production
- Ensure food supply and material sources to smallholder farmers because of diversification of

cropping pattern, e.g. vegetables, fruit trees, cereals, fodders for livestock, fiber, fuelwood and light construction materials

2) Socio-economic level (including cultural level)

A ten-year study (Watson and Loguihon 1980-1990 showed that a hectare of land farmed according to SALT can increase an upland farmer's income dramatically. Even in the first two years of the study, SALT yielded gross incomes which were much higher than the $49.00/crop/ha of farms using traditional practices (burning, plowing, constant weeding, and chemical fertilizers). When the permanent crops (coffee, cacao, banana, etc.) started producing the annual gross income from SALT further increased to $571.49/ha in 1984 and $622.38/ha in 1985.

3) Environmental level

SALT minimizes soil erosion and maintains the fertility of the soil. The double hedgerows of leguminous shrubs or trees prevent soil erosion. Their branches that are cut every 30-45 days and incorporated back into the soil has improved soil structure and fertility. The crop provides permanent vegetative cover which contributes to soil and water conservation and minimizes excessive run-off during heavy downpour. Also, SALT can reduce siltation in downstream areas and coastal waters in a short period of time and helps in the re-greening of our forests and forestlands.

8. Adoption and replicability

1) The three main conditions that led to the success practice/technology

- Passion of the technology generators to look and generate solutions to effects of kaingin or swidden cultivation- replicable elsewhere with some level of adaptation.
- Passion of the technology generators to transfer the technology by all possible means and to all possible end users - replicable elsewhere with some level of adaptation.
- Strong support from government organizations (GOs) and non-government organizations (NGOs) to transfer the technology - replicable elsewhere with some level of adaptation.
- Incentives given to techno-users by the technology generators and support organization in the form of planting material subsidies and grants, technology training and study tours, extension and technology promotions, and farm development grants - replicable elsewhere with some level of adaptation.

9. Lessons learned

1) Human resources aspect: SALT is labor intensive. For farmers, this is a negative factor in technology adaptation particularly among indigenous people (IPs) and smallholder farmers who have limited resources to hire people.

2) Financial aspect: Diversification of crops or multi-cropping concept in SALT requires considerable amount of capital for seeds, planting materials and labor inputs during the initial stage of farm development, if marginal farmers will not be provided with outside support, they might not adapt the technology because of these constraints.

3) Technical aspect: Technical skills in farm management in SALT are crucial considering that it raises multi crops, farmers require reinforcement to capacitate their knowledge in cultural practices to various agricultural and forestry crops, regular technical assistance from extensionists and farm technicians is required to assist farmers so that success in technology adaptation is ensured.

References

1. Agustin, R & Mercado, JR. Improving Vegetable Production through Vegetable-Agroforestry (VAF) System. Flyer-English version. SANRAM, ICRAF, AVRDC, ACIAR, and LFPL. Claveria. Misamis Oriental. Philippines.

2. Catacutan, D & C-Duque-Pinon. 2008. The policy Environment of Vegetable-Agroforestry (VAF) System in Philippine.' Policy Brief. First Quator 2008, Issue 1, Los Banos, Laguna: SANRAM and the World Agroforestry Centre (ICRAF-Philippines).

3. Harold R. Watson: Sloping Agricultural Land Technology (SALT), http://agnet.org/library/eb/400a/eb400a.pdf

4. Miriam R.Nguyen, John Paul A. D Mesa & Agnes C.Rola. Vegetables Agroforestry System: Base line survey results in Songco, in Lantapan, Bukidnon, Philippines, 2006, http://pdf.usaid.gov/pdf_docs/PNADL262.pdf

5. The Fourth National Report on Performance Review and Assessment of Implementation System (PRAIS) of Philippines, Aug. 2010.

14. Republic of Korea: Proven fact: Forest rehabilitation on degraded land

- Jae Soo Bae

1. Which factors influenced ROK's reforestation success?

This section presents a case study from the Republic of Korea (ROK) that demonstrates successful rapid forest rehabilitation while it experienced consistently slow economic development until the 1960s. This case study could help current developing countries facing the challenge of deforestation and forest degradation find appropriate solutions. This study exemplifies how to detect the causes of deforestation and forest degradation and to overcome those causes to rehabilitate forests.

ROK experienced colonization (1910-1945), division into North and South Korea (1945) and the Korean War (1950-1953) during the first half of the 20th century. Even though it was a developing country, ROK industrialized dramatically its economy since 1970s. Transition of forest resources in ROK has been dynamic and rapid, affecting forested land and terrestrial ecosystems.

A persistent rate of loss of forest resources shifted to a distinct increase in forest resources after the 1970s. This forest transition began in 1955 when forest cover was only 35% of the national land area. Both forest cover and growing stock significantly increased later, in the early 1970s. ROK accomplished this shift to forest rehabilitation despite its level of economic development, lower than already developed countries. ROK still sustains 62% of high-stocked forest area while maintaining rapid economic growth and continuous population growth. The volume of growing stock per hectare (m^3/ha), indicating the substantial increase in forest resources of forest resources, has also increased by a factor of 12.3, from 10.5 m^3/ha (1952) to 129.6 m^3/ha (2010).

The case of ROK shows that forest transitions can be implemented in a relatively short period by a central authority, even with imperfect governance and low economic development (Bae et al., 2011). The case of ROK's forest transition is prior to other government-driven cases in China, India and Vietnam that took place from 1990 to 2005 (Mather, 2007).

2. The forest degradation period, 1945-1970

Korea was separated into North Korea and South Korea in 1945, once it gained independence from Japan after 35 years of colonization. The separation became official when the North (Democratic People's Republic of Korea, "DPRK") and the South (ROK), independently established separate governments in 1948, although substantive separation had taken place in 1945. The estimated condition in North and South Korea upon separation is shown in Table 1, including human population of each Korea, forestland area and the volume of growing stock. After separation, ROK had 70% less forestland with 57% less growing stock and 1.6 times more people than the North. The amount at growing stock per South Korean was 36% of the amount of growing stock per North Korean, at 4.7 m^3 per capita. After the divide, ROK had fewer forest resources to meet greater demand.

Rapid population growth in ROK after 1945 also impacted its forests negatively. In 1945 the ROK's

population was approximately 16 million; in 1949 it swelled to 20 million. There were two reasons for the population increase: North Korean residents migrated to ROK and Koreans who had been residing temporarily in foreign countries, particularly China, returned. This sharp increase in population combined with fewer forest resources resulted in forest loss from 1945 to early 1960s in ROK.

Table 1. Comparison of population and forest resources in North and South Korea, 1945

	Population(1000 people)	Forestland area(1000 ha)	Volume of growing stock (1000 m^3)	Average growing stock per ha (m^3/ha)	Average growing stock per capita (m^3/person)
South (A)	15,879	6,834	74,372	10.9	4.7
North (B)	10,021	9,700	130,800	13.5	13.1
Proportion of South to North (%)	158	70	57	81	36
Total	25,900	16,534	205,172	12.4	7.9

Source: Bae et al. (2010).

In 1948, the newly established government of the ROK tried to reduce degraded forestland by setting three goals:

- to regulate excessive tree cutting to protect the forests by promoting the importance of forests;
- to encourage tree planting to increase stocked forest, and
- to encourage coal production to reduce the heavy dependency on firewood for home use (KFPS, 1975).

Forest degradation nevertheless continued from 1945 to early 1960s as the poor national economy did not allow any change from using firewood as the primary energy source to using fossil fuels. The Korean War broke out in 1950 even before these policies were put in place, hence these goals were never achieved. The war further undermined forest conditions to their worst point since national forest resources statistics were established in 1927.

The following account describes the conditions after independence and separation.

"After Liberation, most common people used firewood as fuel for home use. There was a huge lumberyard near the Cheongyangni train station to supply firewood, which was sourced randomly from the mountains, to Seoul. This degraded the mountains as time went by. Furthermore, about 3.2 million Korean emigrants returned from abroad and about 2.5 million refugees flooded into the South after 1945. This large-scale migration provoked more urgent circumstances in ROK. The refugees from the North sharply increased the demand for fuel in big cities. And, due to the shortage of alternative fuels, firewood was the only option available." (BCC, 2000)

Regardless of the government's efforts to reforest degraded land, it was only with the 1973 launch of the First 10-Year National Forest Plan (hereinafter called "the First Plan") that ROK began to recover the volume of growing stock it had in 1945 (Table 2).

From 1945 to 1970, the population doubled, the planted area quadrupled, and the gross national income (GNI) per person increased by 3.8 times (Table 2). However, the total and average volume of growing stock stagnated from 1952 to 1970; ROK did not manage to recover the amount of growing stock it had had in 1945 by 1970. Although many trees were planted, population growth, increased firewood demand and use and illegal logging undermined the government's expectations of fast forest recovery.

The issues of land cleared by burning, landslides, increased degraded areas and the decrease in growing stock remained unsolved in the 1960s. Policies to support reforestation and the use of fossil fuels to replace firewood for home were desperately needed. As the phrase "the cycle of forest degradation" (KFPS, 1975) implies , even when trees were first planted in degraded areas, local people cut those trees before they are fully grown, forest degradation continued unabated. In the 1970s ROK required fundamental changes to free itself from this cycle of forest degradation.

Table 2. Trends in population, forest resources, and economic indicators in ROK from 1945 to 1970

	Population (1000 people)	Stocked forest (1000 ha)	Volume of growing stock (1000 m^3)	Average growing stock (m^3/ha)	Average growing stock (m^3/person)	Every 5 yr. planting performance (1000 ha)	GNI (US$/person)
1945	15,879	4773[a]	74,372	16.6	4.7	-	
1950	20,412	3739[a]	52157[a]	14.0	2.6	51,084	
1955	21,526	3410[a]	49429[a]	14.5	2.3	62,914	
1960	25,012	3,890	55144[a]	14.2	2.2	118,988	79
1965	28,705	5,414	61,746	11.4	2.2	114,028	
1970	32,241	5,752	68,773	12.0	2.1	190,276	254

a: Estimates.

Sources: For population figures, KNSO (2010); for GNI, Bank of Korea (2010); all other data, KFS (Statistical Yearbook of Forest, multiple years).

3. The causes of deforestation and forest degradation

The first step in planning and implementing effective reforestation policies is identifying the causes of deforestation. The fundamental contributing factors for deforestation in ROK were the separation between ROK and DPRK, the Korean War, population growth, poverty and a weak economy. The direct reasons for the deforestation were the use of firewood, burnt off ground, and excessive felling of trees.

The Korean War was both a direct cause and an underlying cause because the war accelerated deforestation by paralyzing the national civil service and any voluntary regulation practiced by citizens. Hence, the damage that resulted from indirect causes associated with the war was greater than the damage that resulted from direct causes. This section describes each of the causes in turn.

1) Underlying causes

a) South-North Separation and the Korean War

Korea's forests were concentrated in northern regions with national forests. In 1910, 81.4% of stocked forests as well as 80.5% of national forests were found in northern regions, including Gangwon-do province (JGGJa, 1910). The forests in the southern regions where the population was concentrated experienced more degradation and privatization.

About 72% of the growing stock by volume was also concentrated in the northern regions (JGGJb, 1927). The northern parts supplied most timber to meet the country's demands: 68% in 1930 and 79% in 1942. From 1927 to 1943, the total growing stock in the northern regions decreased by 32% (JGGJa, 1943; JGGJb, 1927). In particular, the volume of growing stock decreased most significantly in the northern provinces adjacent to China. Large tracts of primary forest with high volumes of growing stock along Yalu River and Tumen River in the northern region were cut to meet colonial and war expenses of the Japanese Government (Bae, 2005). Excessive timber harvesting was the main direct cause of deforestation and forest degradation in those parts.

Regardless of the differences in forest resource distribution across the country's regions, controlling the timber supply and demand as one country was manageable. However, after separation in 1945, the ROK lacked sufficient forest resources. For this reason, the South-North Separation was one of the underlying causes of forest degradation in the ROK.

The Korean War was the central underlying cause of forest degradation in South Korea. By August 1951, almost half the manufacturing buildings and facilities in ROK were damaged (IMHC, 1996). The social chaos during the war encouraged illegal logging and slash-and-burn agriculture, aggravating already devastated forest resources.

Forest condition in ROK reached an all-time low in 1952, when growing stock levels decreased to 36-40% of the level before the Korean War and non-stocked forest accounted for almost half of the total forest land. In addition, wartime activities destroyed many earthworks used for erosion control, and subsequent flooding and landslides during summer monsoons caused secondary damage.

b) Population Growth

The population increase by 4.5 million people from 1945 to 1950, a 25.4% increase (Table 2). The rapid population growth caused negative impacts on forest resources. The use of firewood, including charcoal, was the primary energy source, 90.5% in domestic use until 1950. It still accounted for a significant portion (62.5%) even in 1960 (KCC, 2001). Additional annual firewood consumption amounted to 2.63 million m^3 during 1945 to 1950 (Bae et al., 2010). This implies the loss of forests was roughly equal in volume to the annual increase in total growing stock to supply the additional firewood (the total growing stock in 1945 was merely 74 million m^3). The unexpected population increase also contributed to the increase in firewood demands for home use, timber use for constructing houses and infrastructure, illegal logging, and the expansion of slash-and-burn agricultural fields.

During the period of 1955-1960, the average annual population growth rate of was as high as 3.0%; From

1960 to 1965 it was 2.5%. Population density was 218 people per km^2 in 1955 which increased to 288 people per km^2 in 1965. Under sluggish economic conditions, one immediate result of this growth was the exploitation and poor management of the natural environment, especially forests. The rapid population growth until the early 1950s followed by continued population growth in the 1960s was an underlying cause of ROK's forest degradation.

c) Poverty

After gaining independence, Korea broke its economic ties to Japan which led to serious economic instability in ROK and poverty. Economic hardship was worsened by the political chaos combined with the inconsistent economic policies of the United States Army. Military Government in South Korea (1945-1948). The Korean War resulted in destruction of the remaining production facilities and transportation infrastructure, deepening poverty. After 1953, industrial production started to recover with assistance from the United States. Even then, the main focus was to repair the wreckage caused by the Korean War, not to spur economic development. Once the recovery of the basic infrastructure was completed for the most part by the late 1950s, the economic policy could shift. By 1960, however, the gross national product (GDP) per capita was no more than US$ 80. The majority of Koreans had difficulties making ends meet.

The rural economy fared worse than the urban economy. Agricultural productivity by 1960 had barely improved. Spring famine occurred regularly, and the majority of farmers did not have enough food to sustain their lives. Under these conditions, degraded forest areas remained degraded, as the rural poor sought fuel wood from forests, and additional stocked forests were cleared for the cultivation of crops.

d) Weak administrative enforcement

Whenever a developing country faces slow economic development and imperfect governance, the government's role is especially important (Mather, 2007). After independence, no political group emerged that was prepared to replace the Japanese government's regime of strict regulations and severe sanctions. No regulatory force was in place to stop excessive tree cutting, driven by people's need for fuel wood. With no alternative source of energy, government slogans, such as "Anyone who fells even a small tree faces severe punishment" (BCC, 2000), were ineffective. The government also attempted in 1951 during the Korean War to stop forest degradation by introducing the "Law on Temporary Measures for Forest Protection", which proved ineffective. Due to budget shortfalls and the lack of regulatory means, the government was not strong enough to push for an ambitious reforestation plan.

The ROK's reforestation policies before the First Plan of 1973, except for the 1961 Forest Law, focused entirely on combating forest degradation from illegal logging and slash-and-burn practices as well as controlling soil erosion. These forest policies provided immediate solutions for direct causes of forest degradation without addressing the fundamental causes driving the excessive use of forest resources.

In these policies, the government relied heavily on bans and commands without providing any incentives or rewards that could generate public participation. A new policy was needed that involved the public in a national reforestation program.

2) Direct causes

a) Domestic fuel wood use

The main direct cause of forest degradation was the large volume of firewood consumed for domestic fuel use in a country with already poor forest conditions. In 1955, ROK used approximately 10 million m^3 of trees and branches for domestic fuel use. This amount was equal to 17% of the total volume of growing stock in the same year (Bae and Lee, 2006). By 1960, 62.5% of the country's primary energy was still sourced from firewood and charcoal. At this rate, ROK could expect to face a complete loss of its forests within 10 years.

b) Slash-and-burn

Slash-and-burn farming was another direct cause of forest degradation. Slash-and-burn means preparing lands for cultivation without fertilization through burning all trees and vegetation already on that land. Significant forest damage sometimes occurred because these clearing fires could become forest fires. Since slash-and-burn farmers moved annually in search of a new piece of land to cultivate, it was difficult to forecast the overall forest damage. The government enacted the "Law of Slash-and-Burn Cleanup" in 1966 because slash-and-burn was a nation-wide forest problem. By 1973, when the First Plan was established, there were about 125,000 ha and 300,000 households of slash-and-burn farmers existed. Although this clearing practice seemed to affect only 1.3% of ROK's forestland, it was standard practice for 13-14% of all farming households.

c) Illegal logging

Illegal logging was considered one of the five major threats to society in 1960s and remained a direct cause of forest degradation into the 1960s. During 1967-1972, after the Korea Forest Service (KFS) was established and before the First Plan was launched, the recorded average annual illegal logging was 3,000 incidents causing 17,673 m^3 of damage every year. This only counts the illegal logging incidents registered by the authorities. The number of actual illegal logging incidents was much higher than the number reported, because the administrative arm of the government was weak and alternative fossil fuel sources were deficient prior to 1970. The government estimated that illegal logging volume was 1.3 times greater than authorized logging volume, considering the timber supply available for industrial use from 1953 to1963.

4. Factors in the success of ROK's reforestation[5]

Significant increases in both volume of growing stock per ha and per capita have been achieved since the early 1970s (Figure 1). This demonstrates a clear trend reversal of the previous 45 years of deforestation in ROK, 1927-1972. The average growing stock also overtook the continuous trend of population growth since 1970s. The rate of improvement has continued and it is most likely to remain that way, given the latest trends of population decline and the increasing growing stock in ROK.

[5] Both Part 4 and Part 5 of Section B were entirely retrieved from Bae et al. (2011).

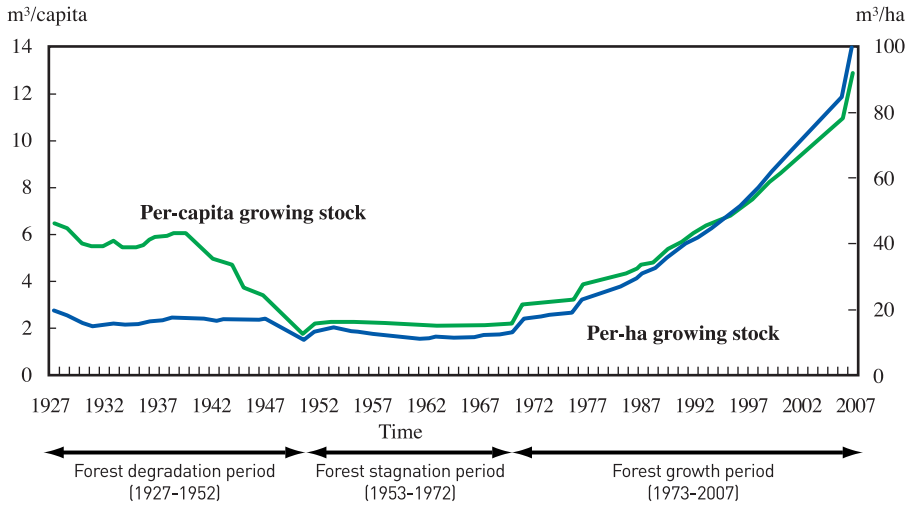


Figure 1. Changes in growing stock on stocked forestland in ROK (1927-2007).
Source: Bae et al. (2010).

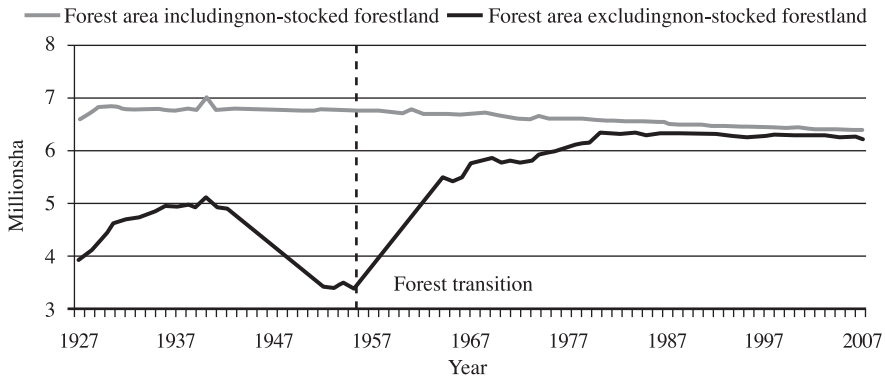


Figure 2. Forest area changes in ROK from 1927 to 2007.
Source: Bae et al. (2011).

During this period between 1927 and 2007, moreover, ROK did not experience any rapid deforestation unlike many other forest-rich developing countries; instead it managed to transform deforested areas into stocked forests (Figure 2). Both underlying and direct factors contributed to this successful reforestation:

Underlying factors:

- Continuous economic growth after the mid-1960s;
- Government-led efforts and supreme leader's strong will;
- Farmers' migration to cities; and
- Establishment of clear forestland ownership.

Direct factors:

- Substitution of firewood with fossil fuels;

- Large-scale reforestation projects; and
- Control of slash-and-burn practices.

1) Underlying factors

a) Continuous economic growth after the mid-1960s

Strong promotion of economic policy and high economic growth rates are well-known central components of the 5-year economic development plans put in place after the 1960s (Sakong and Koh, 2011). In 1953 the GDP was 1.1 billion dollars USD; economic growth rates were about 11 times greater in 1973 and 108 times greater in 1987.

Tree consumption as a domestic fuel source was the prime cause of forest degradation at the time, and it was effectively replaced by fossil fuel. This replacement was encouraged by a government policy that subsidized coal briquettes for domestic use, which provided a disincentive to consuming wood. Also, controlling slash-and-burn was only possible with government incentives: Slash-and-burn famers living in and around mountain areas were relocated and resettled. The rapidly increasing demand for timber was regulated by timber import. Timber imports were supported by the promotion of free trade in timber and constant economic growth. Continuous economic growth established a foundation for combating forest degradation (Figure 3).

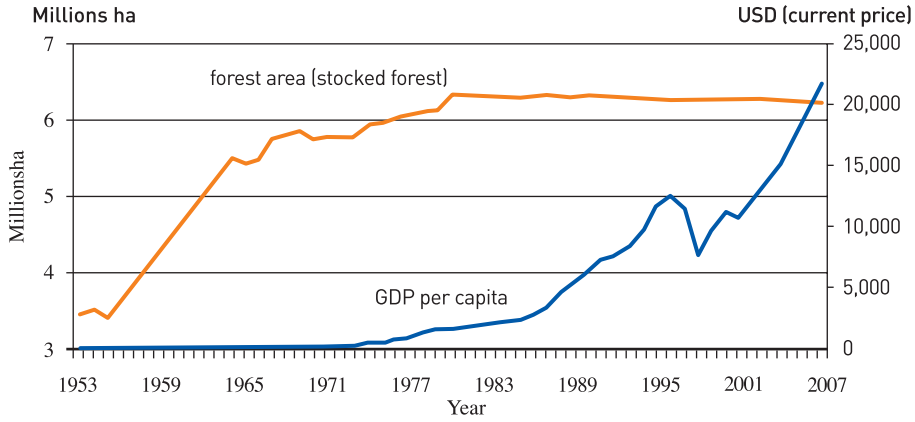


Figure 3. Trends in forest area and GDP per capita.
Source: Bae et al. (2011).

b) Government-led efforts and supreme leader's strong will

The turning point for forest policy in ROK began with the establishment of the First Plan in 1973. Much of the impetus for the plan came from the poor condition of ROK's private forests, which accounted for 73% of the country's total forest area in 1972. Since most of the private forests consisted of smallholdings, landowners had little capacity or incentive to invest in long-term projects. The central government took the lead in reforestation efforts during the 1970s, establishing comprehensive and strict policies to promote forestation. It was necessary to develop an effective institutional framework that included

changes in policy, regulations and enforcement to prevent further forest degradation, to establish fuelwood forests and to plant trees on degraded lands. The First Plan marked a sea change in awareness about forest rehabilitation among people and the government.

In 1972, degraded forestland accounted for 2.6 million ha. At that time, the government transferred the KFS from the Ministry of Agriculture and Forestry (MAF) to the Ministry of Internal Affairs (MIA) to ensure that reforestation was carried out effectively (Kim, 1999). In March 1973, the MIA worked out the First Plan whereby local governments were charged with taking the lead in planting trees rapidly across one million ha with financial, administrative and enforcement support from the central government. The government had three major objectives as described in the First Plan:

1. facilitate full participation of the general public for reforestation of 67% of the national land area and provide income opportunities from forest resources;
2. complete reforestation of 2.6 million ha, or 39% of the national forest area, over the next 20 years, including one million ha reforested during the First Plan period; and
3. mobilize all available private and public organizations, agencies, and schools near forests for the effort (MIA, 1973).

The government also provided income opportunities for rural residents. For example, the MIA encouraged villagers to build tree nurseries and provide seedlings for reforestation efforts by directly purchasing seedlings from the nearby villages (MIA, 1973).

The Second 10-year National Forest Plan (1979-1987) was implemented by KFS (1979). Based on the results of the First Plan, the second plan aimed at establishing 1.06 million ha of commercial forests with long-rotation species replacing fuelwood forests establishment, for rehabilitation of degraded lands. From 1973 to 1987, the size of non-stocked forest decreased from 0.8 million ha to 0.18 million ha, which is 77% decrease. Meanwhile, the growing stock level more than doubled from 13 m^3/ha to 32 m^3/ha during the same period.

c) Farmers' urban migration

Another important factor that contributed to forest rehabilitation was rural-urban migration. During the 1970s, the urban population rose sharply from 3.5 million to 17.8 million. The rural population decreased from 44.7% of the total population in 1970 to just 15.4% in 1990. High wage rates in the cities drew the rural population to urban areas. The wage gap between the cities and the rural continued to expand between 1970 and 1990, as did the migration rate. This migration of rural populations into cities decreased firewood consumption and had a positive effect on the rehabilitation of forests in ROK, resulting in an increase in the average volume of growing stock after the 1970s (Table 3 and Figure 7).

Table 3. Trends in total and rural population, 1970-1990

Year	Total population(1,000)	Rural population(1,000)	Rural population(as % of total population)
1970	32,240	14,421	44.7
1980	38,123	10,826	28.4
1990	42,869	6,661	15.4

Source: KNSO (2010).

d) Establishment of clear forestland ownership

ROK practiced forestland registration based on forest ownership that had been determined by forestland boundaries and owners in the 1920s (Bae et al., 2001). Many developing countries are still challenged with issues of unclear and unstable land tenure. Clear and secure forestland ownership was the one of the underlying factors in ROK's successful reforestation.

2) Direct factors

a) Substitution of firewood with fossil fuels

One of the root causes of forest degradation was the enormous demand for firewood across the country in ROK (FAO, 1982). The inter-agency effort to coordinate energy policy of the Ministry of Commerce and Industry (MCI) and the forestation policy of the MAF in the mid-1950s was an effective approach. The MCI carried out several initiatives to increase coal briquette production, which was the only alternative energy source in ROK in 1956 that could substitute for firewood and charcoal. In 1958, the MAF implemented policies prohibiting the inflow of firewood into Seoul-Incheon and other major cities. They also established fuelwood forests in the agricultural and mountainous villages.

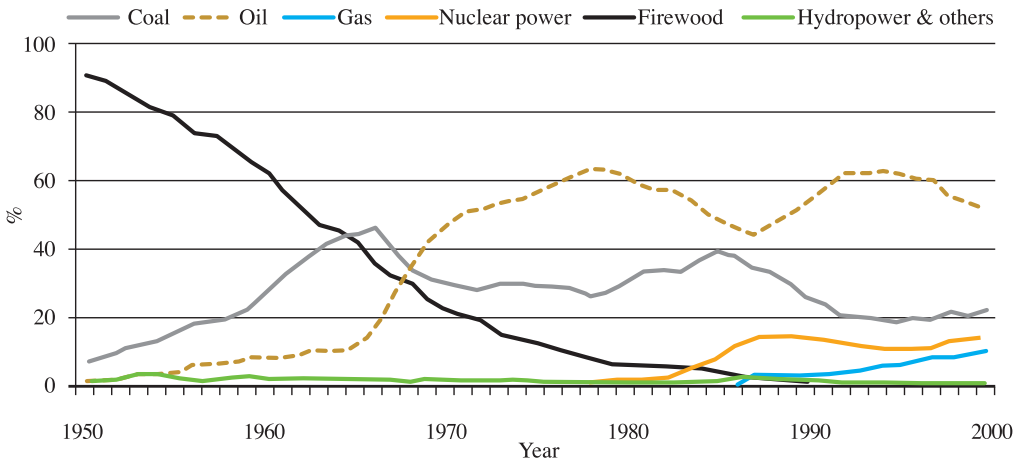


Figure 4. Trends in primary energy consumption.
Source: Bae et al. (2011).

With expansion of coal railroad lines, production of coal briquettes sharply increased in urban areas in the 1960s. As a result, by 1970, only 7% of urban homes continued to use firewood for heating and cooking. Starting with the establishment of the First Plan, numerous projects were implemented to replace home firewood with fossil fuels, such as coal briquettes, and to eliminate slash-and-burn practices. In the 1970s, agricultural villages began to use coal briquettes as fuel for home use, and gas and coal were used for cooking and heating by the 1980s (Figure 4). This substitution of firewood with fossil fuels was a major factor in the continuous increase of forest resources since the 1960s (Oh, 1993; Bae and Lee, 2006; Seo, 2006).

b) Large-scale reforestation projects

Large-scale reforestation policy was effective based on the strong foundation that was created with all other activities mentioned above. Reforestation was essential for greening the degraded land.

(Figure 5) shows the progress made in reforestation between 1946 and 2000. During 55 years, 97,000 ha were planted annually on average. By 2000, planting efforts accounted for 83% of the total forestland or approximately 5,320,000 ha; 94 % of all reforestation was done on previously devastated forestland under private ownership. Additional replanting efforts were repeated in the same areas to overcome some setbacks from natural disasters, rooting failure and lack of post-planting management. The artificial reforestation contributed extensively to improving the basic conditions of ROK's forests.

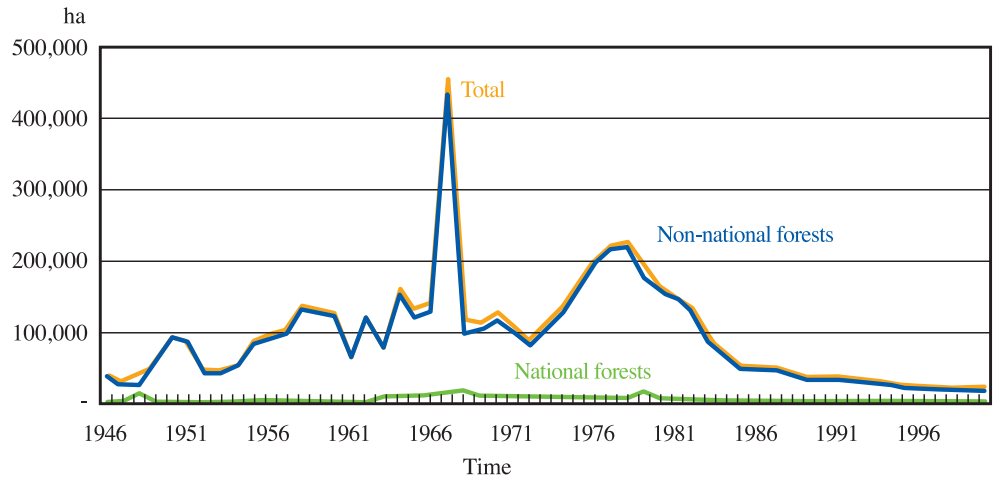


Figure 5. Planting trends , 1946-2000.
Source: Bae et al. (2010).

During 1966-1970, 190,000 ha were reforested annually. Since the KFS was established in 1967, the highest reforestation achieved took place between 1976 and 1980, at an annual average of 200,000 ha. With the substitution of fossil fuels for fuelwood and successful curbing of slash-and-burn clearing, there was less emphasis on reforestation. After 1983, planting efforts dropped to cover 100,000 ha annually. By 2007 the annual areas being planted reduced further to just 20,000 ha.

The rooting and survival rates were likely higher after the 1980s, compared to before the 1970s, due to advancing technology and stricter management after planting. The overall reforestation achievements in the ROK during 1965-1980 set a foundation for ROK to have green mountains throughout the country.

The successful case of soil-erosion control in Young-Il area, the symbol of forest rehabilitation, illustrates that rehabilitation is achievable no matter how bad the devastation seems (see Section 2).

Figure 6. Soil erosion control in Young-Il area in the 1970s (before and after).

c) Control of slash-and-burn

During 1974-1979, the problem of slash-and-burn was completely brought under control. Detailed and strict government measures on slash-and-burn cleanup led to the success. However, despite such government efforts, had the social and economic conditions not been improving, the efforts would not have been successful. Population pressure in agricultural areas is the main factor that promotes illegal slash-and burn practices. Rural population pressure started to disappear in the 1970s. Massive migration of the rural population to urban areas prevented further occurrence of slash-and-burn farmers. The government's financial support enabled slash-and burn farmer to settle in other areas away from the remote mountains. Lastly, development of forest inventory techniques using aerial photography stopped the concealment of remote slash-and-burn clearing, supporting monitoring activities.

5. Success of forest rehabilitation and forest transition in ROK

Changes in the stocked forest area of ROK occurred in four stages (Figure 2):
1. expansion (1927-1942);
2. reduction (1943-1955);
3. re-expansion (1956-1980), and
4. stabilization (1981-2007).

Non-stocked forestland dramatically decreased from 3.3 million ha in 1955 to 170,000 ha in 2007. During the same period, the stocked forest area nearly doubled to 6.2 million ha (Figure 2).

(Figure 3) shows land use changes in ROK from 1952 to 2007. From the trend changes in non-stocked and stocked forestland, we see clear evidence of forest recovery or forest transition. However, there is no evidence that this trend can be explained by the "economic development path" which suggests spontaneous reforestation of abandoned agricultural lands due to increased industrialization and urbanization (Rudel, 1998; Rudel et al., 2005), where the major driving factor of forest transition in ROK is spontaneous reforestation of abandoned agricultural lands. Indeed, from 1952 to 1968, some non-stocked forests were converted to agricultural lands, resulting in increased agricultural land from 1.97 million ha to 2.34 million ha. In the 1970s, some forestland was converted to agricultural land and then converted to residential, industrial and other uses, which explains the later decline of agricultural lands continuing until 2007. However, there is simply no evidence of reforestation of agricultural lands.

In the meantime, the average volume of growing stock changed in three stages (Table 4):
1. reduction (1927-1952);
2. stagnation (1953-1972); and
3. expansion (1973-2007).

Reduction was a period of degradation when growing stock measured both per ha and per capita decreased by 2.9 percent due to the rapid population increase in ROK after World War II. During stagnation, there was no change in per-hectare and per-capita growing stock measures. From 1973 to 2007, both per-hectare and per-capita growing stock measures increased by 20.0 percent and 14.4 percent, respectively, reversing the previous trend. Indeed, the average volume of growing stock in stocked forests increased from 10.5 m^3/ha in 1952 to 100.4 m^3/ha in 2007. Despite the steady increase in population after World War II, the volume of growing stock per capita increased by 7.4 times during the same period (from 1.7 m^3 to 12.9 m^3). In particular, the mass migration of the rural population into cities had a positive effect on forest rehabilitation in ROK (Figure 7.).

Table 4. Average annual rate of change in growing stock volume in three stages

	Forest degradation (1927-1952)	Forest stagnation (1953-1972)	Forest growth (1973-2007)
Per-capita volume of growing stock (%)	-2.9	0.0	14.4
Per-hectare volume of growing stock (%)	-1.9	0.3	20.0

Source: Bae, et al. (2011).

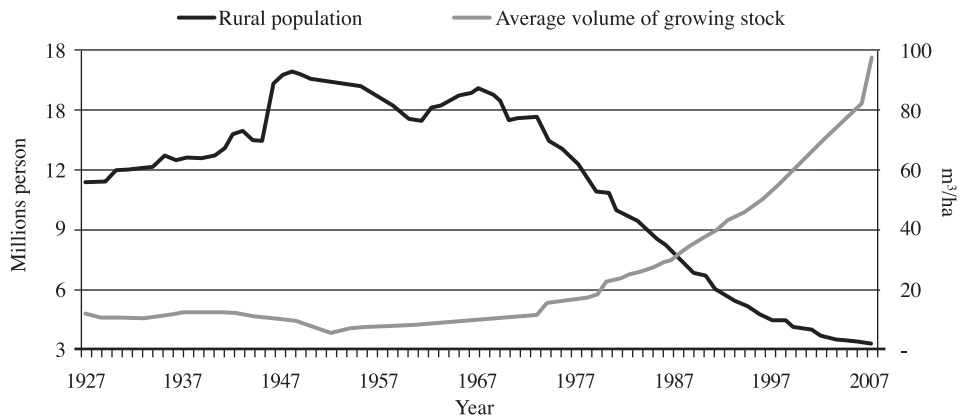


Figure 7. Changes in rural population and a erage olume of growing stock from 1927 to 2007
Source: Bae, et al. (2011).

6. Conclusion

In 1973, President Chung Hee Park clearly presented the public with the goal of turning bare land into a green nation within 10 years and set forestation not only as a national challenge but as the first priority. President Park demonstrated personal interest and reviewed the performance of the First Plan closely,

which enforced every forest policy to focus on reforestation. The early completion of the First Plan is a direct result of the strong government-led efforts under the influence of President Park. The First Plan was a comprehensive plan because it synchronized various policies to attain the goal of one million forested ha.

The First Plan was different from subsequent plans. The First Plan was directly connected to the Economic Development Plan, called the Sae-Maul (new community) Movement, and the National Comprehensive Land Development Plan, which were the most important and comprehensive plans in ROK. The projects for fuel conversion and limiting the uses of forestland for graveyards were interagency collaborations coordinating the efforts of the Ministry of Commerce and Industry and the Ministry of Health and Society. Using his authority as president, President Park positioned himself at the epicentre, overseeing and promoting coordination of various projects, plans, and collaborations among different agencies. Recognizing the role of authoritative oversight is important for a developing country when dealing with common-pool resources, such as forests. The president's strong leadership worked as a very important driver of success in the large-scale reforestation efforts.

The First Plan also linked the national forestation movement to administrative and enforcement powers and advances in forest technology. In addition, the government conducted a public awareness campaign, repeating the slogan, "Cutting trees is a menace and planting trees is an act of patriotism," in the president's public addresses and in other education and publicity campaigns. The government mobilized the bureaucracy by coordinating activities of the central, provincial, municipal, even village, governments to implement the forestation plans. Local forestry associations and cooperatives, which were organized in every village, provided direct and indirect extension services to support the government's forestation policy by offering technical training for rural communities. The KFS and its research organizations supported the forestation policy by developing and transferring forestry technology, such as developing tree species suited for forestation and erosion control technology. The national police force was mobilized to support government policies to prevent illegal logging, slash-and-burn farming, and entering a mountain area without permission. In order to improve the efficiency of forestation, the government transferred the KFS to the MIA and physically integrated the administrative authority, the policing capacity of the MIA and the technological capacity of the KFS. These government-led efforts, especially the First Plan, were critical in the process of forest rehabilitation in ROK in 1970s.

The core success factors that supported forest rehabilitation of ROK were external to the forestry sector. These external factors are more important in identifying the success of forest rehabilitation because general socio-economic conditions extensively and lastingly determine the state of the natural environment, including forests. ROK's success story for forest rehabilitation well demonstrates the significance of such macro conditions.

References

1. Bae, J.S., Kang, Y.S., Noh, B.W., Joo, R.W., 2001. Forest ownership history in the modern and recent times in Korea. KFRI Research Report 182. KFRI, Seoul, 478 pp. (in Korean).

2. Bae, J.S., 2005. The functions of Korea national forests in the Japanese colonial period (19101-945). In: Calver, M., et al. (Eds.), Proceedings, 6th National Conference of the Australian Forest History Society. Millpress, Rotterdam, Netherlands, pp. 235-244.

3. Bae, J.S., Lee, K.B., 2006. Impacts of the substitution of firewood for home use on the forest greening after the 1945 Liberation of Korea. Journal of Korean Forest Society 95 (1), 60-72 (in Korean, with English abstract).

4. Bae, J.S., Joo, R.W., Lee, K.B., 2010. Causes of forest degradation and drivers of forest recovery in South Korea. KFRI Research Series 37. KFRI, Seoul, 150 pp. (in Korean).

5. Bae, J.S., et al., 2011. Forest transition in South Korea: Reality, path and drivers. Land Use Policy , doi: 10.1016/j.l andusepol.2011.06.007.

6. Bank of Korea, 2010. http://ecos.bok.or.kr/EIndex en.jsp.

7. Biographical Compilation Committee for In-wook Jung (BCC), 2000. Pioneer, Jung In-wook. Choonchoogak Press, Seoul, 505 pp. (in Korean)

8. Food and Agricultural Organization of the United Nations (FAO), 1982. Village forestry development in the Republic of Korea: A Case Study. Forestry for Local Community Development Programme(GCP/INT/347/SWE). FAO, Rome, 104 pp.

9. Institute for Military History Compilation (IMHC), 1996. Damage Statistics for the Korean War. IMHC, Seoul, 149 pp. (in Korean).

10. Japanese Government-General of Joseon (JGGJa), Various years (1910-1943), 1927-1943. Statistical Yearbook of the Government General of Joseon. JGGJ, Seoul (in Japanese).

11. Japanese Government-General of Joseon (JGGJb), 1927. Statistics of Forestland. JGGJ, Seoul (in Japanese).

12. Kim, Y.P., 1999. Transfer and restoration in theMinistry of Interior Affair of Korea Forest Service. In: Half a Century Testimony for Agricultural Policy. Ministry of Agriculture and Forestry, Seoul, pp. 415-431 (in Korean).

13. Korea Coal Corporation (KCC), 2001. The 50-year History of Korea Coal Corporation: 1950-2000. KCC, Seoul, 813 pp. (in Korean).

14. Korea Forest Policy Society (KFPS), 1975. The 30-year History of Forest Rehabilitation in South Korea. KFPS, Seoul, 475 pp. (in Korean).

15. Korea Forest Service (KFS), 1979. The Brief of the Second 10-year National Forestation Plan. KFS, Seoul, 61 pp. (in Korean).

16. KFS,1968-2010. Statistical Yearbook of Forest. KFS, Seoul. (in Korean with English heading)

17. Korean National Statistical Office (KNSO), 2010. http://www.kosis.kr/eng/dat abase/ database 001000.jsp?listid=B&subtitle=Population,%20Household.

18. Lee, K.B., Bae, J.S., 2007. Factors of success of the clearance policy for slash-and-burn fields in the 1970s. Journal of Korean Forest Society 96 (3), 325-337 (in Korean, with English abstract).

19. Mather, A.S., 2007. Recent Asian forest transition in relation to forest transition theory. International Forestry Review 9 (1), 491-502.

20. Ministry of Internal Affairs (MIA), 1973. The First 10-year National Forestation Plan. MIA, Seoul, 76 pp.

21. Oh, H., 1993. Changes in forest policy and future forest resources in Korea. In: Choi, J.H. (Ed.), A Mountain and Korean living. Nanam Press, Seoul, pp. 456-473 (in Korean).

22. Sakong, I., and Koh, Y. (Eds), 2011. The Korea Economy: Six decade of growth and development. Korea Development Institute Press, Seoul, 330 pp.

23. Seo, J.S., 2006. Modern History in Korea. Woongjin Knowledge Press, Seoul, 365 pp. (in Korean).

24. Rudel, T.K., 1998. Is there a forest transition? Deforestation, reforestation, and development. Rural Sociology 63(4), 533-552.

25. Rudel, T.K., Coomes, O.T., Moran, E., Achard, F., Angelsen, A., Xu, J., Lambin, E., 2005. Forest transitions: towards a global understanding of the land use change. Global Environmental Change 15, 23-31.

15. Republic of Korea: Management of forest land to promote sustainability: Legal and policy issues

- Im Eun-ho, Victor Squires

1. Background

After the terrible drought period from the late 19th century to the early 20th century, there was a period of Japanese occupation and the Korean War. As the agricultural and economic conditions deteriorated, ROK heavily relied on forest which provides a source of fuel, timber and food. Until 1960s, most of Korean forests were almost denuded due to the over-exploitation of forest resources for wood products, fuelwood production, slash-and-burn farming and so on. It was not avoidable because of extreme poverty, Japanese occupation and exploitation of the resources, Korean War and population growth. Once it was denuded, the soils were eroded severely and lowland areas were flooded due to the intensive rainfall in summer season and relative high slope of mountain terrain.

As a result of all these factors most of the forests were extremely devastated and soils were exposed, then Korean red pines (Pinus densiflora) became dominant in new forests, which accounted for 60% of the total forestland area in ROK. Due to the low diversity of the forest ecosystem, they fell victim to harmful insects, such as pine caterpillar, pine needle gall midge, and black pine blast scale. Over the recent 20 years, pine wilt disease has also caused great damage to tree species. Since the 1980s, there has been less damage done by harmful insects and disease. Damaged area of broad-leaved tree species are gradually increasing.

From 1960s to 1970s, the ROK made great efforts in planting trees on mountains as well as banning illegal logging, exploitation of forest products and clearance of slash-and-burn practices. Forest rehabilitation projects were driven by the government. But success depended full participation from all sectors of society and developed as communities' movements all over the country. Erosion control practices were conducted in the slope area of 740,000 ha. During the period of 55 years from 1946 to 2000, 1.1 billion trees were planted on about 5 million ha, which accounted for approximately 80% of the total forestland.

Figure 1 and 2. Mass plantation movement during 1950-1970s

Forest has recovered due to the efforts to protect forest and reduce the dependence of wood, in addition to the success of reforestation in the 1970s (see Chapter 15). As of the end of 2010, the volume of forest growing stock stands at 109.4m^3/ha. Oak forest is gradually replacing the once-dominant Korean red pine forest due to the natural vegetation development and pests. As of the end of 2010, oak forest accounts for 27%, which is higher than 23% of Korean red pine forest.

The focus now is on how to maintain the forest by applying sustainable forest management (SFM), to preserve biodiversity, sequester carbon and provide for ROK's timber needs for the coming generations.

2. Sustainable Forest Management

1) Legal Framework

The first law that entered into practice under the concept of Environmentally Sustainable Development

(ESD) is the 1994 Amendment to the Forest Law. Article 16 of which stipulates regulations defining the duties of the Korea Forest Service to promote sustainable forest management.

In 2001, the 'Framework Act on Forest' was enacted replacing the existing Forest Law. Its main concept is sustainable forest management (SFM), and assessment criteria and indicators are provided as well. The Act on Promotion and Management of Forest Resources was enforced in 2006 to manage according to the criteria and indicators for sustainable forest management. Thus, a comprehensive legal framework was set to implement SFM at all levels of forest policies.

2) Policy Framework

In the Fourth National Forest Plan (1998-2007), the primary objective was to build a foundation for sustainable forest management. Based on the outcome and result of the Fourth National forest Plan, the Korea Forest Service (KFS) has recently devised the Fifth National Forest Plan for 2008 ~2017. It aims to build a Sustainable Green Welfare Nation through practices of SFM.

In detail, current tasks under the Fifth National Forest Plan are to promote practical application of the SFM criteria and indicators at the local level, to facilitate forest management certification, and to develop forest sustainability index in order to evaluate the quality and condition of SFM. The KFS is improving techniques, human resources and infrastructure to provide firm foundation for the sustainable development of forest resources.

3) Criteria and Indicators

Since the Korea Forest Research Institute (KFRI) raised a need in 1994 to develop criteria and indicators of SFM in the course of its study on sustainable management of forest resources, many efforts took place to develop SFM criteria and indicators suitable for the environment and conditions in ROK. In 2004, the KFS finally developed 7 criteria and 28 indicators and publicly announced them in 2005.

- Criteria 1: Conservation of biodiversity;
- Criteria 2: Maintenance of productive capacity of forest ecosystems;
- Criteria 3: Maintenance of forest ecosystem vitality and health;
- Criteria 4: Conservation and maintenance of soil and water resources;
- Criteria 5: Maintenance of forest contribution to global carbon cycles;
- Criteria 6: Maintenance and enhancement of long-term multiple socio-economic benefits;
- Criteria 7: Legal, institutional and economic frameworks for forest conservation and sustainable management.

4) Methods

a. Forest Fire Control

Annual average of forest fire reaches 500 cases and about 3,700 ha of forests are lost to fire every year. 70% of forest fires occur during dry and windy spring or autumn seasons. Dry climate, westerly winds, and the mountainous terrain affect the frequency and degree of forest fires. It is because of the föhn wind, which is dry slope-down wind occurring in the Eastern Coast from February to April when it is

extremely dry -- with precipitation as low as 170 mm.

Most forest fires occur due to human-induced activities such as accidental fires caused by mountaineers (42%), straw incineration in rice paddies or farmland (18%), etc. Forest fires are often caused by other environmental and social factors such as dominance of coniferous forests, thick humus layers and an increasing number of people enjoying forest recreation due to the adoption of the five-day workweek. The KFS has designated a fire danger period for three months per year, from Feb.1 to Mar.15 and from Nov.1 to Dec.15, urging caution during the period of critical fire danger.

To prevent forest fires nationwide, the KFS has set up the Central Forest Fire Control Center in full charge and Regional Forest Fire Control sub-center in all provinces and counties as well. The KFS is making a great progress in realizing a green nation safe from forest fire with a scientific and systematic approach.

b. Forest Pest and Disease

Since 76% of the entire forests are young stand aged less than 30 years, it is likely to have severe damage and infections by various pests and diseases. In particular, the pine leaf gall midge has been spreading rapidly for the last few years. While mealybug, Japanese alder leaf beetle, and white pine blister rust have been also seen in some areas. After the pine wilt disease was first detected in Busan in 1988, nearly 6,000 ha of forests was infected because no cure has been found from any other countries worldwide.

The KFS has tried various ways to prevent the spread of pine wilt disease by enacting the Act on Pine Wilt Disease Prevention, performing aerial spray every year, treating infected trees with immunization shots, and implementing disaster prevention activities. As the result, the infected trees were successfully reduced up to 92% in 2009, compared to those of 2005. The KFS has carried out multiple prevention activities in pursuing the goal of complete prevention, and will keep trying in future as well. There was nearly 4,000 ha damaged by the oak wilt disease in 2004, but was prevented at the early stage with an effective and strategic method and treatment.

c. Natural Disaster Control

Mountains in ROK are prone to soil erosion since they are mostly young forests with steep slopes. Topsoil loss due to soil erosion has reduced soil fertility and ultimately led to forest degradation. Since 1950s, the erosion control project was carried out under a strong restriction to restore degraded forests in ROK. It has been internationally recognized as one of the most successful erosion control project after the Korean War. However, frequent forest disasters such as land-slides and floods still constantly threaten the lives and livelihoods of the people.

The KFS has been consolidating the systematic forest land management and facilitating soil erosion control projects as precautionary measures. In addition, quick responses and effective recovery actions are undertaken to prevent the hazards of reoccurrences. Such efforts have contributed to not only controlling forest disasters, but also maintaining splendid landscapes and lessening damage to the property of the people.

d. Woodland Management

As social and economic conditions are changing owing to population growth and industrial development, forests as land resources are playing more important roles in diverse fields. The current forests cover 6.44 million ha, and in terms of land conservation, 4.96 million ha of reserve forests accounts for 77% and 1.48 million ha of semi-reserve forests makes up 23%. On average, around 10,000 ha of forests are converted for different purposes every year, so conservation restrictions are placed on reserve forests that maintain high forestry productivity and public functions so as to avoid indiscreet forest conservation. While the KFS has eased irrational restrictions in order to establish an eco-friendly system of forest land use, it has also devised a forest conservation permission scheme which is on operation for analyzing feasibility and investigating suitability. On top of that, the KFS supports foresters whose forests are well-managed, encouraging them to manage and use forests sustainably and eco-friendly.

e. Biodiversity Protection

The KFS continues to expand arboretums in each climate zone including those in Baekdu Daegan Mountains and enhance conservation functions of forest genetic resources through in-situ and ex-situ conservation methods.

The KFS inventories have identified 5712 rare plants in accordance with the IUCN evaluation standards of rare plants. Further, it monitors vitality and conditions of forest ecosystems and maintains reserves of forest genetic resources, which have abundant biodiversity as well as high conservation value in ecology. These reserves including forest wetland are designated and managed systematically.

5) Forest Resources Management

a. Tree Planting

Around 11 billion trees were planted in ROK until 2008 in order to restore the degraded forests which were resulted due to indiscriminate cutting and damage caused during and after the Japanese colonization and the Korean War. The KFS carries out planting practices according to the geological and regional characteristics and diversify plantation activities for various purposes of forest management plans.

In addition, it is establishing the foundation for green growth by creating biomass forests. This biomass forest plantation is different from the existing plantation for long-term cutting (more than 40 years), and fast growing trees are planted in order to supply wood-based biomass materials.

b. Forest Stewardship

The Forest Stewardship Project facilitates tree growth, improves the economic value of timber production, and increases the social value and public benefits of forest including water storage enhancement, disaster prevention, biodiversity, job creation, etc. The KFS made the public value of 73 trillion Korean Won (about $USD 700 million at that that time) as of 2008. Since young forests aged less than 30 years old account for 59% of the total forest area in the ROK, forest stewardship is significantly important.

To promote systematic stewardship practices in multi-functional forests, the KFS has established the First Forest Stewardship Plan (2004~2008) in 2004 and processed forest stewardship activities in 1 million ha. The second forest stewardship plan (2009~2013) has been designed for responding to climate change, and 0.25 million ha of forests are tended every year and in total 1.25 million ha of forests will be managed as planned. Byproducts from tending activities are used for industrial purposes, and wood-based biomass are also utilized for production of wood pellet as fuel substitute, which contributes to moving up Low Carbon Green Growth.

c. Green Job Promotion

The Green Job Project works are focused on forest resources development including forest stewardship, forest disasters prevention, forest rehabilitation and forest biomass use. It also establishes and manages eco-forests and urban forests with the aim of providing more green environment and landscaping.

Under this project, the KFS works toward job creation, enhancing forestry infrastructure for providing various forest benefits for the people, and offering green job opportunities and vocational education to the unemployed with different social background including low-income class, young adults, middle-aged people, women, etc.

d. Wood Pellet

Forest biomass can function as an alternative fuel and carbon sink so it is considered as a key source for addressing climate change. Considering this, the KFS has a plan to supply wood-pellet boilers by 2020 to 143,000 rural households which make up 16% of 900,000 rural households using oil boilers and to facilitate domestic wood-pellet production over 1 million ton by 2020. It already built a wood-pellet processing plant in Yeoju in 2008 for promoting the use and production of wood pellets.

Wood pellet: Wood pellets are a type of wood fuel, made from compacted sawdust. They are usually produced by compressing byproducts of sawmilling and other forest tending activities. The lignin is used as plaster forming a natural glue that holds the pellet together. It is a pollution-free and environmentally sound fuel with high combustion efficiency. Wood pellets are also very easy to transfer, store and use.

e. Domestic Timber

The forests in the ROK are mostly covered with trees planted in the 1970s~80s. Therefore, timber from thinning or forest tending byproducts are mostly harvested for producing pulp or board, while the supply rate of domestic timber has reached approximately as much as 10%. The KFS has been constructing the domestic timber supply system in order to enhance the added-value of domestic timber resource, as well as creating new timber demand by developing eco-friendly wooden goods, nurturing the forest biomass industry and vitalizing the wood culture.

6) Governance in Forest Management

a. Support for managers

Private forests make up 69% of the total forests areas in ROK so it is very important to foster forest

managers and share skills and information on forest management with them.

The KFS is giving its continued support to forest successors who have the willingness and potential to take a central role in local forest management. The KFS organizes a regular meeting with forest land owners every year to strengthen their practical cooperation through National Forest Cooperatives Federation which is expected to play a key role in forest management.

b. Technology Development

The value of forest resources is receiving a great deal of international attention, since the world is facing environmental worsening, climate change and other challenges. Along with this trend, there is increasing demand for and growing interest in forest technologies.

The KFS has established a master plan for forest technology development, and has been promoting technical researches on new varieties development and mass propagation of high - valued forest products. These researches are also focusing on climate change response and energy transition of forest resources. The KFS also works on technology education for forest technicians, and supports basic sciences so as to facilitate better performances and stable implementation in researches. The KFS has organized an industry-academic-research cooperation team with the view of solving technical obstacles likely to occur on sites by developing green technologies. Moreover, it is seeking new potential in forestry R&D which can be playing a key role for low carbon green growth.

c. Mountain Village Project

The mountain villages cover about 45% of the total land area, however only 3.9% of the total population reside in the mountain villages and most of them are aged citizens. The Mountain Village Development Project, accordingly, was initiated by the KFS in 1995 in view of securing a stable working force for forest management and raising household income to enhance local living standards.

For these purposes, more public facilities were built in mountain villages and sawmill construction was encouraged. High value-added natural herb medicine and edible wild vegetables like Wild Ginseng have been cultivated as well. Some of other projects include recreation forests, forest road construction, landscaping plantation, forest tending and thinning. Income projects facilitated direct marketing of forest products between the urban and rural residents. There are 171 model villages developed around the country.

d. Urban and School Plantation

Environmental concerns have been raised recently due to rapid urbanization and population growth. More urban residents tend to get more interested in well-being and quality of life, and there is a growing demand for green spaces in urban areas. Therefore, the KFS has been endeavoring to provide more green spaces for the people in urban areas, meeting one of forest management objectives, which is 'greening for tree-full city'.

Benefits of urban forests include reduction of pollution and noises, enhancement of air quality, improvement of healthy lifestyle, protection of ecosystems, and improvement of city landscapes. To

provide greener and more restful areas, roadside trees are being planted and urban and school forests are being created.

3. Case Study 1 - Baekdu Daegan Mountains

Baekdu Daegan Mountains are a major range of mountains forming the backbone of the Korean Peninsula that stretches out about 1,400 km from Mt. Baekdu in the north to Mt. Jiri in the south. It lies down across big mountains over the total landmass, extending 684 km from Mt. Hyangnobong down to Mt. Jiri in ROK.. It is regarded as Korean spirit.

The government of ROK, in order to preserve the Baekdu Daegan Mountains, legislated the Act on the Protection of the Baekdu Daegan Mountains in 2003. Based on the Act, restrictions are placed on land development in the protected areas as well. About 263,000 ha of protected areas accounting for 2.6% of the total landmass and 4% of the total forest cover have been designated and classified into the core and buffer zones, 170,000 ha and 93,000 ha respectively. The Baekdu Daegan Mountains Protection Plan (2006~2015) was devised in 2005, and the implementation plan is set up every year and protection projects are implemented accordingly, including research projects to build a database of natural resources, support projects to increase local income, restoration projects, and private land purchase projects to assign those sites to the protected areas.

The Baekdu Daegan Mountains, as a core of biodiversity, are the nest of a great variety of flora and fauna. It is one of 102,000 protected areas registered under the International Union for Conservation of Nature (IUCN), and it is highly recognized as well-managed areas with an effective protection system, meeting the objectives of IUCN protected area designation.

Figure 3. Mobilization of local community was a key factor in success of re-vegetation efforts in the 1970s

4. Summary and Conclusions

It is obvious that the government's role in Korean afforestation at the time was crucial but the mobilization of the community was vital to the successful outcome. . Based on this Korean example, it can be concluded that if the government-driven strong initiatives could gain public consensus, even with a low economic level, deforestation problem could be solved in a short period of time. This ROK example provides guidelines, including the creation of a legislative and policy framework, on how developing countries can solve their deforestation and forest degradation issues.

16. Republic of Korea: Hillside Erosion Control and Sand Dune Fixation

- Youn Ho-joong

1. Background

The ROK has predominantly mountainous terrain with steep mountains (with slopes of over 31 degrees) covering 63.8% of the country. As such there is high risk of soil erosion. Because ROK occupies a peninsula with a long coastline there are also coastal dunes, some of which are mobile dune and pose a threat.

This chapter will provide information on how ROK achieved successful rehabilitation and restoration of the devastated mountain area.Techniques used to re-vegetate eroded hillsides and coastal sand dunes also presented with detailed explanations of how the work was done.

2. History of Erosion Control Works

In 1907, the government initiated the first erosion control project on the outskirts of Seoul near Changuimun Gate. The terrace revegetation project and terrace-planting project, which were officially

Figure 1. Before and after where re-vegetation work was carried out on a degraded mountain side

known as the "Erosion Control Works of Inwang Mountain" and "Erosion Control Works of Bukhan Mountain," respectively, lasted for over 20 years. The results can still be seen in the mountains of Bukhan, Dobong and Kwanak.

Since 1918, additional erosion control projects around the Geum, the Nakdong and the Seomjin Rivers, were undertaken to secure the water resources. These projects aimed to alleviate the problems related to environment, such as flooding, severe drought and poverty that were a carry-over from 1922 - 1947. In the 1950s, during the Korean War, extensive illegal logging and wood scavenging resulted in severe forest degradation, which required the government to initiate temporary measures to control the critical damage. However, the temporarily-enacted law regarding this issue did little to accomplishing visible progress or feasible outcomes.

In 1952, the Village Forest Association was established. Through government subsidies, this particular association greatly contributed to forest rehabilitation in damaged and deforested areas. The cost of the labor was compensated by the food donated by the United Nations Korean Reconstruction Agency (UNKRA) at the time. In exchange for their labor on forest rehabilitation projects, war victims were given UNKRA wheat flour in return.

In 1955, with the assistance of the International Cooperation Agency (ICA), the scale of erosion control work extended. By the 1960s, it became a primary policy concern prompting enactment of the Forest Law of 1961, soon to be followed by the Erosion Control Law (legislation number 977) on January 15, 1962. These legislative measures, which served to increase public interest and involvement, preceded the government's promotion of erosion control as a major part of the national reconstruction project, and 80% of the Forest Administration's total budget was dedicated to this. By 1963, approximately 180,000 hectares of hillside erosion work was completed as a result of these efforts.

In 1973, the government developed the First National Forest Plan (1973 - 1982) to fulfill the stipulation of the Forest Law of 1961 that required the construction of a forest every ten years. The project included several ambitious goals - 82,268 hectares of hillside erosion control, 952 hectares of sand dune fixation and 500 km^2 of erosion control work - with the purpose of establishing a systematic approach towards the forest rehabilitation of highly damaged areas. In order to stop human-induced erosion, perpetrators of the devastation had to be held accountable for reconstruction. The success of erosion control work at the time can be largely attributed to careful management, implementation, and the use of the land registry system and relevant maps, which detailed the location of the worst erosion-affected areas.

In 1979, the Second National Forest Plan (1979-1988) commenced with the aim of controlling hillside erosion on 78,268 hectares, fixing and stabilizing 400 hectares of sand dunes along the sea coast, and conducting torrent erosion control on 3,300 sq. kilometers of land. Approximately 20% of the erosion control work was accomplished through government contracts with local villagers. This strategy not only improved the income of local households, but was also in accordance with the "Saemaeul Undong" (the New Community Movement), a political initiative that sought to narrow the disparity between urban and rural residents, as well as modernize the rural economy.

Erosion Control work temporarily halted in 1977 before resuming in 1984. In 1986, the construction of erosion control dams began. By 1988, the Third National Forest Plan (1988-1997) began with several goals that built on previous progress - 5,549 hectares of hillside erosion control, 306 hectares of

preventive erosion control, and 18 hectares of coastal forest creation, as well as the construction of 1,620 erosion control dams. In 1988, additional preventive erosion control measures were applied to areas vulnerable to dangerous landslides.

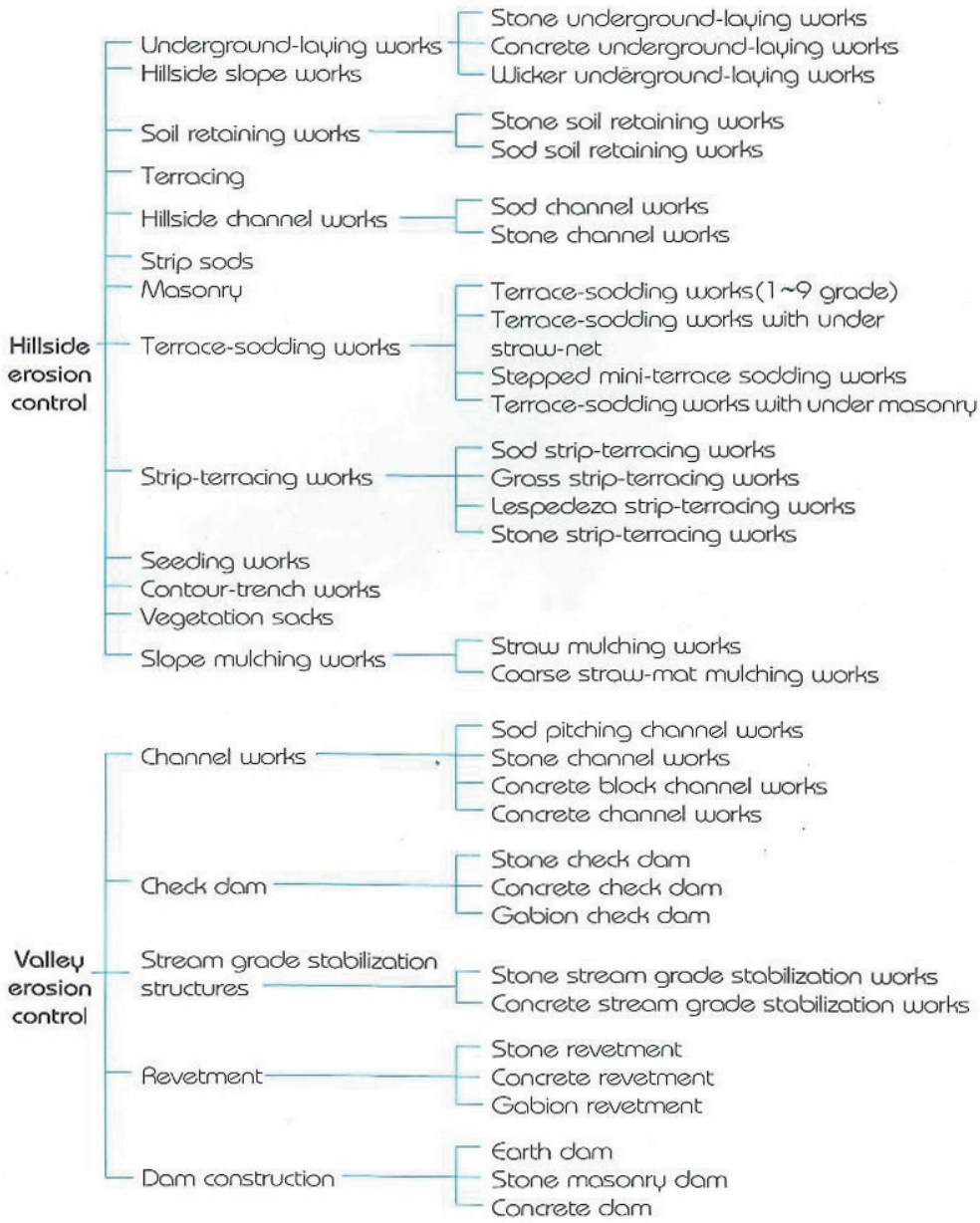
For the past 86 years, the government has conducted erosion control projects appropriate to the scale and steepness of the terrain at various sites. In 1993, changes in working conditions, such as labor shortages and insufficient machinery, led the government to use construction contractors. In order to improve the effectiveness of this new contract-based system and modernize the basic conditions of mechanization, the Erosion Control Law was revised and amended on March 24, 1994.

Table 1. Achievements of Erosion Control Projects

Erosion control projects	Total	Period			Investment cost (million won)
		'45~'72	'73~'87 (1st & 2nd Forest Development Plans)	'88~'94 (Forest resources development plan)	
Total					375,039
Hillside erosion control (ha)	726,219	643,973	77,182	5,064	206,526
Landslide preventive projects (ha)	208	-	-	208	4,979
Sand dune fixation (ha)	3,718	2,733	942	43	1,445
Mountain torrent conservation (km)	3,649	2,353	366	930	57,769
Erosion control dam site)	480	-	54	426	17,205
Miscellaneous					87,115

3. Hillside Erosion Control

There are a number of processes involved and a number of successful approaches have been devised to restore hillsides and ensure the proper disposal of run-off in valleys (Table 2).

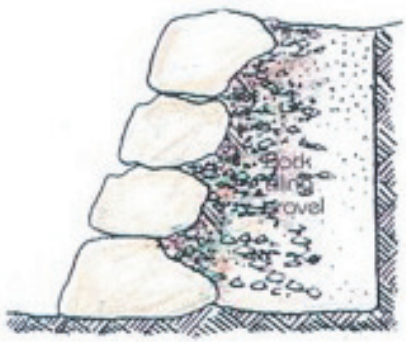


1) Soil Retaining Works

A soil retaining structure is a mechanism to prevent soil erosion and preserve the slopes, which are sometimes vulnerable to landslides. There are many options available when constructing a soil arresting structure, such as concrete, stone, concrete block, concrete plate, timber, etc - however most of the time the decisions will be based on the cost-effectiveness of the grading and construction.

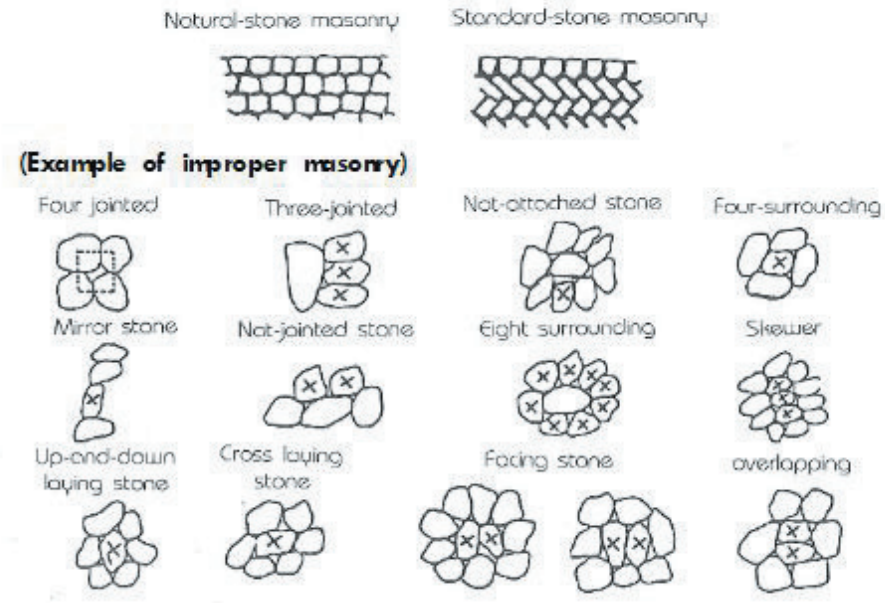
Soil retaining works using both sod and stone

Working guideline



Stone constructed soil retaining works

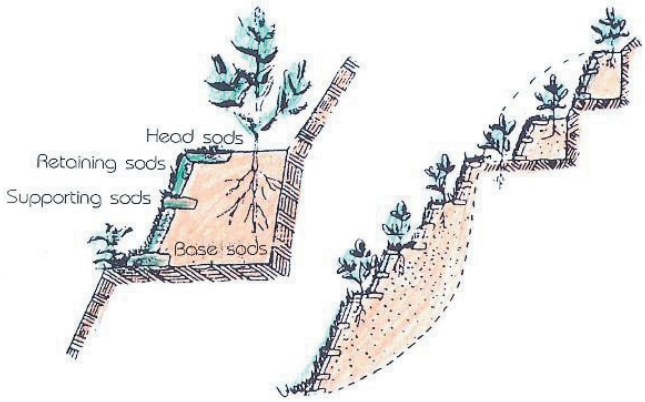
- Working guideline



2) Use of sod in Terracing

After grading the hill slope and terracing, sod is placed on the front of the step, and trees are planted on the terrace. This terrace sodding structure looks like a contoured terrace. The purpose of this structure is to preserve the soil banks, increase tree growth on the terrace, reduce the flow speed of hillside runoff, prevent rill erosion, disperse scattered hillside runoff, and cultivate a proper environment that allows plants access to water. This method is usually used in places such as on denuded hills and where the precipitation is heavy and the soil is not sticky. Recently, due to the insufficient supply of sod, substitute materials have been used. The width of the terrace depends on the hill slope gradient (usually 60-70cm), whether the slope is steep or the soil is shallow (less than 50cm). When this work is conducted, even if the soil is soft, the terrace is not cut unnecessarily, and if the soil layer is shallow, it is cut just enough to make the terrace properly. The rule of thumb is enough to maintain soil stability. This reduces the distance of soil transportation and can preserve the topsoil. Without such preventative measures, the sod would decay within a few years, and the terrace would rapidly return to a natural slope.

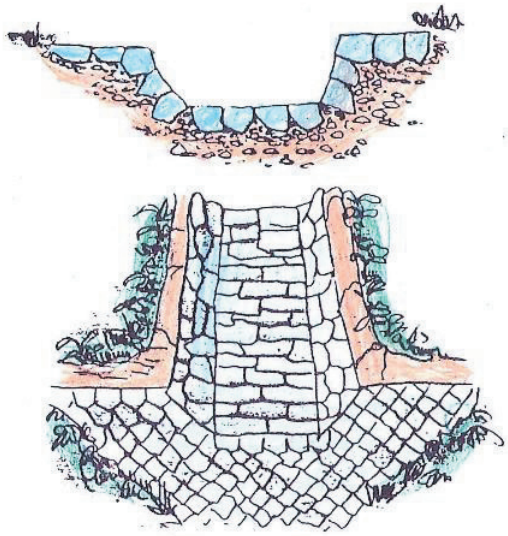
■ **Working guideline**



3) Stone-lined Channel

Hillside channels are created to prevent runoff on hill slopes by draining away excess water and simultaneously acting as protective barrier for other control-related work. They should be installed in places where runoff can be effectively collected. An open and straight channel should be constructed on the lower side of the slope, because the runoff capacity of the hillside channel could change at any time. The gradient of the hillside channel should remain the same for its entire length, because if water yield is consistent, then the soil can absorb it, and the gradient should not change along the slope.

Working guideline



4) Preventive Erosion Control

a. Landslide Control

Landslide control includes various works such as surface and subsurface drainage, soil pressure fixing, preventing for falling stone, and cross and longitudinal erosion control of the stream bed to protect lives and properties of the people from mountain hazards in the dangerous landslide zone.

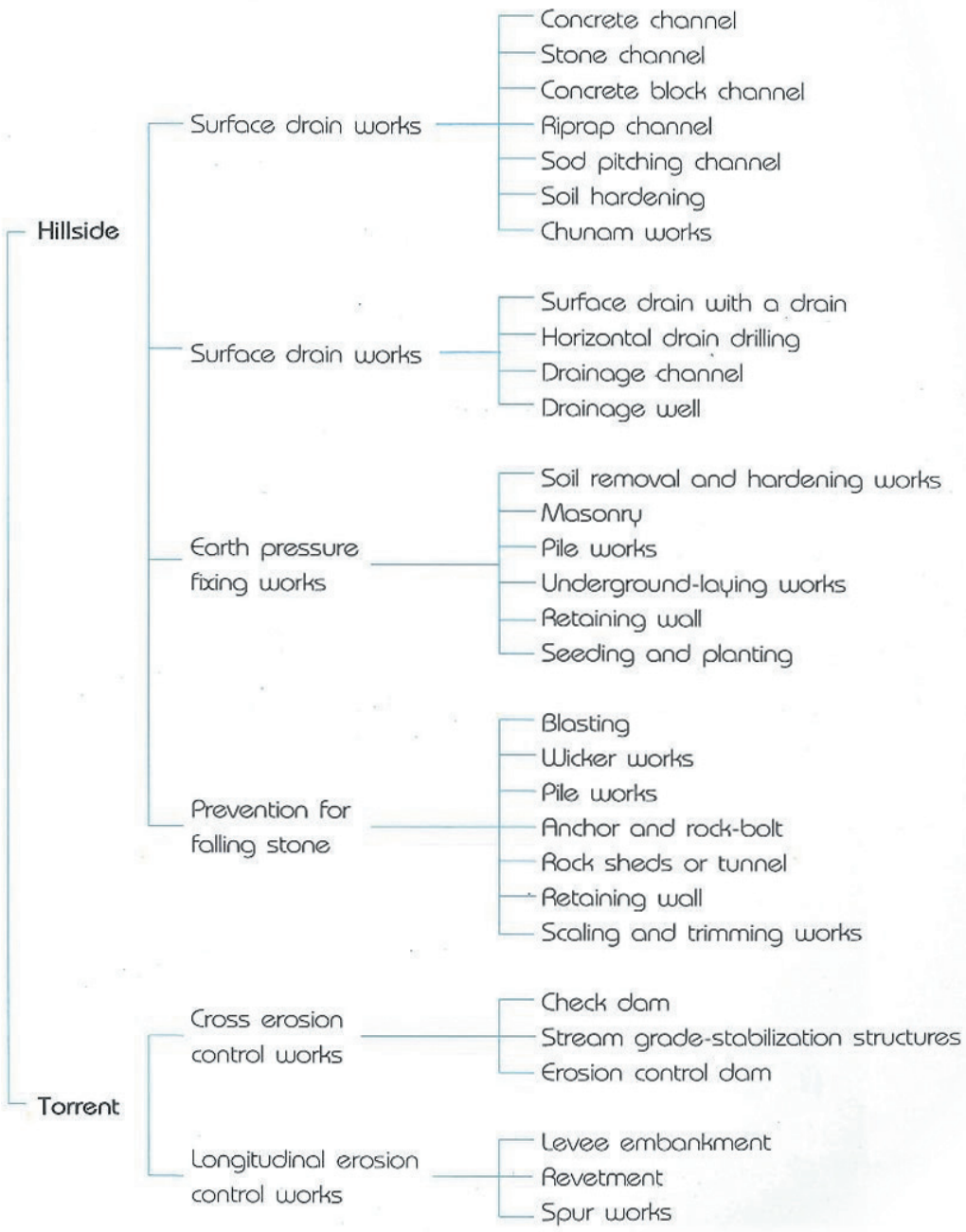
– Seokpo-ri, Duseo-myeon, Ulsan-gun, Kyongsangnam-do

Before preventive erosion control

After preventive erosion control

b. Landslide control work

As the photos show, there is a series of related tasks and approaches that are combined to bring about effective control of landslips and landslides. Most depend on diverting or harnessing torrents and dissipating the energy they contain. Once the water is controlled efforts to stabilize the soil will be possible. Combinations of engineering works and biological methods (see photos) are the most effective.


Hillside
Surface drain works
Concrete channel
Stone channel
Concrete block channel
Riprap channel
Sod pitching channel
Soil hardening
Chunam works
Surface drain works
Surface drain with a drain
Horizontal drain drilling
Drainage channel
Drainage well
Earth pressure fixing works
Soil removal and hardening works
Masonry
Pile works
Underground-laying works
Retaining wall
Seeding and planting
Prevention for falling stone
Blasting
Wicker works
Pile works
Anchor and rock-bolt
Rock sheds or tunnel
Retaining wall
Scaling and trimming works
Torrent
Cross erosion control works
Check dam
Stream grade-stabilization structures
Erosion control dam
Longitudinal erosion control works
Levee embankment
Revetment
Spur works

5) Sand dune Fixation

Sand dune fixation includes a variety of work, such as soil dressing, the installation of sand accumulation and stabilization fences, all of which prevent houses, farmlands from being buried by shifting sand dunes.

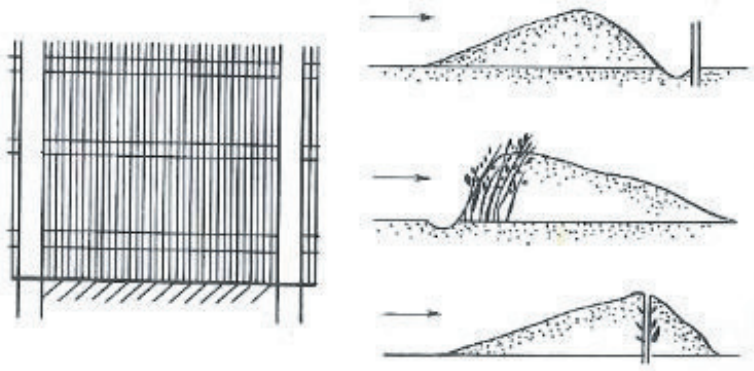
– Sindu-ri, Wonbuk-myeon, Seosan-gun, Chungchongnam-do

Before sand dune fixation

After sand dune fixation

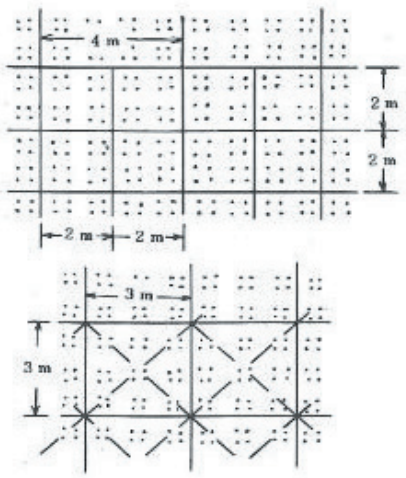
Sand accumulation fences

Working guideline



- Sand dune stabilization fences

- Working guideline



5. Summary and Conclusions

Much of the work reported here was done in an earlier time when labour-intensive methods were the only way. Nowadays, for those who have the right equipment, there are less labour-intensive methods. However, as this publication will serve the interest of developing countries within Asia and the Pacific (and beyond) the Editors thought it appropriate to include the detailed methodology.

As the photos show, even severely degraded sites can be remediated with much effort and the right approach. ROK's experience in these difficult environments may be an inspiration to others.

17. Republic of Korea: International Cooperation and Public-Private Partnership Programme to Mitigate Desertification

- Park Hye-min, Kwon Byong-hyon and Moon Kook-hyun

A. Government Initiatives

1. Background

The ROK has been actively involved with overseas activities especially in developing countries of Asia since 1998. With ROK's successful past experiences and technologies on forest rehabilitation, a wide range of international cooperation activities was implemented at both, government and civil-society levels. The activities were carried out in countries such as China, Indonesia, Mongolia and Myanmar. In China and Mongolia, the main activities have been focused on plantation to combat desertification. The KFS main efforts in Indonesia include restoration of damaged area after tsunami, development of local species' seeds, and capacity building for mitigation of and adaptation to climate change. Restoration of drylands has been the major focus of the activities conducted in Myanmar.

Such activities have not been limited to mitigation of desert and drylands, but also covered sending experts to the region, offering training sessions and organizing workshops and international symposia to transfer hands-on knowledge and technology. Especially, The ROK's proven forest restoration methods and sapling-cultivation technology, as well as the plantation techniques were passed on to several countries through the various channels mentioned above.

Also, the KFS has built bilateral cooperation partnership especially with Asian countries including China, Indonesia, Mongolia, and Myanmar, so as to achieve more opportunities for both parties to continuously monitor and maintain the previous projects as well as the new ones.

Currently, two joint projects with Indonesia were successfully completed and four other projects in China, Indonesia, Mongolia and Myanmar are still ongoing. This part of the chapter aims to elaborate on the previously mentioned projects.

2. Korea-Mongolia Greenbelt Project

1) Project Period: 2007-2016 (10 years)
2) Implementing Agency: KFS, Ministry of Nature, Environment and Tourism of Mongolia (referred to as "MNETM" hereafter)
3) Objectives:
   - To contribute to combating desertification and alleviating the damage of Dust and Sandstorm (DSS) by plantation in Mongolia
   - To strengthen the capability of Mongolian forestry experts via joint research and training sessions
4) Details:

The joint project plans to be promoted for a 10-year period from 2007 as part of the "Government Action Plans to Prevent the Damages of Dust and Sandstorm (DSS)" (2008), which was established based on agreements of fourteen governmental organizations of the ROK. The KFS has been supporting the project financially and sending a project manager to local sites. Project sites and the required labor force for the project were provided by the MNETM.

Project sites are located in Lun Soum (125km west of Ulaanbaatar) and Dalanzadgad (480km south of Ulaanbaatar). Lun Soum is one of the 27 sub-districts of Tuv Aimag and it has been affected by desertification. Dalanzadgad is located at high altitude and it is classified as a semi-desert area.

Up until 2010, two plant nurseries have been created and plantation work has been carried out in the total area of 651 ha in Lun Soum and Dalanzadgad. Mainly planted species are as follows: Poplar (*Populus* spp.), dwarf elm (*Ulmus pumila*), sea buckthron (*Hippohae rhamnoides*), apricot (*Prunus armenica* var. *ansu*), Chinese tamarisk (*Tamarix* spp.) and Chinese peashrub (*Caragana sinica*).

Further, Plantation Technology and Education Centre is now built to provide extensive trainings to the local forestry government officials and the residents. Exchange of experts and training programmes have been carried out to bolster the capacities of human resources.

In addition to activities to combat desertification, a collaborative research is currently taking place between the Korean and Mongolian experts in order to establish effective strategies to control forestry harmful insects.

3. Plantation Project for Desertification Prevention in China

1) Project Period: 2007 - present
2) Implementing Agency: Future Forest (Korea), All-China Youth Federation (China)
3) Objective:
   - To contribute to alleviation of DSS and combating desertification via promoting plantation projects in the Kubuqi Desert in Inner Mongolia
   - To promote participation of civil societies in combating desertification activities and to increase capabilities of civil societies

4) Details:
The KFS has been financially supporting the Future Forest since 2007. This project was born as one of the "Government Action Plans to Prevent the Damages of Dust and Sandstorm (DSS)" (2008) as well as part of the Official Development Assistance (ODA) project. Its site is located in the Kubuqi Desert, Inner Mongolian Autonomous Region of the People's Republic of China. It lies to the south of the Yellow River and north of the Ordos Desert.

By 2010, Simon Poplar (*Populus simonii*), *Salix psammophila*, *Astragalus mongolicum* were mainly planted in 804 ha of the desert area. Also, the KFS has been sending "Green Volunteers", a group of university students, to the project site to raise awareness and further strengthen the relationship between the youth groups of the ROK and China.

There are also various other participants that have been actively involved in this project other than KFS. Korea International Cooperation Agency (KOICA), Korean Airlines, SK Group, a few other Korean

government agencies and private companies are other main partners of the project.

4. The Project for the Greening of the Dry Zone of Central Myanmar

1) Project Period: 1998-2000 (first round), 2004-2005 (second round), 2008-2010 (third round)
2) Implementing Agencies: Korea Forest Research Institute (first round), Korea Society of Forest Environment Research (second round), KFS (third round)
3) Objectives:
   - To increase the productivity through rehabilitation of dry area and contribute to revitalizing the local economy through restoration of the historical site
   - To ultimately improve the living standards of the locals
4) Details:

The middle part of Myanmar is composed of 67,547km^2 of dryland and this takes up to 9.8% of the total land area. The area is deteriorating and is at the risk of being affected by desertification. The government of Myanmar has established its respective "Rehabilitation of Dryland Centre" along with 30-year of Complete Master plan (2001-2031). The KFS has been supporting such rehabilitation activities since 1998. KOICA being the donor agency, the Ministry of Forestry of Myanmar and all the implementing agencies listed above were able to cooperate to run the project at three different times.

The project undertaken during these three different periods made it possible to create the forest area of 600 ha in Madalay Province - Tu Yin Taung, Ngalinpok, Nyang-u. Eucalyptus (*Eucalyptus camadulensis*), Neem (*Azadirachta indica*), and Flamboyan (*Delonix regia*) were mainly planted. As well, a new system for a tube well and irrigation facilities was formed along with fences to protect the planted trees from the livestock. Two plant nurseries were also built to raise the saplings to be used for rehabilitation. Techniques such as production skill of containerized seedlings and cultivation were transferred as part of the project through capacity building programmes.

Required equipment to the project such as, excavators, trucks and cultivators were also provided along with education activities. Currently, KOICA is in the process of promoting the fourth round of the project and is to be focused on management of 600 ha of rehabilitated forest area, additional plantation and economic development of the local community.

5. Korea- Indonesia Cooperation Projects

Indonesia is the country that the KFS has been cooperating with since 1987 after signing the MOU on bilateral forestry cooperation. In 2006, with the launch of "The Rehabilitation of Mangrove Forest and Coastal area Damaged by tsunami" project, four other collaborative projects for Desertification and Land Degradation (DLD) and Sustainable Forest Management (SFM) have been promoted.

From 2006 until 2008, in the province of Ache (Banda Ache), "The Rehabilitation of Mangrove Forest and Coastal area Damaged by Tsunami" project was taken place. As well, "The Project of Seed sources and Nursery Technology Development in Indonesia" was taken place in Rumpin, Purwakarta, and Jasinga of West Java and Sotek of East Kalimantan. Finally, Korea-Indonesia Joint Project for Adaptation to and Mitigation of Climate Change in Forestry has been taken place in the east and the middle area of Rombok Island.

1) The Rehabilitation of Mangrove Forest and Coastal area Damaged by Tsunami

a) Project Period: 2006- 2008
b) Implementing Agencies: KFS, Ministry of Forestry of the Republic of Indonesia
c) Objectives:
- To rehabilitate mangrove forest which serves as a buffer zone for the damage in northern Sumatra Island, where it was severely affected by the tsunami that occurred on December 26, 2004;
- To contribute to the improvement of the situation both environmentally and economically through preventing land erosion and protecting fish resources; and
- To restore biological diversity and to contribute to stabilization of daily lives of the locals.

d) Details:
Mangrove is a type of species that only grows by the seacoast or at the mouth of river in tropical and sub-tropical zones. The wood could be used as timber, and furthermore, the trees provide a habitat and a spawning ground for aquatic life, which ultimately promotes biological diversity and proliferation of water resources. In addition, it contributed to local community's increased income and alleviation of damages caused by tsunami.

After the tsunami of 2004, approximately 25,000 ha of Mangrove forest in northern part of Sumatra Island was destroyed and in order to restore the damage, in total of 550 ha of Mangrove forest was rehabilitated in the province of Acheh (Banda Acheh and 5 other districts). Moreover, the Mangrove Information Centre was established with an intention of maintaining and managing the rehabilitated Mangrove forest. Workshops on Mangrove plantation techniques were held and the local forestry government officials and the local residents were further trained by the local experts of Indonesia as well as the Korean experts for capacity building.

2) The Project of Seed Sources and Nursery Technology Development in Indonesia

a) Project Period: 2005-2007 (first round), 2008-2010 (second round)
b) Implementing Agencies: KFS, Ministry of Forestry of the Republic of Indonesia
c) Objective: To contribute to rehabilitation of devastated forest of Indonesia through dissemination of improved tropical seeds and transfer of cultivation and plantation technology
d) Details
The project was promoted at the request of Indonesian government at the Korea-Indonesia Forestry Cooperative Committee. The KOICA was the donor agency and the KFS implemented the project. Government of Indonesia provided project sites and the labour force. The project sites were in Rumpin in West Java, Jasinga, Karawang and Sotek in East Kalimantan.

The first round of the project took place at three different locations: Rumpin in West Java, Jasinga, Karawang and Sotek in East Kalimantan. With the project, one plant nursery (5.7 ha) and the experimental forest area (169 ha) were established. Furthermore, there was a construction component, which included research centre, greenhouse and storage areas. As well, the necessary equipment for soil analysis and tissue culture, knowledge sharing and training sessions were also provided. The Rumpin Seed Sources and Nursery Centre was built and primarily took care of the nursery, experiment forest and the greenhouse facilities. The centre also collected tropical tree species then selected 11 best species for mass production that were environmentally friendly and socially acceptable to the local community.

The second round of the project was carried out in West Java namely Puwakarta area, and the total of 231 ha of the experimental forest created. Saplings produced from the Rumpin Seed Sources and Nursery Centre were cultivated, analyzed and assessed by growing conditions species by species. They were also classified and selected by growth amount. Management of experimental forest established by first round and monitoring of selected species were also carried out. Additionally, some temporary nursery areas and plantation facilities were created in order to increase adaptability prior to actual planting activities in the local communities.

The Rumpin Seed Sources and Nursery Centre and the experimental forests, which were built as a successful outcome of the first and the second rounds of the project, are under continuous care and management till this day by Korea-Indonesia Forest Cooperation Centre.

3) Korea-Indonesia Joint Project for adaptation to and mitigation of Climate Change in Forestry

a) Project Period: 2008-2013
b) Implementing Agencies: KFS, Ministry of Forestry of the Republic of Indonesia
c) Objective:

- To reinforce adaptation to and mitigation of climate change through Afforestation and Reforestation Clean Development Mechanism (A/R CDM) in Indonesia, carbon emission reduction and expansion of carbon absorption during growth

d) Details:
The project is planned to go on until 2013 (a 5-year project) in Lombok Island, Indonesia. It is a joint project between KFS and the Ministry of Forestry of the Republic of Indonesia funded by KOICA.

The main tasks of the project are the followings:

- The pilot project of A/R CDM;
- Inspection of validity of Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) application;
- Organizing global symposiums and workshops to share information regarding A/R CDM and REDD;
- Support technical equipment and software for satellite image analysis; and
- Exchange of experts.

As for the case of A/R CDM, the ultimate goal is to draft a Project Design Document (PDD) and register it with the CDM Executive Board (EB) of UNFCCC. It should go through the proper registration procedures - domestic approval needs to be first obtained by the Designated National Authorities (DNA) and it can be further assessed by the CDM project Designated Operational Entities (DOE). 300 ha of forest would be established and estimated amount of net anthropogenic GHG removals by sinks is 10~15 tCO_2/year per hectare.

As for the case of REDD, the causes of deforestation and forest degradation can be assessed through remote sensing and analysis of satellite images and based on the assessment, the REDD methodology can be applied. This process will lead to development of a new model for preventing deforestation and forest degradation.

Moreover, two international symposia and three workshops have been and will be held to share information regarding A/R CDM, REDD and progress of national activities of the respective country parties. There was also exchange of experts - both short-term and long-term - and relevant government officials.

B. Private Sector Initiatives

1. Background - Project Outline

Plantation activities have been carried out in order to combat further desertification and reduce the damage of desertification in the Kubuqi Desert, Inner Mongolian Autonomous Region of the People's Republic of China.

2. Objectives

1) Combating desertification in the Kubuqi Desert through the "Korea-China Friendship Forest" programme should be considered as one of the important activities by Future Forest against climate change and prevent Dust and Sandstorm (DSS). In fact, it is one of the most crucial activities that can prevent the further damage of the DSS which usually blows over to Korea on the westerlies.

2) At the 15th Asia-Pacific Economic Cooperation (APEC) summit held in Sydney in 2007, it was agreed to try to expand forest area within the region to 20,000,000 ha by 2020 via the "Sydney Declaration". Hence, Future Forest was determined to participate in such global trends and has tried to secure the expansion of the forest area at the national level.

3. Details

1) Future Forest has signed an MOU with the All-China Youth Association and the local government of Dalateqi District in Inner Mongolia with a goal of combating the DSS and Desertification. With the support of KFS, Future Forest has completed the project with the details below:
   - Project title: Establishment of Green Great Wall in the Northwest Region of China for Combating the Dust and Sandstorm (DSS) and Desertification (referred to as "the project" hereafter)
   - Financial support: KFS
   - Implementing agency: Future Forest
   - Executed by: All-China Youth Association, the local government of Dalateqi District
   - Period: 2006-2010
   - Details: Plantation for rehabilitation of the Kubiqi Desert

4. What has been done

Future Forest's plantation activities in China have been undertaken in areas such as Beijing Inner Mongolia, Xi An, and Lanzhou creating the "Korea-China Friendship Forest" from 2002 until 2005.

As part of CSO activities, Future Forest completed the "Korea-China Green Growth Collaborative Project" during the period of 2006-2010 in the Kubuqi Desert, Inner Mongolia. The project was funded by governmental organizations (KFS, Korea Green Promotion Agency, KOICA), local government (Gyeonggi-

do), and private corporations (Korea air, SK). 1,207 ha of desert area were rehabilitated by local species, which has drought resistance. The specific tree species are as below.

5. Species of Trees and Methods Used for Plantation

1) Species of trees for plantation

It is important to consider the geographical conditions when choosing the suitable species of trees to plant. Equally, adaptability of the species in infertile and dry lands and clear ecological efficiency need to be taken into account. The local species listed below are the suggested ones.

- *Populus simonii*
- *Populus alba* var. *pyramidlis*
- *Salix gordejevaii.*
- *Hedysarum mongolicum*
- *Pinus sylvestris* var. *mongolica*
- *Agtragalus adsurgens*
- *Caragana Korshinskii*

Populus simonii

Caragana Korshinski

Salix gordejevaii.

Hedysarum mongolicum

Pinus sylvestris var. mongolica

Astragalus adsurgens

2) Planting pattern and density

The distance between any two adjacent trees and rows varies depending on the geographical condition (gradient) and the degree of mixed species. However, here are the general rules.

a. Populus
- The distance between any two adjacent trees: 1.2 - 1.5m
- The distance between any two adjacent rows: 2.0 - 4.5m

b. Salix gordejevaii
- The distance between any two adjacent trees: 0.5 - 1.0m
- The distance between any two adjacent rows: 2.0 - 8.0m

c. Hedysarum mongolicum
- Generally 0.5 - 8.0m

In a moving sand-dune area, the distance between any two adjacent trees is generally similar regardless of the species of trees being planted. However, the distance between the rows varies depending on the gradient and the location of sand dunes.

Populus is mainly planted in inclined planes with an easy access to irrigation facility near the main work road. Salix gordejevaii is planted in an area where watering vehicle cannot be easily accessed. Also, it is generally planted mixed with Populus.

6. Who has been involved

1) Chinese partner

- All-China Youth Association - planning international cooperation projects, signing MOUs, managing and monitoring the project
- All-China Youth Association International Cooperation Project Centre - planning international cooperation projects, strategic planning, establishing and managing the local NGO branch,

managing external relations, dealing with communication, organizing relevant public events, reviewing and providing relevant documents

2) Chinese implementing agency

- Dalateqi Public Centre of Biodiversity - a local Dalateqi NGO. Main duties include, plantation, desert fixation, protecting planted trees against wind, local site monitoring, documents drafting, and public relations.

3) The local government of Dalateqi District

- It is the third party involved in the local project trying to promote the desert management project as one of the main government's activities. Their assistance included but was not limited to, securing the land use rights for plantation, management of the local farmers and relationships with other relevant local agencies, education of stock-farmers, local awareness raising, support of manpower via volunteers and interns

4) Local Experts

- Local forestry technicians and experts were involved. The general plantation project planning is carried out with advices given by forestry technicians. They provide instructions on saplings, planting, nurturing, monitoring after planting, fire-preventing and controlling diseases by harmful insects. Also, experts from Dalateqi Public Centre of Biodiversity provide technical guidance.

5) Labour Force

- Stock-farmers have been being affected by desertification and desert storms have good hands-on knowledge and participate in carrying out the project.

7. Summary - Value of Outcomes

Future Forest has successfully contributed to mitigating the expansion of the Kubuqi Desert and the DSS blowing over to ROK. "Great Green Wall" project resulted in a windbreak forest in Inner Mongolia (stretches 16km from south to north and 0.5km from east to west). The project has also been meaningful through promotion of new joint solutions to issues ranging from planting of shelterbelts, education, and poverty alleviation to adaptation to climate change. A key has been to strive for conformity of nature and the active involvement of local stock-farmers. Activities such as afforestation, development of agricultural areas, establishment of sustainable communities, development of renewable energy, education and cultural activities, research on deserts and green lands are all part of efforts of Future Forest's ultimate attempt to contribute to sustainable development.

Figure 1. Planted trees (Populus)

Figure 2. Volunteers' planting activities

Figure 3. Project site in 2007 and 2009 (before and after plantation)

C. PRIVATE SECTOR MODEL - YUHAN KIMBERLY

1. Background

As was documented in the Elion Case study (Chapter 4) the private sector can play an important role in restoring degraded lands, re-vegetation efforts and in raising awareness among a country's citizens and leadership. In this section we summarize the history and achievements of the "Keep Korea Green" movement and its various spin-offs. The story shows that ordinary people, and even the national government, can respond when there is a clear vision and a respected business tycoon to champion the ideas.

Multi-sectoral reforestation and greening initiatives have been conducted in north Korea, Mongolia, China and other Asian countries as part of the expanded list of initiatives of the movement.

2. The Origin and Development of the Movement

One Korean businessman named K.H. Moon launched the "Keep Korea Green" movement in 1984 as the first green movement in Korea initiated by the business sector.

K.H. Moon continued to lead and expand the green initiatives for 24 consecutive years until he retired as President and CEO of YuHan-Kimberly in September 2007 to serve public roles. The "Keep Korea Green" campaign is now carried by his successors as a legacy and as a corporate social responsibility of the company.

During the 24 years of K.H. Moon's leadership, over 84 million seedlings were produced and replanted in South Korea, North Korea, Mongolia, China and other Asian countries. Since 2008, additional 6 million seedlings could be produced and replanted by YuHan-Kimberly.

Table 1. Citizen's participation

m^2	Mil. Won	Trees	Bench
33	1.5	1	-
330	15	10	1
3,300	150	100	10
33,000	1,500	1,000	100

other benefit & responsbility

1. Special invitation for tree planting program

2. Green Ownership for 10 years

3. Support for maintenance

3. Other CSO Activities

K.H. Moon also launched many new green initiatives first time in Korea, including Green Camp for Youth (1988), Forest For Life National Movement (1998), School Forest (1999), Forest For Peace (1999), North East Asia Forest Forum (1999), Forest of Friendship (2000), The National Trust of Korea (2000), Seoul Green Trust (2003), UNEP Eco-Peace Leadership Center (2006), and many others. The "Keep Korea Green" campaign was conceived and developed during the period 1983 to 1989, the launch took a year from concept stage to internal approval and on August 14, 2004, there was governmental approval on the first green initiative led by private sector, but on condition that all the replantation expenses would not be tax-deductible!

Initially, K.H. Moon's "Keep Korea Green" campaign was not appreciated well both internally and

externally. Most people, in the beginning, were very skeptical. For them, it did not make any sense that a large consumer product company would embark on a green initiative.

On top of that, they thought it was not smart for a joint-venture company to do a public campaign without any tax exemptions. The 44% points additional tax was imposed on reforestation campaigns and it continued for 10 years till 2003. It was a real ordeal to KH Moon, since there were ceaseless pressures internally to stop the "Keep Korea Green" campaign.

However, the visible, miraculous differences made on the reforestation sites began to draw people's attention and recognition. As a result in 2003, the New President of ROK ordered the Ministry of Finance to exempt taxes on "Keep Korea Green" initiatives effective January 1, 2004.

It was a victory of the 10 years volunteering! A victory of corporate social responsibility and corporate citizenship movements in Korea!! The first 10 years' lonesome efforts could be more than compensated by the public recognition and tax exemptions. But, that was not the end.

To fight against the massive social unrest, K.H. Moon proposed Forest For Life National Movement, which benchmarked on Civil Conservation Corps in 1930's in the USA. The new National Movement, FFL, was instantly echoed by all sectors and could be launched for nature conservation and for job creation in March 1998 with blessings of New Administration. It was a huge success. More than 100,000 jobless people could be invited into man-made forests for thinning, opening and trimming.

They could revitalize not only forests but also themselves and their families, earning new skills as foresters and gardeners and making monthly income of US$ 700 per person for 6 months. With their efforts, more than 300,000 hectares of overly closed forestlands could be thinned, opened and revitalized. Recognizing the environmental and economic successes of the The Forest For Life National Movement, the campaign was renewed for additional 5 years from 2003 till 2007 as governmental official project

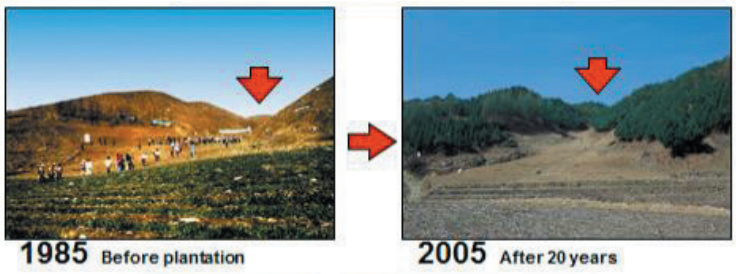
Creating 100,000 jobs

The great success of these multi-sectoral reforestation and greening initiatives were expanded into Forest For Peace (1999) for reforestation of North Korea, North East Asia Forest Forum (1999) and Forest Of Friends (2000) for reforestation of Mongolia, China and other Asian countries.

Domestically, The Forest For Life and Keep Korea Green movements together supported the launches of many new green initiatives including The National Trust of Korea (2000), CEO Environmental Sustainability Forum (2001), Seoul Green Trust (2003), Urban Environmental Design Center (2004), etc.

The over 84 million seedlings, which were planted during 1984 to 2007 now have grown into beautiful 27 years-old and younger healthy forests throughout Korean peninsula and North Asia, keeping Korea and North Asia Green!!

Newly-Weds
Greening the Country




-Planting trees by newly-wed couple- -Seedling delivery-

School Forest Movement

The Project supports 300 schools every year.

Further reading

1. Anti-desertification efforts by Korea-based Future Forest published online and in the print edition of The Korea Herald
   http://www.koreaherald.co.kr/NEWKHSITE/data/html_dir/2009/08/26/200908260035.asp

2. Future Forest www.futureforest.org/english/activities/2008_gc.php

3. The Keep Korea Green campaign allowed Korean people to participate in forest-cultivating activities through a variety of programs. Yuhan-Kimberly has also worked in other North Asin countries.
   www.koreaherald.com/business/Detail.jsp?newsMLId=20100414000506

4. Through the Keep Korea Green campaign, Yuhan-Kimberly employees volunteer their time for community and environmental programs.. CSR Program Directory.
   www.csrpedia.com/programs/keep-korea-green

18. Sri Lanka: National Priorities for Rehabilitating Degraded Lands and Controlling Land Degradation

- C. Stanley Weeraratna

[BACKGROUND]

Figure 1. Location of Sri Lanka

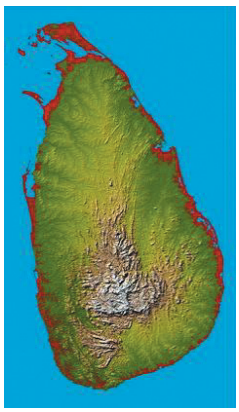


Figure 2. Topography of Sri Lanka

Sri Lanka is an island situated in the Indian Ocean, close to the equator lying between latitudes 6˚ and 10˚N and longitudes 79˚ and 82˚. Sri Lanka (See Figure 1.) has a total land area of 6. 5 million ha and a population of about 20 million of which nearly 80 percent is rural-based. Approximately 30 percent of the country is cultivated under annual crops such as rice and other cereals, vegetables and perennial crops such as tea, rubber, coconut. About 30 percent of the land is under forest or wildlife conservation areas and the remaining 40 percent is under pasture, patina grass and urban uses etc.

1. Topography of Sri Lanka

Extensive faulting and erosion over time have produced a wide range of topographic features. (See Figure 2.) Three zones are distinguishable by elevation: (1) the Central Highlands indicated in the center of the country, (2) the Low country indicated by the greenish color area in the map and (3) the coastal belt indicated by red colour area in the map.

The south-central part of Sri Lanka-the rugged Central Highlands-is the heart of the country with an elevation above 300m. The core of this area is a high plateau, running north-south for approximately 65 kilometers. This area includes Sri Lanka's highest mountains. (Pidurutalagala is the highest at 2,524 m) There are about 150 mountain peaks ranging from 1000-2000 m and 12 peaks ranging from 2000-2500 m. Several rivers originate from this area and flow to the sea. The land descends from the Central Highlands to a series of escarpments and ledges at 400 to 500 meters above sea level before sloping down toward the coastal plains.

Most of the island's surface consists of plains between 30 and 200 meters above sea level. In the southwest, ridges and valleys rise gradually to merge with the Central Highlands, giving a dissected appearance to the plain. Extensive erosion in this area has worn down the ridges and deposited rich soil for agriculture downstream. In the southeast, a red, lateritic soil covers relatively level ground that is studded with bare, monolithic hills. The transition from the plain to the Central Highlands is abrupt in the southeast, and the mountains appear to rise up like a wall. In the east and the north, the plain is flat, dissected by long, narrow ridges of granite running from the Central Highlands.

The climate of Sri Lanka is influenced to a considerable extent by its location. Presence of the sea around the country makes it free from temperature extremes, and influence humidity to a great extent. The highland mountains in the south central part of the land that rises to around 2,000 m standing across the passage of monsoonal winds which determines to a considerable extent the intensity and the pattern of rainfall.

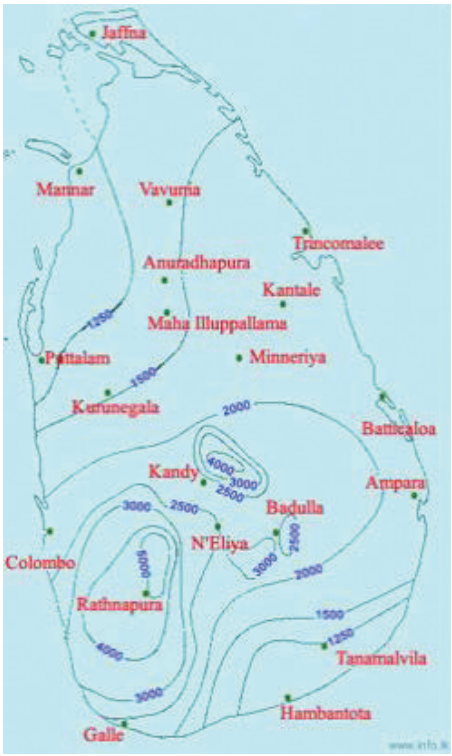


Figure 3. Rainfall in Sri Lanka

Sri Lanka being a tropical island, the mean temperature is 27.5˚C. Relatively higher temperatures (30 - 35˚C) are experienced in Northern, North-Central, and North -western, North - eastern and Eastern Districts, during March - June. The range of the mean monthly temperature differences through out the year in many parts of the country is 5 - 10˚C.

Sri Lanka receives rainfall mainly through monsoonal and convectional rain. The annual average rainfall varies from about 500 mm in the arid parts of the northwest and south-east of the island to around 5000 mm in some areas of the south-western slopes of the central hills. (See Figure 3.)

The wet zone comprises the south - west part of the country covering around 23% of the total land extent and receives an annual rainfall of 2500 - 5000 mm. The intermediate zone covers about 13% of the country and receives an annual rainfall of 2000 -2500 mm and the remaining portion of the country, covering nearly 64% of the land is categorized into the dry zone, which receives an annual rainfall of 1250-1500 mm.

2. Land Use

A wide variety of crops are cultivated in Sri Lanka. These belong to two main groups. One group is plantations crops, and crops such as tea, rubber and coconut belong to this group. The other group of crops is the domestic crops or food crops to which belong cereals such as rice, legumes, spice crops, etc. The extents under these crops are indicated in the Table 1 given below.

Table 1. Pattern of Land Utilization in Sri Lanka - 2007 (in hectares)

Plantation Crops	Extent in Ha	Food Crops	Extent in Ha
Tea	220,000	Paddy	737,000
Rubber	118,000	Other cereals	40,000
Coconut	395,000	Legumes	26,000
Minor Export Crops	85,000	Subsidiary Food Crops	25,000
Cashew	36,000	Oil Crops	20,000
Sugarcane	15,000	Yams	10,000
Total	871,000	Total	858,000

Most of the plantation crops are cultivated in the wet and intermediate zone. Food crops are cultivated in the wet, intermediate and dry zone (Weeraratna and Weerasingha, 2009)

3. Land Degradation

Land Degradation indicates degradation of the land due to soil erosion, soil compaction, nutrition depletion, development of salinity or acidity, loss of bio-diversity, etc. All these factors cause productivity of land to decline, making crop production less profitable. Also, it causes silting of rivers, tanks and reservoirs resulting in a decrease in the carrying capacities of these water bodies. Leaching of nutrients in to tanks and other bodies cause eutrophication. This process causes water to be polluted and death of aquatic organisms.

In Sri Lanka, major contributors to land degradation are soil erosion and soil fertility degradation. Over exploitation of ground water, salinization, water logging and water pollution are also becoming important contributors to land degradation. According to the Global Assessment of Soil Degradation (GLASOD), about 50 percent of land in Sri Lanka is degraded. The area affected by soil fertility decline is 61 percent of the total agricultural land. It has been estimated that nearly one third of the land in Sri Lanka is subjected to soil erosion, the erodible proportion ranging from less than 10.0% in some districts to over 50.0% in others. Severe erosion takes place in the hill country on sloping lands under market gardens (vegetables and potatoes) tobacco, poorly managed seedling tea and chena cultivation. Soil erosion is also considered a threat to agricultural production in the rainfed farming areas in the Dry Zone. The extent of soil erosion under different land use is indicated in Table 2.

Table 2. Estimates of erosion under different land uses

Land Use	Soil loss (tons/ ha/year)
Well-managed seedling tea	20.0
Poorly-managed seedling tea	75.0
Vegetatively-propagated (VP) tea	15.0
Rubber	10.0
Paddy	5.0
Mixed garden	75.0
Chena	75.0
Tea smallholding	20.0
Coconut smallholding	100.0
Market gardens	0.3
Dense forest	10.0
Scrubland	10.0
Patana	5.0
Towns	10.0
Unproductive land	15.0

Stocking, M.A. (1992). Soil erosion in the Upper Mahaweli Catchment, Sri Lanka. Environment and Forestry Division, Mahaweli Authority of Sri Lanka.

4. Land degradation in the Central Highlands

Land degradation is evident in many parts of the country. In the central highlands i.e lands above 300 m, severe land degradation has been reported. In the central highlands, tea is one of the main crops cultivated. There are four agro-ecological zones (upcountry wet zone, mid- country wet zone, up-country intermediate zone and mid-country intermediate zone), and 25 agro-ecological regions in the central highlands The main soil group orders in this area are Ultisols and Inceptisols (Dassanayaka and Hettiarcahci, 1999 (and the average annual rainfall varies from around 2000 - 5000 mm (Manchanayaka and Madduma Bandara,1999). The terrain in the central highlands is mainly hilly/mountainous and to some extent, rolling. The slopes of the hilly terrains are 15-30% while that of the mountainous terrains are around 30%. The rolling terrains have a slope of 8-15%. The cultivation of crops in these terrains is conducive for soil erosion. Apart from slope of the terrain, heavy rainfall of high intensity, some of which are erosive storms which are reported in some parts of the Central Highlands, promote land degradation. It has caused many adverse effects such as depleting soil productivity, lowering crop yields, sedimentation of major hydro power generation reservoirs, loss of bio diversity and making lands more susceptible for climatic changes etc.

Total extent of tea areas in Sri Lanka is reported to be about 212,716 ha of which about 44% is managed by smallholders. In the Central Highlands, around 115,000 ha of tea lands are managed by commercial tea estates under Regional Plantation Companies, and 45,000 ha by tea smallholders. As indicated above, the terrain in which tea is cultivated in the central highlands is mainly hilly, mountainous and to some extent, rolling and the cultivation of crops in these terrains is conducive for soil erosions. Soil erosion is a serious environmental problem in the central highlands due to the long and steep slops with poor crop and land management practices (Manchanayaka and Madduma Bandara, 1999)

The land degradation in tea cultivations occurs due to physical, chemical and biological processes. Soil erosion is the most commonly occurring process of physical land degradation while acidification due to heavy rainfall and use of chemical fertilizers cause chemical degradation (Wijeratna, 2010). Loss of biodiversity and soil organic matter due to clearing of forests for planting of tea and inadequate ground cover (by tea, shade trees and other covercrops) are the major causes of biological degradation.

According to a number of studies, the loss of top soil due to water erosion in the tea lands in the central highlands could be around 40 t/ha/yr, causing the soil depth to decrease by 30-50 cm (De Alwis and Dimantha 1981). This has been responsible for reduction of land productivity of tea by around 30-50%. As a result, a large extent of tea lands has been abandoned. About 43,000 ha of old seedling tea lands in the central highlands are reported to have been affected by serious soil degradation by mid 1980s. Land slides tend to occur frequently in such degraded lands. The central highland is the watershed feeding major rivers in the country. Depletion of soil in such watersheds will have extremely undesirable effects on water supply for Agriculture, domestic use and power generation.

Soil degradation in tea lands can be reduced by a considerable amount with proper soil conservation measures and good cover of tea. However, practices which are recommended to control land degradation are not effectively implemented due to a number of barriers related to socio- economic and governance.

Figure 4. Eroded Land in the uplands

Land degradation is also of common occurrence in areas of the central highlands where non-plantation crops such as potato, and vegetables such as cabbage, carrot, leeks etc. are cultivated. In 2005, about 2,500 ha of lands were cultivated to produce 76,900 t of potato and around 100,000 t of vegetables. Due to the high economic returns especially from potato and vegetables, farmers tend to cultivate steep sloped lands, which are not recommended for annual crops such as potato. Severe soil loss, around 15t/ha, has been reported in land cultivated with vegetable and/or potato. (Samarakoon, 2004. Further, farmers involved in potato and vegetable cultivation use heavy doses of agrochemicals; Insecticides, Fungicides, Herbicides and non organic fertilizers as soil and foliar application which may be harmful for the soil micro flora and fauna.

Land degradation is also common in the mid-country districts where crops such as tea, rubber, and vegetables are cultivated.

5. Land degradation in the low-country

In the low country wet zone districts (elevation 0-300m above sea-level) the topography of the lands is less hilly compared to those in the up and mid country and hence soil degradation takes place to a relatively less degree. However, heavy rainfall and cultivation of lands exceeding 60% slope, non-adoption of soil conservation measures are reported to cause soil degradation even in the low country wet zone. The major soil degradation effects noted in this part of the country, in addition to soil erosion are development of salinity and/or acidity.

In the low country dry zone too, land degradation takes place to different degrees depending on cropping systems practiced. Soils in some parts of the dry zone have become acidic due to land degradation.

It is widely accepted that land degradation is one of the most critical problems affecting the future economic development in Sri Lanka. The demands of a rapidly expanding population has set up pressures on the island's natural resources and these in turn have resulted in a high level of environmental degradation. The more important manifestations are heavy soil losses; high sediment yields; soil fertility decline and reduction in crop yields; marginalization of agricultural land; salinization; landslides and deforestation and forest degradation.

6. High Sediment Yields

A part of the soil that is removed is transported by rivers and streams leading to sedimentation of reservoirs, downstream floods etc., commonly referred to as the off-site effects of soil erosion. Some recent studies undertaken within the Upper Mahaweli catchment have shown high rates of sediment yield in some rivers. Sedimentation is also taking place in small village tanks in the Dry Zone.

7. Soil Fertility Decline and Reduction in Crop Yields

It is commonly believed that the depletion of soil fertility has led to a loss of productivity of agricultural lands in the country. The decline in yields of major food crops as well as plantation crops over the past several decades has been attributed to the loss of valuable top soil due to erosion. It is widely accepted that agriculture on sloping lands in many areas is generally maintained by the artificial replacement of nutrients removed by erosion.

8. Salinization and Water Logging

Records of the actual extent of land affected by salinity nor data that indicate recent trends are available, but sporadic studies seem to indicate the development of salt affected soils in low land areas in the Dry Zone. Salinization of low- lying farm lands in coastal areas due to salt water intrusion is also a problem. Although water-logging is not considered a serious problem nevertheless some lands in the coastal districts of the Wet Zone have been withdrawn from agriculture due to excess water.

9. Marginalization of Agricultural Land

A sizeable extent of agricultural land in different parts of the country has become marginal or uneconomic. It has been estimated that there are now 1.2 millions hectares of land mostly in the Dry Zone which are unproductive and put to only limited use. It has also been estimated that at least 30.0% tea lands in the country can be considered as marginal or uneconomic. A substantial portion of the remaining unutilized state lands is also considered to be marginal in nature.

10. Landslides

A reconnaissance survey carried out in landslide prone areas has indicated that approximately 12,500 square miles are vulnerable to landslides. The available evidence seems to indicate that the country has been experiencing a spate of landslides over extensive areas in the central and south-western parts of the country, since the early eighties.

11. Deforestation and Forest Degradation

The natural forest cover in the country which stood at 80.0% until the turn of the century had dwindled to less than 24.0% by 1992. The deforestation has taken place both legally and illegally. Legally forests have been cleared for agriculture and settlement schemes and other development projects. They have been cleared illegally for shifting cultivation and for agriculture and settlement by encroachers. The quality of the forests in the country has also been declined due mainly to shifting cultivation, illicit felling of trees and encroachments.

[ACTIVITIES AND PROGRAMMES]

1. Policy Initiatives

The government's concern towards environmental issues in general and particularly on land degradation has led to various policy initiatives, strategies, and legislation being developed to deal with issues pertaining to land management. On the whole there is a large number of policies, strategies and laws to provide the basis for implementing the policy initiatives on land management.

In 2002, a National Action Program for Combating Land Degradation was prepared for implementation; a National Watershed Management Policy was formulated for central highlands in 2004, and the entire central highlands was declared as conservation area in 2008 under the Soil Conservation Act No. 24 of 1951 later amended in 1996. Identification and protection of highly environmentally sensitive areas, integrated management of upper watersheds and rehabilitation of degraded agricultural lands are

identified as main strategic actions to be taken according to " Mahinda Chintanaya" the programme of the present government. The above policy level decisions collectively show national priorities for rehabilitating degraded lands and controlling land degradation in the country.

2. Measures to combat land degradation

In view of the government' s concern towards land degradation and other related environmental issues, various policy initiatives, strategies, and legislation have being developed to deal with issues pertaining to land management. The need to reverse the current attitudes towards resource exploitation prompted the Government to include two important clauses in the second Republican Constitution adopted in 1978.

a) "The state shall protect, preserve and improve the environment to the benefit of the community."
b) "The exercise and employment of rights and freedoms is separable from the performance of duties and obligations and accordingly it is the duty of every person in Sri Lanka to protect nature and conserve its riches."

These objectives were not rigidly followed and as a result environmentally damaging practices particularly within the agricultural and forestry sectors continue. The need to take remedial action was recognized by the government that came in to power in 1994, and the President in her Policy Statement made on the occasion of the opening of the new Parliament in 1995 outlined a program of action for the agricultural sector which included two major reform initiatives intended to encourage conservation farming and to promote the sustainable management of natural resources. A declaration was made that:

a) "Farmers will be encouraged to adopt a co-ordinated approach to land use on small farms, based on micro catchments and integrate all activities in the farm in to a single development work plan" and " the adoption of appropriate land and water management will be promoted as an integral part of the crop-stock production process."
b) "Environmental guidelines will be developed an enforced through a combination of regulations and market incentives to ensure that land, water, forestry and fisheries resources are utilized in a sustainable manner."

3. National policies and plans implemented to control land degradation

During the last two decades a number of policies and plans related to control of land degradation were brought out. Among these are the following.

1) National Environmental Action Plan (1992)

The National Conservation Strategy was subsequently develop into an action oriented plan by the Central Environmental Authority in close collaboration with relevant ministries, government agencies and non-governmental agencies. In the mean time, the World Bank had expressed its interest in providing environment assistance to the country and initiated the preparation of an Environmental Action Plan (EAP). This document was completed in 1990 and included the more important recommendations of the draft NCS plan.

Based on a policy decision, the core contents of the Action Plan, the EAP and the Sri Lanka National

Report submitted to the UN Conference on Environment and Development in 1992, were combined to produce a comprehensive National Environmental Action Plan (1992-1996), The National Environmental Action Plan was updated in 1991. A third National Environmental Action Plan (NEAP) has been prepared for the period 1998 to 2001, with sets out the agenda for the 21st century.

2) National Forestry Policy - 1995

The forestry sector has been facing a number of problems. These include, the continuing decrease in the forest cover; the expanding conflicts between forestry and agriculture; the ineffectiveness of the efforts at protecting forests; the inefficient management of state owned forests; the inability of the forests to meet the further demands for wood; and inequities in the distribution of benefits from forest resources. The forestry policy was formulated to address these issues.

3) National policy framework - Ministry of Agriculture Lands and Forests - 1995

The National Policy Framework was prepared to realize policy objectives spelt out in the election manifesto of the People's Alliance prior to the General Election held in 1994.
The document synthesized some of the fundamental principles and perspectives for a National Policy Framework in the three sectors of Agriculture, Lands and Forestry, which were brought within a single Ministry after 1994. The framework declared that a national land policy for Sri Lanka has been long overdue and that haphazard allocation of allocation of state lands without proper and systematic land use planning has caused enormous damage to the land base of the country and consequently to the environment.

It went on to add that "Given the fragile nature of this scarce natural resource which is vital for the continuing sustenance of life in all its forms it is essential that we manage it with care and efficiency, so that its benefits would accrue not only to our generation but also to generations yet to come on whose behalf we hold it in trust"

4) National land use policy (draft) - 1996

The specific objectives of the land use policy is to, to promote land suitability evaluation and allocation of land rationally among competing uses; to ensure that the utilization of land is based on the capability of land and the needs of both the community and the national economy; to enhance the productivity of the land resources to the optimum levels; to ensure food and food security in the long run; to promote land uses that will minimize environmental damage; to reduce vulnerability to natural and man-made disasters; to ensure orderly economic growth and balanced regional development; to reduce dependence on land as a means of providing employment opportunities; to promote a rational distribution of population and settlements and; to harmonize or integrate diverse and complex objectives for management and development of land by different agencies.

5) National Water Resources Policy - 2000

The National Water Resources Policy is a statement of the government's intentions regarding the management of the country's inland water. The policy adopts and "indicated" approach which recognizes natural linkages. Emphasis is placed on water resource management within river basins and aquifers,

including both upstream and downstream water uses, government and other stakeholders.

6) Technologies for Controlling Land Degradation

A number of technologies/strategies are implemented to control land degradation. These can be broadly categorized as Mechanical, Biological and Agronomic measures (National Action Plan, 2002).

7) Mechanical Measures

Mechanic al measures act as barriers to over land flow of water and reduce the velocity of the flow to a non-erosive level. This allows much of the water to infiltrate into the soil. Mechanical measures such as contour platforms, level bench terraces, stone terraces, contour drains and contour bunds have been successfully practiced in tea, and rubber plantations.

On hilly slopes where an abundant supply of water is available from springs and streams people have leveled land into narrow strips along the contour referred to as contour terraces. The width o f the terrace depends on the steepness of the slope and the depth o f the soil. Such leveled terraces have been utilized to grow irrigated rice in hilly areas.

Where stone is found in abundance, erection of narrow strips of stonewalls across the slope has served as a good soil conservation measure. The stone walls generally have a width of 50 cm and a height of about 45 cm above the ground on the upper side of the wall. The wall is constructed on a foundation, which is at least 15 cm deep. The distance between two stonewalls is dependent on the slope of the land. On the average they are constructed at a spacing of about 5-10 meters.

Lock and spill drains are commonly used in tea estates. These drains are so named because there is a block of earth retained every 4-5 meters within the drain to retain water in the drain. Water starts to flow from one section to another only when that section is full. These drains are constructed slightly off the contour with a mild gradient. The drain is about 50 cm wide and 60 cm deep. The blocks are about 45 cm long and few cm lower than the depth of the drain. The major advantage of a lock and spill drain is its capacity to allow more water to seep into the soil. These drains are more popular on gently sloping land with deep soils. Stone bunds and log barriers have been traditionally used by people to protect highland crop areas from soil erosion.

8) Water Harvesting

The village tank system in the dry zone of Sri Lanka is an effective system of water harvesting and soil conservation. Village tanks are in a series of small reservoirs built by making embankments across rivulets, which are either perennial or non-perennial streams. This is commonly referred to as the minor tank cascade system. Due to the geographical location, the system has the capacity to catch spill water from upstream reservoirs in addition to the run-off collected from its watershed area.

9) Biological Measures

Biological measures include systems such as avenue cropping (alley cropping), and Sloping Agricultural Land Technology (SALT). These measures have been adopted to mitigate soil erosion and to improve soil

fertility. Selection of appropriate methods is based on the crop, soil, agro-ecological conditions and economic viability.

Sloping Agricultural Land Technology (SALT) was introduced to Sri Lanka in the late eighties. Hedgerows of tree species (usually legumes) are established on the contour in place of stone walls or lock and spill drains. Hedgerows are established as single rows or as closely spaced double rows. The tree species used are Gliricedia, Calliandra, Desmodium, Flamingia,, etc. Legumes are usually preferred as they have the capacity to enrich soil by fixation of atmospheric nitrogen and to produce more organic matter .The system needs regular maintenance for it to be successful. Cost is lesser than mechanical soil conservation measures.

10) Agronomic Measures

Agronomic practices provide effective conservation of soil nutrients and moisture when adopted in conjunction with other mechanical and biological soil conservation measures. Most of the agronomic measures are practiced as normal cultivation practices.

Mulching is a practice where either live or dead plant material is applied as a soil cover in between rows of crops. The mulch protects the soil surface from raindrop splash and retard the velocity of surface run-off. It also reduces the evaporation from the soil surface and conserves moisture. Later the plant material decomposes and adds organic matter and other soil nutrients to the soil.

In strip/inter cropping alternate strips of crops are established on the contour. Tall and short crops are established in alternate strips. As the tall crops with lesser canopy have the tendency to expose soil for high erosion the short canopy crops have the capacity to protect the soil from splash erosion. Much of the soil that is eroded from the high canopy crop strip is retained in the short canopy crop strip.

Contour planting is widely adopted in many crops, which are planted with spacing in between rows. Planting of annual crops on the contour has become more popular with the introduction of agricultural machinery for land preparation and other agricultural operations.

11) The Vetiver System

The Vetiver System (VS) is dependent on the use of a very unique tropical plant, Vetiver grass - Vetiveria zizanioiodes. The plant can be grown over a very wide range of climatic and soil conditions, and if planted correctly can be used virtually anywhere under tropical, semi-tropical, and Mediterranean climates (Phithag Inthapan and Sawatdee Boonchee, 2003). It has characteristics that in totality are unique to a single species. When vetiver grass is grown in the form of a narrow self-sustaining hedgerow it exhibits special characteristics that are essential to the many different applications that comprise the Vetiver System.

The species of V. zizanioides, that is promoted in nearly 100 countries for VS applications originates in south India, is sterile, non invasive and has to be propagated by clump subdivision. Generally nursery multiplication of bare rooted plants is the preferred method. The average multiplication rate varies but is normally about 1:30.

Figure 5. Vetiver planted on the contour

After about three months nursery clumps are divided into planting slips of about 3 tillers each. These are then planted 15 cm apart on the contour to create, when mature, a barrier of stiff grass that acts as a buffer and spreader of down slope water flow, and a filter to sediment. (See figure 5)

A good hedge will reduce rainfall run off by as much as 70% and sediment by as much as 90%. A hedgerow will stay where it is planted and the sediment that is spread out behind the hedgerow gradually accumulates to form a long lasting terrace with vetiver protection. It is a very low cost, labor intensive technology (linked to the cost of labor) with very high benefit: cost ratios. When used for civil works protection its cost is about 1/20 of traditional engineered systems and designs.
Vetiver grass can be used directly as a farm income product, or it can be used as an application that will protect river basins and watersheds against environmental damage particularly point source environmental problems relating to: (1) sediment flows (2) excess nutrients, heavy metals and pesticides in leachates from toxic sources. The two major uses are closely linked.

12) Cultivation of tree species in river and stream banks

Several species of trees such as Arecanut (Areca catechu), Kitul (Caryota urens), Bamboo (Bambusa vulgaris), Kumbuk (Terminalia arjuna) are grown along the stream banks to conserve the stream banks. These trees produced timber and firewood required by the villagers. Systematic harvesting of these tree species also provide sustainable protection to the land and yield some useful products. These tree species are also used as hedges to protect steep slopes from soil erosion.

13) Mixed varieties of trees in home gardens

In some home gardens a variety of trees of different heights (canopy layers) are allowed to grow under natural competition for sunlight. Due to natural competition for light the trees form a canopy structure that maximizes the utilization of sunlight and land and minimizes soil erosion. Tall trees such as Jak (Artocarpus integrifolia), Kitul (Caryota urens) form the upper canopy. Nutmeg, pepper, coffee, banana form the middle canopy and the shrubs, and root crops form the lower canopy.

References

1. Dassanayaka, A.R and Hettiarcahci, L.S.K (1999). Soils of the upcountry wet zone in Soils of the Wet Zone of Sri Lanka. pp 12-138. Soil Science Society of Sri Lanka.

2. Fourth National Report for Implementing the UNCCD, 2010.

3. Krishnarajah ,P. (1985). Soil erosion control measures for tea land in Sri Lanka. Sri Lanka J Tea Science 54: 91-100.

4. Manchanayaka, P and Madduma Bandara, C.M. (1999) Water Resources of Sri Lanka. Natural Resource Series No4, National Science Foundation.

5. National Action Programme for Combating Land Degradation in Sri Lanka (2002) Natural Resources Management Division, Ministry of Envitnment & Natural Resources, Sri Lanka.

6. Panabokke, C.R. (1966). Soils and Agro-ecological environments of Sri lanka. Natural Resource Series No 2. Natural Resources, Energy and Science Authority of Sri Lanka.

7. Phithag Inthapan and Sawatdee Boonchee, (2003). Research on Vetiver Grass for Soil and Water Conservation in the Upper North of Thailand. Office of Land Development Region 6, Land Development Department Chiang Mai, Thailand.

8. Stocking, M.A. (1992). Soil erosion in the Upper Mahaweli Catchment, Sri Lanka. Environment and Forestry Division, Mahaweli Authority of Sri Lanka.

9. Weeraratna,C.S. and Weerasingha. P.A. (2009) Agriculture of Sri Lanka .pp. 84.

10. Wijeratna, M.A. (2010) Present status of Land Degradation in the up and mid-country and Control Measures. Proc. of the First National Symposium on Land Degradation. June 2010.

19. Thailand: Appropriate Technology to Combat Desertification

- Worapong Waramit

[BACKGROUND]

The Kingdom of Thailand is the 50th largest countries in the world; most nearly equal in size to Spain. Located just 15 degrees north of the equator, Thailand has a tropical climate and temperatures typically range from 19 to 38 degrees C (66-100 F). Thailand's largest peak, Doi Inthanon, is 2,565 meters (8,415 ft) tall. Thailand covers 510,890 sq km of land and 2,230 sq km of water. The coastline of Thailand is 3,219 km long. Thailand's longest shared border is with Myanmar, about 1,800 km.

The weather in Thailand is generally hot and humid: typical of its location within the tropics. Generally speaking, Thailand can be divided into three seasons: "hot", rainy, and "cool" seasons, though Thailand's geography allows visitors to find suitable weather somewhere in the country throughout the year.

1. Causes of desertification

The major causes of desertification found in Thailand are: (a) climatic factors i.e. heavy rain during the monsoon period dissolves and translocates soil minerals and seasonal drought; (b) human activities i.e. land use without soil improvement, over-exploitation of land, land use on steep-slope lands causing soil erosion and expansion of saline soils.

Thailand is moderately forested, although its forest cover has roughly halved since 1960. At present, Thailand has slightly less than 30 percent of forest cover. Most of the forests are restricted to relatively inaccessible mountainous areas

Table 1. Changes in forest areas and agricultural land, 1961-1998

National Economic and Social Development Plans	Area (ha/person)	Population (million)	Forest area		Agricultural area	
			million ha	%	million ha	%
First (1961-1966)	2.42	27.18	27.20	53.3	10.32	20.1
Second (1967-1971)	1.58	32.45	24.75	48.2	13.26	25.8
Third (1972-1976)	1.36	37.62	22.59	44.0	16.72	32.6
Fourth (1977-1981)	1.18	43.44	18.67	36.4	18.21	35.5
Fifth (1982-1986)	1.06	48.49	15.68	30.5	19.78	38.5
Sixth (1987-1991)	0.96	53.42	14.61	28.4	20.99	40.1
Seventh (1992-1996)	0.89	57.37	13.50	26.3	21.14	41.2
Eighth (1997-2001)	0.84	61.20	12.96	25.3	21.20	41.3

Source: Office of Agricultural Economics (2000)

[ACTIVITIES AND PROGRAMMES]

Thailand is conducting many PROGRAMMES and activities that are in line with the objectives of the Convention. They include land use planning in several watershed areas, conservation of land and water PROGRAMMES, the establishment of land development villages, etc.

Table 2. Summary of past and on-going

Name of projects	Project implemented within the framework of the NAP.	Project implemented within the framework of	Time-frame	Partners involved	Overall budget (million USD)
1. Soil improvement by aqua organic compost and products of microorganism.	Yes	NAP	2004-2008	No	74.023
2. Soil improvement by green manure.	Yes	NAP	2004-2008	No	
3. Transfer of technology to farmers.	Yes	NAP	2004-2008	No	48.725
4. Saline soils improvement.	Yes	NAP	2004-2008	No	9.995
5. Provision of soil and water conservation system on low land and upland.	Yes	NAP	2004-2008	No	52.204
6. Organization of demonstration plots for learning centers.	Yes	NAP	2004-2008	No	3.2
7. Tree plantation to protect soil salinization in Khong, Chee, and Moon basins.	Yes	NAP	2004-2008	No	4.257
8. Small scale water resources management.	Yes	NAP	2004-2008	No	72.356
9. Development of areas under water-use management system.	Yes	NAP	2004-2008	No	90.378
10. Improvement of natural water resources as sources of production base for communities	Yes	NAP	2004-2008	No	9.937

Source: Office of the Kingdom of Thailand to implement the United Nations Convention To combat Desertification (UNCCD), National Report 2006.

1. Volunteer Soil Doctors Participatory Approach in Land Management

Volunteer Soil Doctors, stereotype of personnel of Land Development Department (LDD) who technically assist farmers to manage their land, were firstly known to public in 1992. The initiative is one of strategic approaches that the LDD uses for the public to easily understand its tasks and responsibilities.

Basically, Volunteer Soil Doctors cooperate in assisting farmers to obtain better understanding and

practice soil conservation and sustainable land resources management. Therefore, Volunteer Soil Doctors will be fully supported with tools, maps, and manuals developed by which the LDD to help them perform their tasks effectively. Moreover, they will receive privilege to carrying out demonstration farms in close cooperation with the LDD HQs offices and local branches and technical stations at provincial level. The following basic missions under commitment include:

- They are entitled to carry out public relation activities in making announcements; delivering messages to farmers; inviting farmers to participate in observation, study tour, workshop and others.
- Being service centers for information and technology transfer especially through demonstration farms.
- Volunteer Soil Doctors will be able to give basic recommendation and answer to possible questions they may receive from farmers.
- They are also entrusted to distribute to farmers some specific agricultural materials such as lime, fertilizer, seeds, and etc.
- They are assigned to help farmers know the type and cropping suitability of the lands they own in order to assist farmers practice sustainable agriculture effectively.
- They are also assigned to help farmers prepare their farm plans and management especially soil improvement and conservation.
- They will be messengers who receive feedback, needs, problems and queries from farmers to the LDD for consideration.
- In case when LDD starts new project they will be asked to gather most required information for the project.
- Occasionally, they will be invited to join in group of instructor for interested agencies.

As mentioned above that Volunteer Soil Doctors are representatives of the LDD as well as collaborators at different levels. Collaboration has been made systematically through an established network as can be seen in chart below.

2. Recent Activities

1) Royal Yellow-Blue Project

To commemorate Their Majesties' respective birthday anniversaries, His Majesty's on 5 December and Her Majesty's on 12 August, all agencies under the Ministry of Natural Resources and Environment jointly organized the Royal Yellow-Blue Project in Honor of Their Majesties. Launched in August 2010, the project is a demonstration of the people's loyalty towards Their Majesties. The project will be completed in December in 2010.

At Khao Yai National Park, students and the general public led by the Ministry of Natural Resources and Environment planted 3,000 timber Agarwood, as further observance of Her Majesty's 78th birthday anniversary on 12 August 2010.

2) Research and Development on Water Reuses Technology in Tropical Regions

The Environmental Research and Training Center (ERTC) under the Department of Environmental

Quality Promotion (DEQP), Ministry of Natural Resources and Environmental (MNRE), has launched a joint research R&D project on water reuse technology in tropical regions in collaboration with four universities in Japan, as follows: University of Tokyo, Tohoku University, Waseda University and Ritsumeikan University, with support from the Japan Science and Technology (JST). The project will cover the period 2008-2013. Thai counterparts in the project include researchers from ERTC, Chulalongkorn University and Kasetsart University. The project objective is to develop appropriate water reuse technology for wide application and to establish a R&D center for water reuse technology in tropical regions.The research project is focused on appropriate water reuse technology using advance membrane techniques, constructed wetland, and decentralized water circulation system. Risk assessment will be conducted as part of a waterborne pathogen study. An information platform on water quality will be designed to set safety guidelines concerning water usage levels in Thailand. As shown in the schematic diagram, the project will have four outputs. Water reuse technologies developed in Outputs 2 and 3 are evaluated in Output 4, based on considerations of human health and the potential recycling of treated wastewater. Output 1 aims to develop the capacity building of Thai research specialists in water reuse technologies, based on a collaboration resulting from Output 2 to 4. These integrated outputs are expected to contribute to effective management of water resources in tropical regions not only in Thailand but also in other countries in tropical regions.

3) Organic Horticulture for Environmental Protection

Since 2005, the ERTC's SEER Sub-division has been conducting research on organic horticulture, in order to reduce the use of chemical substances in agriculture and to reuse agricultural waste based on an appropriate formula to produce organic fertilizer. In 2007, tests of organic fertilizer efficiency involving seven types of kitchen vegetables (red basil, spring onion, cockroach berry, water convolvulus, sweet basil, red lettuce, and chili) were carried out in accordance with the on-farm treatment (OFT) theory at Amphur Wangnamkeaw, Nakorn Ratchasima Province, and at the ERTC experiment plot in Pathumthani Province. The results indicated that plants tested in the experiment plot using ERTC's organic fertilizer formula were stronger, grew better, and yielded more harvests compared with plants in beds with no fertilizer. Dissemination of the results to farmers and consumers is being done on a continuing basis. In 2009, tests in the demonstration plot were done to compare the result of planting kitchen vegetable using organic and chemical fertilizers, involving three types of vegetables (eggplant, cockroach berry, and chili) at Tumbon Jedriw, Amphur Banpaew in Samut Sakorn Province. The results showed that plants grown in the organic demonstration plot were stronger and bigger in size and had thicker leaf sizes and stronger trunks. Although, the total harvest from the organic demonstration plot was less than that from the chemical demonstration plot, prices for the organic vegetables were 20 to 50 per cent higher than prices for plants grown on chemical fertilizers and chemical herbicides. Moreover, organic horticulture provides better heath and more income to the farmers. As well, it ensures environmental and natural balance, returns nutrients to the soil, and encourages sustainable use of cultivated areas. Promoting organic horticulture is an easy way to protect the environment, biodiversity, and natural resources for the next generation.

[SUMMARY]

Since 1989, Thailand has had a ban on all logging in natural forests, and has implemented a series of supporting measures to protect the remaining forests and to promote private sector involvement in forest management and plantations. Thailand presently has more than a half-million hectares of

plantation forests. Table 5 shows the extent of primary forests has not been drastically reduced since the 1990s (Table 3, 4).

Table 3. Change in forest area in Thailand, 1990-2005

Country/area	Forest area			Annual change rate 1990-			
	1990	2000	2005	1990-2000		2000-2005	
	0 000 ha	0 000 ha	0 000 ha	0 000		0 000	
				ha/year	%	ha/year	%
Thailand	15 965	14 814	14 520	-115	-0.7	-59	-0.4

Data source: FAO, FRA 2005.
Note: 1990's figure on the extent of forest for Guam is FAO's estimate based on information provided for 2000.

Table 4. Change in extent of primary forests, 1990-2005

Country/area	Area of primary forest			% of total forest area			Annual change rate	
	1990	2000	2005	1990	2000	2005	1990-2000	2000-2005
	0 000 ha	0 000 ha	0 000 ha	%	%	%	ha/year	ha/year
Thailand	6 451	6 451	6 451	40.4	43.5	44.4	0	0

Data source: FAO, FRA 2005.

Table 5. Change in extent of forest plantations, 1990-2005

Country/area	Area of forest plantations			% of total forest area			Annual change rate	
	1990	2000	2005	1990	2000	2005	1990-2000	2000-2005
	0 000 ha	0 000 ha	0 000 ha	%	%	%	ha/year	ha/year
Thailand	2 640	3 077	3 099	16.5	20.8	21.3	43 700	4 400

The Thailand National Action PROGRAMMES (NAP) had a proper balance using, preservation natural resources effect. Also, gave to the management of livable environmentally healthy cities and the preservation of local culture and arts.

Further reading

1. ASIA-PACIFIC FORESTRY COMMISSION, The Future of Forests in Asia and the Pacific: Outlook for 2020.

2. DEQP (Department of Environmental Quality Promotion) Newsletter, 2010, Department of

Environmental Quality Promotion, Ministry of Natural Resources and Environment, Volume 2 July-September 2010, Thailand.

3. First National report on the UNCCD Implementation, April 2002, Land Development Department, Ministry of Agriculture And Cooperatives, Bangkok, Thailand.

4. National Action Programme for Combating Desertification in the Kingdom of Thailand. March 2004 Land Development Ministry of Agriculture and Cooperatives.

5. PACIFIC FORESTRY COMMISSION, What does it take? The role of incentives in forest plantation development in Asia and the Pacific, 2004, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS REGIONAL OFFICE FOR ASIA AND THE PACIFIC (Thomas Enters and Patrick B. Durst) Bangkok, 2004.

6. Proceedings of the Workshop on Forests for Poverty Reduction, August 2003, Opportunities with Clean Development Mechanism, Environmental Services and Biodiversity 27-29 August 2003, Seoul, Korea (Editors H.C. Sim, S. Appanah and Y.C. Youn).

7. THAILAND, COUNTRY PROFILE, IMPLEMENTATION OF AGENDA 21, 1992, Review of Progress Made Since The United Nations Conference On Environment And Development.

8. Third National Report on the UNCCD Implementation. May 2006, Land Development Department, Ministry of Agriculture And Cooperatives, Bangkok, Thailand.

9. Volunteer Soil Doctors Participatory Approach in Land Management by Focal Point Office for UNCCD, Documents from Land Development Department, Ministry of Agriculture and Cooperatives, Bangkok, Thailand.

20. Uzbekistan: Sustainable Land Management in Practice

- Gulchekhra Khasankhanova and Raisa Taryanikova

[BACKGROUND]

Republic of Uzbekistan is a double land-locked country, centrally situated in the heart of Central Asia (CA) within the Aral Sea Basin. Almost 80% of land areas of the country are comprised of deserts and semi-deserts, including the Kyzylkum, the largest desert of CA. As a whole, the territory of the country, located in the arid zone of Asia, is highly susceptible to land degradation, desertification, and climate change. It is estimated that more than 52% of the arable lands and 73% of grasslands are presently undergoing degradation (4). The level of low income population in the country has decreased from 27.5 % (2001) to 25.8 % by 2005, but in rural areas it remains still high. About 64 % from 27 million population lives in rural area, and they directly or indirectly depend on irrigated agriculture. The situation is aggravated by the fact that local farmers have limited experience and knowledge of advanced soil and water conservation technologies for promoting the best practices of sustainable Land management (SLM).

There is a broad agreement [IFPRI (ADB, 2009)] that Uzbekistan is among those countries most vulnerable to climate change due to a high sensitivity of its arid arable lands, high density of population and growing food insecurity (15). Average rates of warming since 1950 along the territory of the Republic have been increased by 0.29˚C per decade, which is more than twice the world average.

The government of Uzbekistan is deeply concerned by the increasing social, economic and environmental consequences of land degradation and climate change risks. Recent disasters caused for instance by recurrent droughts, have reinforced the government's political will to cope with these problems comprehensively (18)(15).

Suggested approaches and best practices of SLM were collected and compiled by the Central Asian Countries Initiative for Land Management (CACILM) and National Secretariat in Uzbekistan - Dr. Gulchekhra Khasankhanova and Dr. Raisa Taryannikova, in collaboration with the national team and scientists, and leading national professionals outside CACILM in the field of SLM and monitoring and assessment of land degradation and desertification (Table 1). They are important common efforts in support of the regional partnership and collaboration through learning, dissemination and replication of best practices in collaborative SLM.

[ACTIVITIES AND PROGRAMMES]

In response to the above-mentioned challenges, the Government of Uzbekistan through its responsible institutions has involved actively itself into the CACILM. The CACILM Multi-country Partnership Framework (CMPF) is one of six GEF country pilot partnerships (CPPs) on sustainable land management at different stages of implementation.

CACILM is a multi-country and multi-donor, long-term (2006-2016) program in the spirit of UNCCD

aimed at restoring, maintaining and enhancing productive functions of land in the five countries of the CA, while preserving its ecological functions. Its ultimate goal is to increase economic and social well-being of the population who depend on the land resources. In each participating country, National Programming Framework (NPF) on Sustainable Land Management (SLM) forms its strategic basis. CACILM is implementing the programmes at national and multi-country levels, through the Support Project of CACILM Multicountry Partnership Framework (CMPF-SP). In Table 1, the different projects, its programmes and main objectives are summarized that have been conducted in the past decade, or that are still ongoing.

1. Recent Activities

The overall goal of the National Focal Point to the UNCCD (NPF) of Uzbekistan is to combat land degradation through the strengthening and mainstreaming of sustainable land management approaches among all land management stakeholders. Attaining this goal will result in stabilized/ improved ecological integrity and better living standards of rural population affected by DLDD.
The goals and projects of the NPF group on the seven priority program areas identified are: (a) Capacity building for creating an enabling environment and for the integration of SLM into policy and planning; (b) Adaptation of agriculture to climate change; (c) Sustainable management of forests and renewable energy; (d) Sustainable management of pastures and carbon sequestration; (e) Applied research; (f) Integrated resource management; and (g) Restoration of vulnerable ecosystem in the Aral Crisis Region. These issues and challenges have impacts which are not limited to the national borders, but which affect ecosystems of neighboring countries and are of global importance.

The experiences gained and lessons learned in the framework of the CACILM, and other projects related to land degradation and sustainable land and water management over the last ten years with support from the international community have helped increasing the possibility for successful transition of principles and practices of sustainable land management in Uzbekistan.

[SUBSTANTIAL EXAMPLES]

A. Case Study 1 - Integrated management for sustainable use of salt-affected and gypsiferous soils in the Syrdarya and Kashkadarya regions

1. Background

This study was implemented in the framework of the FAO Technical Cooperation Programme Project "Integrated Management for Sustainable Use of Salt-Affected and Gypsiferous Soils" in Uzbekistan from 2002 until 2005 (Khasankhanova G, Khamzina T, Khamzin S and Abdullaev U). This project was directly aimed to introduce and demonstrate appropriate integrated low-cost, low-risk management and cultivation techniques in support of food security in the country (FAO/TCP/UZB/2901, 2002).

Pilot areas in Uzbekistan were selected in Syrdarya and Kashkadarya regions where the impacts of salt-affected and degraded soils are very pronounced. The project was supported by the regional and local administrations. Farm leaders and farmers interested in this project were involved in its implementation.

Table 1. Summary of regional initiatives aiming at developing best SLM practices

#	Name of Project/ Program	Implementation Timeframe	Main Goal
1	CACILM Multi-country Partnership Framework Support Project under GEF3 CPFA, Republic of Uzbekistan	2009-2013	The Components of CMPF-SP under GEF3: (i) SLM - Research (ICARDA); (ii) SLM - Information System (GEF / ADB); (iii) SLM - Knowledge Management (GEF/ADB); (iv) SLM- Capacity Building (GEF/GM/UNDP/GIZ)
2	Achieving Ecosystem Stability on the Degraded Lands of Karakalpakstan and Kyzylkum Desert, Uzbekistan (GEF/UNDP/ CACILM)	2008-2013	To achieve ecosystem stability by testing and demonstration of the SLM approaches and practices in partnership with local communities at a pilot scale in Kyzyl Rovat and Kazakhdarya
3	Land Improvement Project in Bukhara, Navoiy and Kashkadarya regions (GEF/ADB/ CACILM)	2009-2012	The objective of the GEF project is to test and demonstrate technical, institutional and organizational approaches and SLM practices and improvement of marginal resources (drainage water) use in the large economic, cultural and ecological areas of Uzbekistan, located along the Great Silk Road.
4	Economic and Ecologic Restructuring of Land and Water Use in the Khorezm Region; workpackage on developing alternative strategies for highly salinized, degraded croplands. (BMBF/UNESCO/ZEF Bonn)	2002-2012	To develop and adapt the regional concept of development at the example of the Khorezm region. In this paper included is the concept of setting aside degraded croplands for ecological restoration via afforestation.
5	Conservation of Tugai Forests and Strengthening Protected Areas' System in the Amudarya Delta of Karakalpakstan (GEF/UNDP)	2008-2012	To conserve the globally significant biodiversity in the Southern Aral Sea in Karakalpakstan through applying new management approaches and involving local communities and leaders in conservation and sustainable use of natural resources.
6	NeWater research project: <<New Approaches to Adaptive Water Management under Uncertainties>>. The integrated project in the 6th EU Framework Programme	2005-2009	To develop new approaches for IWRM, considering integrated approach of river basins and uncertainty in social and economic and climatic changes.
7	GEF Small Grants Programme (GEF/UNDP)	2007-2012	To support activities of NGOs and local community organizations directed at climate change mitigation and adaptation, land degradation and other.
8	Enhancement of Living Standards in Fergana Valley in support of the Welfare Improvement Strategy in Uzbekistan (UNDP)	2008-2010	To increase capacity for local development planning and improve access to basic services and income generation in support of the Millennium Development Goals.
9	Stabilization of Aral Sea Dried Seabed in Central Asia (GIZ/UNDP)	2009-2010	To support the measures taken by the Republics of Uzbekistan and Kazakhstan on limiting the destructive effect of wind erosion via afforestation.
10	Capacity Building for Clean Development Mechanism (UNDP)	2005-2008	To enhance the capacity to effectively utilize the Clean Development Mechanism
11	Integrated management for sustainable use of salt-affected and gypsiferous soils and Component of Farmers' Field Schools (FAO/TCP/UZB)	2002-2005	To test and demonstrate integrated low-cost and low-risk techniques to rehabilitate the salt-affected and gypsiferous soils and transfer SLM practices through Farmer Field Schools in the Syrdarya and Kashkadarya regions.

2. The objective and methods

The immediate objectives of the project were to: (a) strengthen the national capacity building; (b) introduce, test and demonstrate sound integrated low-cost, low-risk soil, water and crop management techniques to the farmers; (c) impact assessment of demonstrations on soil quality and crop production; (d) transfer demonstrated integrated management techniques and improve knowledge, skills and know-how of farmers through Farmer Field School (FFS) approach; (e) analysis of the socio-economic cluster of the FFS among involved farmers of pilot areas.

The programme for monitoring the changes in quality of soil, water and crop yield was completed for four cropping seasons in the pilot farms to compare and evaluate the effects of the demonstrated soil management and rehabilitation programmes.

Training and extension programmes, including round table discussions and seminars were conducted throughout the project duration. Local communities and farmers involved in FFS were questioned and results will be released in the near future (7)(8).

3. Results and Achievements

In the selected salt-affected heavy soils and waterlogged salt-affected soils of the pilot farms, there were two main components: Best Management Practices (BMP) versus current farmer practices and a quantitative economic and technical assessment of individual management practices (treatments). The BMP sub-plot in each pilot farm included: shallow drainage + leaching (crop water requirements + 20% leaching with more irrigation frequency (i.e. 6 irrigation instead of 4 irrigations during crop growing period) + organic matter (10 tons/ha) + deep ploughing (50-60 cm) + land leveling + furrow irrigation with raised beds + mineral fertilizers (N150 P100 K30). The current practice sub-plot (farmer practices) was implemented after consultations with local staff and farmers. In the gypsiferous pilot farm, the farm was divided into two main plots, one with a shallow gypsum layer depth at 0.2 to 0.5 m and one with a deeper gypsum layer depth at 0.5 to 1.0 m. Each major plot was divided into eight sub-plots. The crop rotation in all three sites was: wheat, green gram (seed used and other part was mixed in the soil), barley and cotton.

Demonstration of the FAO approach to integrated management of problem soils indicated possibilities to improve soil properties and soil health, water use efficiency and increase crop yields. As a result of introducing BMP in the demonstration sites during two years, four crops (wheat/green gram/barley/cotton) have been grown which increased crop production and in turn farmers' benefits.

Rehabilitation and strengthening of on-farm drainage provided both favourable water and salt balances of the soils and subsoil, ensured a salt free root zone and kept the water table below the threshold that enhances salinization. These measures consequently led to a reduction in ECe of 6-7 dS/m in BMP and OM practices. Impact of irrigation treatments on the demonstration farms led to a decrease of water use per one ha of 14-22 percent and of water use per one ton of yield to 41- 62 percent. BMP treatment gave the highest t net revenues and the financial analysis confirmed the high level of potential benefits. The value of NPV at the discount rate 14% was 5,723 US$ with a IRR of 31%.

In order to strengthen agriculture extension and enhance knowledge management of smallholder

farmers' capacity, in the pilot-areas training of FFS groups consisting of 20-22 farmers (of total 191 farmers) was implemented by twelve Core Trainers/Facilitators. The results of a socio-evaluation study showed that about 45 percent of the farmers have no formal agricultural education; from them, 25 percent had no experience in agriculture. Those who had a formal higher education had the least risks to be non-profitable. About 26.3 percent of FFS alumni evaluated their participation as very important for their activities; 52.1 percent - as important, 19.4 percent - necessary, and the rest was unsatisfied by their participation in FFS. Discussions and interviews in focus groups confirmed the need in extension of FFS approach and had identified priority farmer strategies and proposals for overcoming existing problems.

This result proves farmers' perception of FFS as a necessary factor for increasing their benefits, improvement of water and land resources use, and accordingly quality of life and promotion of human development. FFS provided good chance to learn how smallholder participants may improve their capacity and water use efficiency without attracting much money, but based on knowledge and farmers community.

The compilation of the BM practice with FFS approaches, developed in the framework of this study is an emergency need and important for agricultural development. It is closely related not only to develop agricultural policy and relevant institutions, but also the strengthening of farmer's skills and experiences and feedback to the stakeholders required.

Figure 1. Overview of the demonstration sites showing: (a) increasing of soils organisms, which are 'ecosystem engineers'; (b) increasing of wheat yields; (c) transferring of appropriate practices to farmers in the pilot area.

B. Case Study 2 - Participatory Steppe/Pasture Management in Uzbekistan: Improved Grazing of Desert Steppe

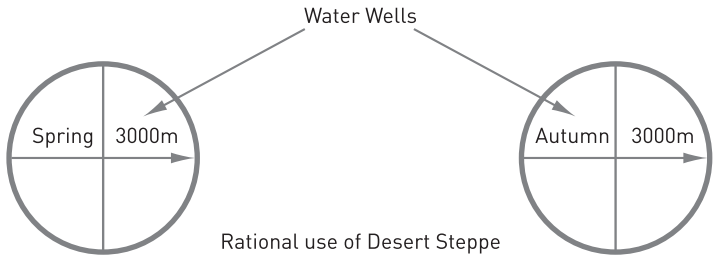
1. Background

Land degradation in desert and semi-desert areas has two ultimate effects - ecosystem instability and poverty. In fact, these two effects are inextricably linked and each can cause the other. Steppe/pasture degradation leads to the loss of its fodder capacity. In the Kyzylkum Desert in Uzbekistan, the vegetation varieties have been reduced, especially the rare species grazed by animals, and more than one million ha of steppe/pasture is affected by the phenomenon of moving sand. Around settlements, vegetation cover is seriously damaged. These implications are also visible in other parts of Uzbekistan.

The technology of rotational grazing has been applied in the framework of the GEF/UNDP project

"Achieving ecosystem stability on degraded land in Karakalpakstan and the Kyzylkum Desert" under the CACILM project. [Bekmirzaeva I, Usupov S et.al]. The selected demonstration site was identified within a Karakul Sheep Breeding Shirkat (cooperative farm) around Kyzyl Rovat Community of Romitan District in Bukhara Region. The project area is located in the Kyzylkum Desert on the right bank of the Amudarya River. The altitude is 190 meters above sea level. The climate is extremely continental with an average annual precipitation of 127 mm, varying from 42 mm to 197 mm from year to year. The absolute minimum temperature is -21°C and the maximum temperature is +47°C

2. The objective and methods



The objective of the project is to test, evaluate and confirm innovative solutions for sustainable land management at a pilot scale and replicate best practices to achieve ecosystem stability on degraded land in Karakalpakstan and the Kyzylkum Desert in Uzbekistan.

The pilot project is focused on the development of innovative approaches and methods of rotational grazing to improve steppe/pasture productivity and efficient growth of livestock production. New scheme of steppe rotation worked out for grazing cattle of community and sheep farms. The Commission of Steppe Use was established under local community authorities. This commission coordinates and monitors process of steppe/pasture using. Project team held a range of trainings for community members and disseminated learning materials contributing in practice of rational steppe/pasture use and evaluation approaches of vegetation covering to assess steppe/pasture capacity. The community selects shepherds and manages their activity through involving more families in this steppe/pasture use system.

3. Results

Based on a participatory survey approach and field inventory, the current state of land degradation, the seasonal variation of steppe/pasture productivity, and the technical capacity of water wells and other infrastructure has been defined. A new scheme of balanced rotational grazing for different groups of land users has been introduced that increases steppe/pasture productivity more than two times. Steppe/pasture areas around wells where sheep herds of the Shirkat are grassed have been split in 2 sectors.

The first is used in spring and the second in summer. In the autumn, the sheep herd moves to the second water well where the 2 sectors are used accordingly in autumn and winter. The launching of group grazing system has contributed to increasing productivity of local animals, and has reduced the grazing

distance twice and the degree of grass consumption increased three times. The productivity of animals using steppe/pasture within the rotation grazing system in average is 15-25 % higher than that of the sheep grazed unsystematically.

In order to promote participatory management of steppe/pasture, steppe/pasture use commissions have been created at community level. The status, responsibility and functions of these commissions have been prepared and discussed with target groups of stakeholders. It has allowed development and implementation of local plan of effective and nature friendly steppe/pasture management in partnership with local communities.

4. Impacts on productivity and ecosystem services

A best practice on sustainable steppe/pasture use is demonstrated at the local level and a realistic opportunity for improving and protecting steppe/steppe/pasture productivity is provided. However, the lack of knowledge and experience at the local level constrains promoting the wider dissemination of project achievements and advantages.

5. Dissemination

More than 160 local community members and livestock specialists have participated in seminars and trainings performed within the project area. Two sets of recommendations on consumption and storage of steppe/pasture fodder have been prepared. Experience materials have been disseminated among the local population through the information center of project and submitted to district government for acquaintance. The practical materials of project achievements have been presented to the participants of the Academy of State and Social Formation under the President of Uzbekistan.

6. Recommendation for decision makers

The systematization of steppe/pasture use has to be developed in accordance with specific conditions of the respective target area and accomplished with the appropriate rehabilitation of steppe/pasture infrastructure (wells, pumping equipment etc.).

In order to promote the wider dissemination of experience and knowledge, it is recommended to create extension service centers at local and provincial levels to support sustainable steppe/pasture management and livestock keeping.

C. Case Study 3 - Awareness building through steppe/pasture monitoring in Farish District

1. Background

Farish District in Uzbekistan is situated some 300 kilometers southwest of the capital Tashkent. Most of its area is covered by a semi-desert plain in the north, which is used as steppe/pasture land, and the Nuratau mountain range in the south. Especially in the mountain villages, population density is relatively high compared to other arid and non-irrigated areas in Uzbekistan. For many households, livestock grazing is the main income source apart from the small gardens. The numbers of private livestock have dramatically increased during the last twenty years, leading to severe overgrazing and degradation of steppe/pastures around the villages.

In the framework of the regional program "Sustainable Use of Natural Resources in Central Asia", which is financed by the German Ministry for Economic Cooperation and Development and implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, an orientation phase for the project "Sustainable community-based pasture management" was started in Farish District in September 2010 [Mukimov T, Beshko N, Ganiev S, Wiedemann C and Fischer-Zujkov U]. The main aim of this one-year orientation phase is to gather information about the situation in the district and to raise awareness about steppe/pasture degradation problems among the local population in order to prepare possibly a follow-up project.

2. The objective and methods

The steppe/pasture monitoring was developed as a first step for wakening the interest of local communities in steppe/pasture management. Small steppe/pasture plots (3 x 4 meters) were fenced by individual households in selected villages on the project territory in February / March 2011. After they were given the necessary construction materials (metal tubes and barbed wire), the partner households built the fences on their own sources.

Originally, these plots were intended to serve for scientific vegetation monitoring and for the dissemination of seeds. However, it was necessary to convince the local population of the benefits of the fenced plot and make them committed to maintaining and protecting it, otherwise the fence would soon be destroyed. Therefore the partner household, local authorities and other villagers living nearby were systematically involved into the monitoring process:

1) A seminar was conducted by the project team nearby the fenced plots to discuss reasons for steppe/pasture degradation and to explain the benefits of the fenced plot (protection against grazing, better growth of vegetation and protection of biodiversity, dissemination of seeds). In the end of the seminar, a monitoring group was elected, which usually consisted of a member of the partner household and the most active participants of the seminar.

2) Monitoring diaries were prepared with the names of the members of the monitoring group and a photo of the seminar on the front page in order to make them proud of their work and increase their commitment. Simplified criteria were identified which should be checked during each monitoring visit both on the fenced plot and on an unfenced reference plot of the same size:
   • Number of plants of the two or three main species

- Average height of plants of the two or three main species
- Vegetative cover

3) A seminar was conducted by a botanist and a steppe/pasture expert for the members of the monitoring group to explain the criteria, to practice the individual steps and to fill in the monitoring diary together.
   - The monitoring groups are expected to do the monitoring regularly (twice a months during spring, once in two months during the other seasons), but support from the project team will be necessary for the first few monitoring sessions.

3. Results

During both seminars, local villagers showed remarkable interest in the vegetation inside the fenced plot and identified plants with high commitment. It is hoped that this not only makes them feel responsible for "their" plot, but also makes them to develop an interest in the condition of "their" steppe/pastures and understand the negative effect of overgrazing through the comparison between the fenced plot and the unfenced reference plot.

Several lessons have been learnt during this process:

- Fenced plots should be closer to the house of a partner household which is responsible for its protection and can control it easily;
- Symbolic incentives (well-designed monitoring diary, simple monitoring instruments, etc.) are important to give the monitoring group a sense of its own importance and to increase the commitment of its members;
- Monitoring by local villagers cannot be expected to meet scientific requirements. Criteria should be highly simplified, understandable even to non-experts and measurable even without special instruments. If scientific monitoring on the plots is necessary, it should be done additionally; and
- Monitoring activities can be an effective first step in drawing the villagers' attention to the condition of their steppe/pastures and to degradation problems, but it needs follow-up by the project (continuous support of monitoring activities, facilitation of the identification of solutions for the degradation problems).

However, it is still too early to assess any long-term impact and the sustainability of the monitoring groups and their monitoring activities.

4. Dissemination

In the framework of the project orientation phase in Farish Dsitrict, four steppe/pasture plots have been fenced in different villages (Khudzhur, Sayat, Osmonsoy, Omonboloq). In the general seminars, altogether some 50 villagers have been invited to join the discussion on steppe/pasture degradation problems. In the special seminars for the members of the monitoring groups, altogether some 15 persons have been trained in monitoring steppe/pasture vegetation.

Dissemination is not intended for the time being, as the activities in the framework of the project orientation phase will focus on those villages in which monitoring groups have already been established.

D. Case Study 4 - Afforestation of Degraded Croplands in the Lower Amudarya River

1. Background

Climate change is predicted to exacerbate water scarcity in Central Asia particularly in the rivers' downstream areas that already suffer from water stress and salinity-induced cropland degradation. As opposed to water-intensive reclamation leaching of highly salinized croplands, an adaptive option of converting degraded parcels to high-carbon stock systems of salt-tolerant plants have been reviewed for the viability to generate ecosystem services and incomes. Areas experiencing shallow groundwater table, commonly found within the degraded irrigated croplands, are viewed as promising for afforestation given the possibility to reduce the irrigation water demand of forest.

The viability of alternative uses of the degraded cropland such as conversion to multipurpose tree plantations have been assessed within framework of the projects "Economic and Ecological Restructuring of Land and Water Use in the Region Khorezm (Uzbekistan)" (www.khorezm.zef.de) and "Opportunities for Climate Change Mitigation via Afforestation of Degraded Croplands in Central Asia" (www.zef.de/1631.html), implemented by the Center for Development Research (ZEF) [Khamzina A., Lamers J.P.A. and Vlek P.L.G]. The field experiments were conducted in afforestation sites established on degraded agricultural land in the Khorezm Region of Uzbekistan and southern Karakalpakstan. This region is a part of the Amu Darya River lowlands within the transition zone of the Karakum Desert and the Kyzylkum Desert and belongs to the Central Asian semi-desert zone that is characterized by an extremely continental climate. Mean annual rainfall of 100 mm fell mostly outside the growing season and was greatly exceeded by the potential evapotranspiration of 900?1000 mm. According to the local soil fertility classification (bonitet), about 15?20% of the irrigated land in Khorezm is currently considered to have low suitability for cropping, mostly due to elevated groundwater table resulting in soil salinization. About 80% of land is allocated to cotton rotated with winter wheat.

2. The objectives and methods

The studies are aimed to explore the role of small-scale tree plantation and community forests for ecological restoration and rural livelihoods in response to environmental changes such as growing water scarcity and cropland degradation. Conversion of marginalized and abandoned croplands to tree plantations has been assessed as a strategy to increase the productive capacity of the land by improving soil fertility and provisioning useful agriculture produce, and to contribute to the global effort of climate change adaptation and land degradation mitigation via carbon sequestration in biomass and soil. The research program has encompassed agroforestry, eco-physiological, socio-economic and policy aspects to identify the environmental, economic, institutional and informational conditions under which the remedial afforestation projects can be realized in the context of Central Asia.

3. Results and impacts on productivity and ecosystem services

Promising candidate species for afforestation were assessed using multiple physiological and socio-economic criteria that singled out the currently underutilized Elaeagnus angustifolia L., Ulmus pumila L. and Populus euphratica Oliv. (Khamzina et al. 2006). The establishment and growth of these tree species were field-tested under deficit irrigation during 2003-2011. Irrigated with 80-160 mm yr^{-1}, the plantations successfully established on highly saline soils with the root-zone electrical conductivity (EC) over 20 dS

m^{-1}, underlain by shallow (0.9-2.0m) groundwater with an EC ranging between 1-5 dS m^{-1}. Following the cessation of irrigation after two years, the tree plantations effectively used the groundwater and produced 10-60 t ha^{-1} yr^{-1} of above-ground biomass (Khamzina et al. 2011). Thus, by drawing on relatively untapped groundwater resources, afforestation can contribute to water saving as "unused" irrigation water from afforested plots would become available for use on productive cropland.

The conversion of degraded cropland to tree plantations increased soil total N stocks in the upper 20 cm layer by 6-30% in five years. The increase in plant-available soil N was the highest in E. angustifolia plots that were effectively fixing N_2 at the rate of 0.02tha^{-1} yr^{-1}. Increases in the concentrations of plant-available P of up to 74% were significant irrespective of tree species, suggesting an efficient nutrient pump (Khamzina et al. 2011). Thinning the 5-year-old plantations by a half of their initial density (2,300 stems ha^{-1}), to make room for growing trees, generated a fuel wood energy value varying from 6 tons of oil energy equivalent (toe) per hectare (U. pumila) to 10 toe ha^{-1} (P. euphratica). This would satisfy the average annual per capita energy needs of 55-90 people in Uzbekistan and exceeds by 400% the energy value gained over the same period from cotton stalks, commonly used in rural households. Fodder quality of E. angustifolia and U. pumila, characterized by crude protein and metabolizable energy content in leaves, was comparable to alfalfa hay (Khamzina et al. 2011). These observations are further evidence that afforestation of the degraded cropland with mixed-species plantations would be a sustainable land-use option that can also generate a new source of fuel wood and fodder thus easing the pressure on natural forests and steppe/pastures.

Planting trees on the degraded lands also provides an opportunity to combine the efforts of combating desertification and rehabilitating land degradation and reducing CO_2 emissions. Five years after afforestation, the soil organic C (SOC) stocks rose by 10-35%, adding 2-7 t C ha^{-1} to the upper 0-20 cm soil layer, with E. angustifolia being the most effective tree species in soil Carbon sequestration. Depending on tree species, Carbon sequestration in woody biomass ranged from 11 to 23 t ha^{-1} already in the 5th year of afforestation (Khamzina et al. 2011). If such Carbon sequestration in the biotic and soil pools occurs in an afforestation project certified under the Clean Development Mechanism (CDM), the resulting Carbon payments could encourage afforestation in degraded areas.

The Net Present Value of afforestation, considering the production of fruits, fuel wood, leaf fodder and carbon sequestered after seven years ranged from 510 to 4,130 USD ha^{-1}, depending on the species potential (Djanibekov et al. submitted). This significantly exceeded the profits that farmers would achieve from annual cotton and winter wheat cropping on marginal land. Rice was most commercially attractive but required large irrigation amounts which cannot be secured in the long-run in the view of increasing irrigation water scarcity.

4. Dissemination and replication

The implementation of afforestation project has been tested during 3 years within "Follow-the-Innovation" initiative that aimed to integrate the research results within the local farming practices and to analyze the process of adapting the scientific recommendations to the local settings (Hornidge and Ul-Hassan 2010). Following field visits aimed to solicit farmers' interest and evaluate land suitability, two farms were selected as primary stakeholders for a participatory afforestation in Khorezm. The farmers were supplied with saplings and assumed responsibilities of establishing and maintaining tree plantations. The forest experts have paid regular visits to the afforestation sites, providing consultations

and jointly with farmers monitoring the plantation development.

5. Recommendations for decision makers

Overall evidence on ecosystem rehabilitation and financial viability of afforestation under low irrigation supply suggests that converting highly degraded cropland parcels within the irrigated lowlands to long-term forest use is an attractive option. However, the legislative aspects of abandoned degraded croplands for artificial biological plantation, and related land tenure issues need to be addressed. Afforestation can be further promoted by improving processing and marketing of tree products and services. Thus processing locally gathered non-timber products, e.g., turning traditional fuel wood into wood briquettes could add value, create jobs, and exploit new markets. Environmental services from afforestation, when translated in monetary terms, can significantly increase the value of degraded land used for plantation. In this context, the existing international carbon market can be explored for small-scale plantation participation in the CDM thus linking the local and global interests via participatory afforestation. Agricultural extension services and transfer of technical and ecological know-how may help increase the appreciation of the benefits of tree-based systems and motivate farmers to plant ecologically appropriate tree species.

E. Case Study 5 - Integrating the FAO LADA approach into monitoring and assessment of DLDD and SLM

1. Background

This project was implemented in the framework of the CMPF-SP of the CACILM aimed for fulfillment of UNCCD plans. It supports the adaptation of an integrated approach to land use planning and management, taking into consideration current international efforts towards a harmonization of land data and information management. In this context, CACILM has adopted the FAO LADA methodology to develop the Central Asian Sustainable Land Management Information System (SLM-IS) at three levels (global, national and local). The example of its successful practice in Uzbekistan is presented below [Khasankhanova G, Khamzina T, Ibragimov R, Yakovlev Y, Manuyk N. and Abdullaev U].

2. The objective and method

The main objective is an application of FAO LADA methodology for design and incorporation of a national SLM-Information system into global land use systems to enhance reliable monitoring and assessment of land degradation and sustainable land management in arid and semi-arid areas of Uzbekistan.

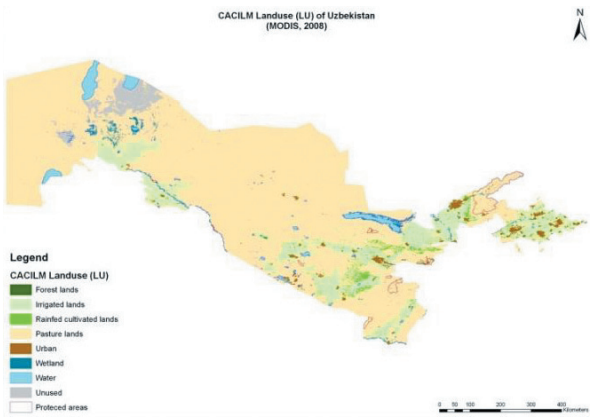
The guideline on <<Mapping of Land Use System at Global and National Scales for Land Degradation Assessment Analysis>> and global datasets (GLC-2000, AgroMaps, SRTM data) and satellite images was provided by FAO LADA [17, 19]. The hotspot evaluation has been complemented with remote sensing interpretation to provide an historical and seasonal change NDVI on example of CACILM demonstration sites at national and regional levels. Three main aspects was assessed during field monitoring of the hotspots analysis of the CACILM demonstration sites: (a) abiotic aspects, like soil type, soil salinity, geomorphology, geologic units, etc; (b) biotic aspects, like vegetation cover and vegetation type, degradation of vegetation by human impacts, etc. (c) management aspects like rangeland use, intensity of land cover (over- and under grazing), etc.

3. Results

Design and implementation of the SLM-IS in Uzbekistan was started in early 2008 by a development of baseline information on land degradation in the country and sub-regions, and development of key indicators for monitoring, assessment and rehabilitation techniques for SLM. Land use, land cover, socio-economic data, and recent spaced-based techniques data with other indicators have been used to establish baseline information for monitoring and assessment of changes in land and water resources and rural livelihoods.

The compilation of land degradation information has been supported by the adaptation of FAO LADA LUS approach. MODIS Vegetation Indices Dataset (MOD13Q1, 250m) of 2007-2008 and LANDSAT TM has been the primary data source for interpreting historical and seasonal change of NDVI and establishing the baseline information on land degradation, hot and bright spots analysis and impact on rural livelihoods in Uzbekistan.

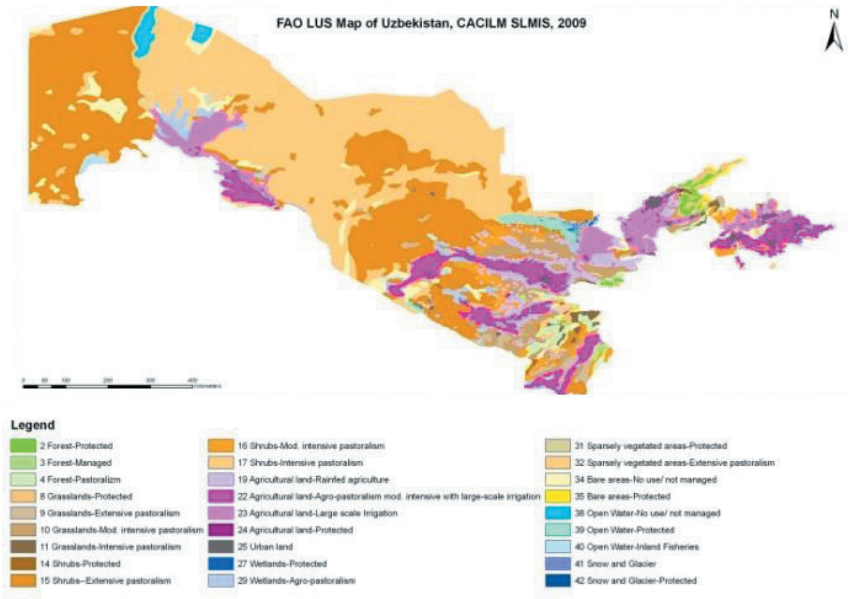
The baseline has been established in terms of key indicators. These are: (a) monthly Vegetation Indexes; (b) land degradation (soil salinity and waterlogging, soil erosion, loss of soil organic matter, soil compaction, overgrazing, deforestation and loss of biodiversity); (c) land cover change, and (d) socioeconomic indices (population density, rural income, poverty level, etc). Based on the LANDSAT TM and MODIS image classifications expert judgments on rehabilitation methods are specified. The physical situation within each identified land use unit on the satellite images is characterized for general crop condition, soil and water salinity, etc. The measures for rehabilitation of degraded lands in order its suitability for agricultural production was provided (1) (2).



The new UZB National Land Use System (LUS) map consists of 25 classes of land use, where each of them is subdivided into 3-4 classes depending on biophysical attributes of ecosystem, land use attributes and socioeconomic features: (a) biophysical attributes of the LUS - temperature regime class, length of growing period class, dominant soil units and landscapes (terrain information); (b) the land use attributes- dominant livestock types, livestock density, dominant crop types; (c) socioeconomic attributes of the LUS: population density and poverty.

The incorporation of the national SLM-IS into global land use systems have enhanced a reliable

monitoring and assessment and data sharing systems to avoid and predict land degradation and climate change risks, and adaptation policy measures and management tools for decision making and ensure resilience against rangeland degradation, droughts and other climatic challenges.



4. Impacts

Established SLM information system of Uzbekistan have (a) improved the current weaknesses of the national data base; (b) enhanced the countries' institutional capacity to assess and monitor land degradation and rehabilitation techniques and (c) promoted information and data sharing between the national and multicountry systems as well as between CACILM and LADA, and other global systems. It has allowed bringing together national group of Central Asian Countries' experts from different institutions for harmonization of the generated information to adopt integrated land use planning and land management tools at local and national levels for decision making in land and water management.

The adaptation of LADA methodology is an effective framework to improve the effectiveness of monitoring and assessment of DLDD and SLM, and to adapt policy and mitigation measures for land use planning and management at global, national and local levels.

5. Recommendations for Decision-making

The incorporation of national SLM-IS into global land use systems have enhanced reliable monitoring and assessment and data sharing systems to more effectively combat desertification and mitigate land degradation; better biophysical and socio-economic modeling and adaptation policy measures and management tools for decision making in support of SLM and ensured resilience against land degradation, droughts and other climatic challenges.

Experiences gained during design and implementation of the SLM-IS activities have clearly demonstrated the need for: (a) capacity building in new diagnostic and spaced-based management tools, monitoring and assessment approach to enhance incorporation of national and multicountry SLM information systems into global spatial scales; (b) improvement of knowledge and institutional capability; (c) scientific capacity on adaptation and mitigation of vulnerable arid ecosystems to climate change impact and (d) verification of theory in practice.

References

1. ADB, CACILM (2007): CMPF Support Project - SLMIS project document (http://cacilm.adb.org)

2. ADB CACILM (2009): Final Report on Field Monitoring and Assessment Studies Conducted at Selected Sites. NSIU, Tashkent, Uzbekistan.

3. Bekmirzaeva I., Yusupov S., Rabbimov A. "Livestock and pasture management plans for Kazakhdarya and Kyzyl Ravat region". Materials of the project "Achieving ecosystem stability in degraded land in Karakalpakstan and Kyzylkum desert". 2010.

4. CACILM National Programming Framework of the Republic Uzbekistan, Tashkent, 2006, 48p.

5. Chub V.E. Climate Change and Its Impact on the Hydro-Meteorological Processes, Agricultural and Water Resources of the Republic of Uzbekistan, Tashkent: Uzhydromett, NIGMI, 2007, 132p.

6. Djanibekov N., Khamzina A., Djanobekov N., Lamers J.P.A. How attractive are short-term CDM afforestation and reforestation projects in arid areas? The case of Uzbekistan. Manuscript submitted to Forest Policy and Economics journal.

7. FAO Farmer SPI. Soil Productivity Improvement through Farmer Field Schools. FAO AGLL: http://www.fao.org/ag/agl/agll/farmspi/

8. FAO/TCP/UZB/2901, 2004. Integrated Management for Sustainable Use of Salt Affected and Gypsiferous Soils. Final Report, Tashkent, Uzbekistan.

9. Freddy Nachtergaele, Monica Petri (2009) FAO LADA: Mapping Land Use system at Global and Regional Scales for Land Degradation Assessment Analysis, Rome, 2009.

10. Hornidge, A.-K., Ul-Hassan, M., 2010. From 'plausible promises' to transdisciplinary innovation research in Uzbekistan - Process outline and lessons learnt.Rural Development News 2 (2010): 53-63.

11. Khamzina A., Lamers J.P.A., Worbes M., Botman E., Vlek P.L.G. 2006. Assessing the potential of trees for afforestation of degraded landscapes in the Aral Sea Basin of Uzbekistan. Agroforestry Systems 66: 129-141.

12. Khamzina A., Lamers J.P.A., Vlek P.L.G. 2011. Conversion of degraded cropland to tree plantations for ecosystem and livelihood benefits. In: Martius C., Rudenko I., Lamers J.P.A., Vlek P.L.G. (eds.), Cotton, Water, Salts and Soums - Economic and Ecological Restructuring in Khorezm, Uzbekistan. Springer.

13. National Action Plan to Combat Desertification in the Republic of Uzbekistan, Tashkent, 2000.

14. Recommendations on pasture and livestock management. Materials of the "Establishment of Nuratau-Kyzylkum Biosphere Reserve (NKBR) Project as a Model for Biodiversity Conservation in Uzbekistan". Tashkent, 2007.

15. Second National Communication of the Republic of Uzbekistan under the United Nations Framework Convention on Climate Change. Tashkent, 2008, 206p.

16. TA 6479-REG: Addressing Climate Change in the Asia and Pacific Region - Building Climate Resilience in the Agriculture Sector- Manila, 2009.

17. UNDP. 2003. The Common Country Assessment of Uzbekistan, Tashkent.

18. Water critical resource for Uzbekistan's future, Tashkent: UNDP, 2007, 12p.

19. Yusupov S., Rabbimov A. "The scientific and practical issues, challenges and solutions to efficient use of Kyzylkum pasture". "Zooveterinariya" magazine. March 2011: 43-46.

Key Word Index