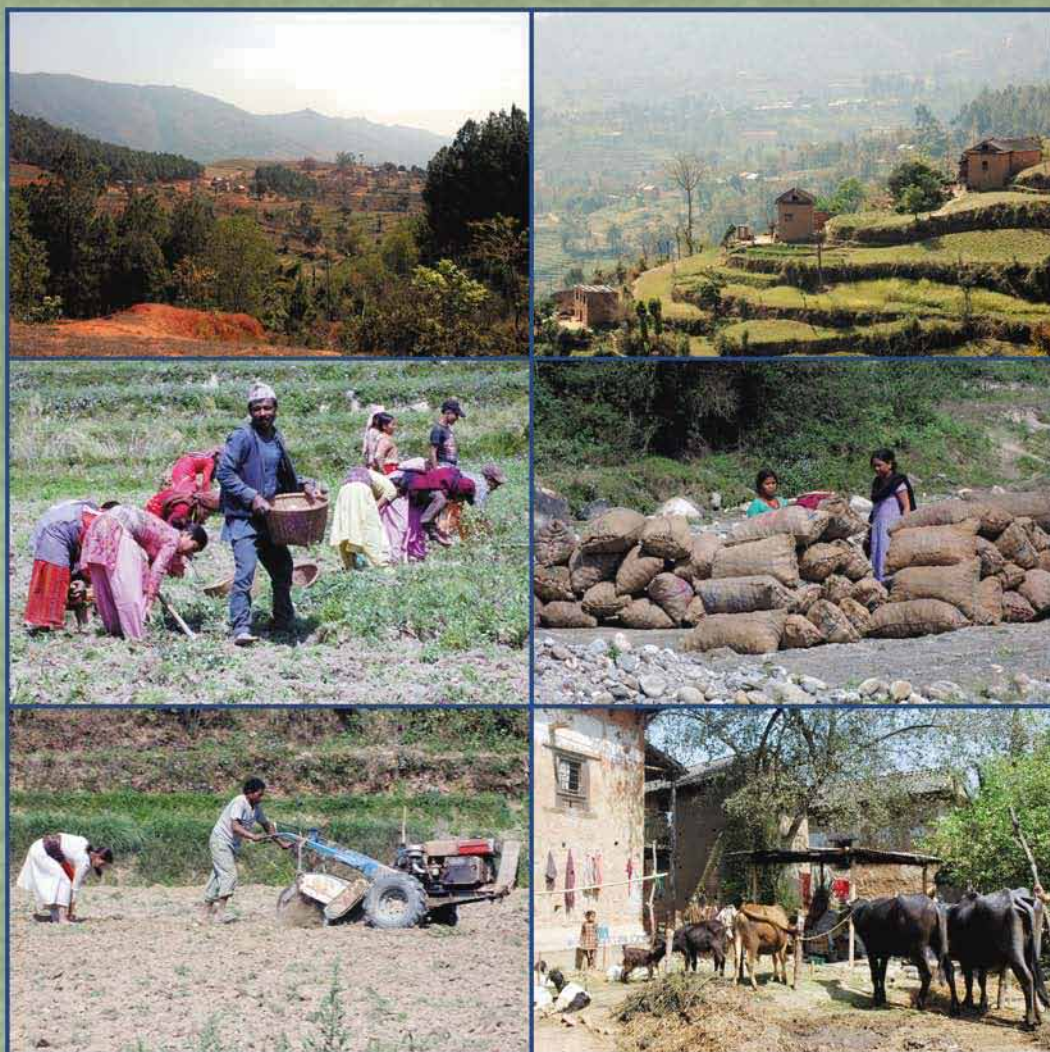


# Good Practices in Watershed Management

Lessons Learned in the Mid Hills of Nepal



# About ICIMOD

The **International Centre for Integrated Mountain Development** (ICIMOD) is an independent 'Mountain Learning and Knowledge Centre' serving the eight countries of the Hindu Kush-Himalayas – Afghanistan , Bangladesh , Bhutan , China , India , Myanmar , Nepal  and Pakistan  – and the global mountain community. Founded in 1983, ICIMOD is based in Kathmandu, Nepal, and brings together a partnership of regional member countries, partner institutions, and donors with a commitment for development action to secure a better future for the people and environment of the extended Himalayan region. ICIMOD's activities are supported by its core programme donors: the governments of Austria, Denmark, Germany, Netherlands, Norway, Switzerland, and its regional member countries, along with over thirty project co-financing donors. The primary objective of the Centre is to promote the development of an economically and environmentally sound mountain ecosystem and to improve the living standards of mountain populations.

# **Good Practices in Watershed Management**

Lessons Learned in the Mid Hills of Nepal

People and Resource Dynamics Project – Nepal Team

**International Centre for Integrated Mountain Development (ICIMOD)**

Kathmandu, Nepal

March 2007

**Copyright © 2007**

International Centre for Integrated Mountain Development (ICIMOD)  
All rights reserved

**Published by the**

International Centre for Integrated Mountain Development  
G.P.O. Box 3226  
Kathmandu, Nepal

**ISBN 978 92 9115 017 5****Editorial Team**

**Matthew Zalichin** (Consultant Editor)  
**A. Beatrice Murray** (Senior Editor)  
**Dharma R. Maharjan** (Technical Support; and Design Layout)

**Photo credits**

All photos from PARDYP Nepal

**Printed and bound in Nepal by**

Quality Printers (Pvt) Ltd.  
Kathmandu

**Reproduction**

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder, provided acknowledgement of the source is made. ICIMOD would appreciate receiving a copy of any publication that uses this publication as a source.

No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from ICIMOD.

**Note**

The views and interpretations in this publication are those of the author(s). They are not attributable to ICIMOD and do not imply the expression of any opinion concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries, or the endorsement of any product.

## **The PARDYP Nepal Team**

Anil Shrestha	Sociologist
Bandana Prajapati	On-farm coordinator
Bhawani S. Dongol	Research Associate
Bhuban Shrestha	Country Coordinator
Birendra Raj Adhikari	Hydro-meteorologist
Diwakar Maskey	Social Forester
Gopal Nakarmi	Geologist
Juerg Merz	Hydrologist
Keshar Man Sthapit	Country Coordinator
Madhav P. Dhakal	Research Associate
Madhav Pandey	Social Forester
Megh Rajani Rai	Sociologist
Prabhakar Bickram Shah	Country Coordinator
Pradeep Man Dangol	Research Associate
Prem Raj Neupane	Agronomist
Radha Karki	Social Forester
Smita Shrestha	Water Management Assistant
Yamuna Ghale	Agronomist



# Contents

Foreword	vii
Acknowledgements	viii
Executive Summary	ix
Acronyms and Abbreviations	xi
<b>1: INTRODUCTION</b>	<b>1</b>
Background	1
Brief Description of the Watersheds	3
<b>2: SOIL LOSS AND RUNOFF</b>	<b>9</b>
Background	9
Soil Loss and Runoff Monitoring	10
Farmer's Perceptions	15
Farm Management	16
Lessons Learned and Recommendations	17
<b>3: WATER SCARCITY</b>	<b>19</b>
Background	19
Water Demand and Supply	20
Management Options	24
Lessons Learned and Recommendations	34
<b>4: WATER QUALITY</b>	<b>37</b>
Background	37
Water Quality Monitoring	37
Water Quality Improvement Options	38
Lessons Learned and Recommendations	40
<b>5: ON FARM</b>	<b>41</b>
How Can Farmers Maintain or Improve Soil Fertility?	41
Leachate Study in the Jhikhu Khola Watershed	44
How to Rehabilitate Degraded Land	45
How Can We Increase Farm Income?	49
What Approaches Can be Used to Build the Capacity of Communities?	51
How to Reduce Workloads, Especially of Women	54
Lessons Learned and Recommendations	56

<b>6: ACCESS</b>	<b>59</b>
Background	59
What are Feasible Local Rules and Practices for Ensuring Equitable Access to Natural Resources?	59
Access to Institutions and Information	62
Access to Natural Resources	62
Decision-making for Different Activities	66
Lessons Learned and Recommendations	67

## **7: BIBLIOGRAPHY AND FURTHER READING** **69**

### **ANNEXES (on CD-ROM in back pocket)**

- Annex 1: Rainfall of the Jhikhu and Yarsha Khola Watersheds
- Annex 2: Rainfall of the Yarsha Khola Watershed
- Annex 3: Description of the Soil Loss and Runoff Plots
- Annex 4: Soil Loss, Runoff, and Rainfall in the Jhikhu Khola Watershed
- Annex 5: Soil Loss, Runoff, and Rainfall in the Yarsha Kola Watershed
- Annex 6: Crop Water Requirement Analysis
- Annex 7: Rainfall Analysis
- Annex 8: Barabot Spring in Dhotra, Jhikhu Khola Watershed
- Annex 9: Roof Rainwater Harvesting Jars
- Annex 10. Monitoring of the Water Table in Dug Wells of the Jhikhu Khola Watershed
- Annex 11. Water Balance
- Annex 12. PARDYP's Experience with the System of Rice Intensification
- Annex 13. Changing Cropping Patterns
- Annex 14. Water Quality Studies
- Annex 15. Leachate Study in the Jhikhu Khola Watershed



# Foreword

The middle altitudes of the Himalayan region are intensively used and highly populated. The management of land, forest and water in these areas is the basis of mountain livelihoods. The land use practices employed depend on the complex dynamics of water-land relationships as well as the diverse social, institutional, and economic conditions found throughout the region. These practices have profound impacts on the productivity and sustainability of mountain watersheds as well as the millions living downstream.

The importance of understanding the dynamics and relationships between socio-economic and biophysical aspects of middle altitude mountain watersheds led ICIMOD to amalgamate earlier projects on the rehabilitation of degraded land and mountain natural resources into the 'People and Resource Dynamics in Mountain Watersheds of the Hindu Kush-Himalayas' project (PARDYP) in 1996 based on experience in Nepal. The Swiss Agency for Development and Cooperation (SDC) joined the International Development Research Centre (IDRC, Canada) in providing funding and intellectual support.

PARDYP illustrates the collaborative regional approach taken by ICIMOD. Research and the daily management of project sites were undertaken by the collaborating focal institutions in China, India, Nepal, and Pakistan. The participating scientists from these countries were the project's researchers. Technical backstopping was provided by specialists from the Universities of British Columbia (Canada), Zurich and Berne (Switzerland).

This publication documents the experience and lessons learned from the PARDYP-Nepal sites. Detailed hydro-meteorological data, together with land use related data, were collected and analysed to increase understanding of topics such as land degradation and water management. The results have been archived for future research use on climate change, land use dynamics, and sustainable mountain agriculture and are partly presented here. Many of the easy-to-implement technological options for improved livelihoods and community-based management of natural resources developed by the project are relevant across the middle altitude zones of the Himalayan region and are also presented here. The document also addresses many of the questions commonly asked about managing mountain natural resources and forms the basis for developing the next generation of watershed management programmes.

I hope that the publication will be useful to extension workers, planners, development specialists, researchers, and policy makers in national institutions, NGOs, and donor agencies working on watershed management and mountain agriculture. I would like to extend my sincere gratitude to SDC, IDRC and ICIMOD core donors for their generous financial support.

J. Gabriel Campbell Ph.D  
Director General, ICIMOD

# Acknowledgements

This report was written by a group of PARDYP-Nepal staff. Keshar Man Sthapit led the preparation. Pradeep Dangol contributed the chapter on 'Soil Loss and Runoff Monitoring'; Bhawani Dongol contributed the chapters on 'Water Scarcity and Water Quality'; Madhav Dhakal contributed the section on management options in the 'Water Scarcity' chapter, the 'On Farm' chapter, and the case studies in the 'Access' chapter; and Anil Shrestha contributed the institutions section of the 'Access' chapter.

Our heartfelt thanks go to all the station observers who took the hydro-meteorological measurements, the field staff involved in the supervision and implementation of the field activities, and the farmers involved in implementing the activities. Thanks also go to all the professional staff who served PARDYP in the many research studies and implementation of field activities, and all the students who carried out research in the watersheds in part fulfilment of their academic studies (B.Sc., M.Sc., and Ph.D.).

This document follows the format and questionnaires developed at a workshop with participants from three of the PARDYP country teams (India, Nepal, and Pakistan), the regional support team, and a technical backstopping team (from the University of Berne). Thanks go to all the members of these teams, especially Dr. Rolf Weingartner.

The support of different line agencies, especially the Department of Soil Conservation and Watershed Management, Spice Crop Development Centre, District Forest Office, District Agriculture Office, and Divisional Irrigation Office, is gratefully acknowledged.

Special thanks go to Roger White, Sanjeev Bhuchar, Isabelle Providoli and other ICIMOD staff for their thorough review and valuable suggestions, and to Eklabya Sharma for his support in preparing the document. Thanks to all participants at the 'Dissemination Workshop on Lessons Learned under PARDYP' held on 25 May 2006 at Dhulikhel, Kabhre District for their comments and suggestions, and especially Gregor Doppmann for his comments.

Last but not least, we thank the Publications Unit in the IMCO Division of ICIMOD for the preparation of the book in its final form.

People and Resource Dynamics Project-Nepal (PARDYP)  
ICIMOD, 2006

# Executive Summary

From September 1996 to June 2006, ICIMOD conducted research to investigate the dynamics and relationships between socioeconomic and natural resources' factors in five middle-mountain watersheds across the Himalayas (in China, India, Nepal, and Pakistan). The People and Resource Dynamics Project (PARDYP) in Mountain Watersheds of the Hindu Kush-Himalayas was funded by the Swiss Agency for Development and Cooperation (SDC) and the International Development Research Centre (IDRC).

The research focused on farming systems, agricultural productivity, water management and access, and equity issues in resource management for middle-mountain watershed areas of the region. It aimed to design future interventions, and to scale up the successes thus far achieved. This publication summarises the lessons learned and recommendations from the project activities in Nepal as follows.

- Erosion studies from Jhikhu and Yarsha Khola watersheds show that **soil erosion from properly farmer managed agricultural land is much less than originally believed. However, erosion increases when the slope is more than 10 degrees.** Most sedimentation originates from areas such as landslips, degraded slopes, roadsides, gullies, and stream banks. Peak runoff is generally observed during intense and high rainfall reaching daily amounts of 100 mm or more.
- **Nutrient leaching is a far more important issue to farmers than farm soil erosion.** In rainfed agricultural land, the leaching volume at 45 cm depth in the soil profile is significantly higher than surface runoff.
- **Increasing demand for water.** Upland communities are concerned about low flows during the pre- and post-monsoon seasons, which affect both irrigation and household needs. However, the data show that the low-flow problem is not due to reduced precipitation or water supply within the watershed, but mainly to increasing demand for water – both for irrigation and drinking – and to poor local water management.
- **Improving water management.** Some tested technological options include eyebrow pitting in degraded land for improving soil moisture, catchment conservation to improve water availability for drinking water, plastic lined conservation ponds to harvest surface water for irrigation, and harvesting roof-water for drinking purposes. Drip and sprinkler irrigation techniques and the System of Rice Intensification (SRI) are among other options tested for increasing the efficiency of water use.
- PARDYP's research on water quality shows that **microbiological contamination of drinking water is severe** and must be addressed through preventing contamination and improved treatment of both catchments and water sources.
- **Forest area cover** in the Jhikhu Khola watershed **remained stable** between 1972 and 1996. **Forest density improved significantly** during the same period mainly as a result of community forestry programmes that increased people's participation and ownership in the management of forests. The entire community forest area within

the Jhikhu Khola watershed was mapped showing forest types, tree density, and maturity class. These maps helped the District Forest Office Kabhre in planning the community forestry programme in the watershed.

- **Agriculture in the middle-mountain watersheds of the Himalayan region is intensifying and becoming more market oriented**, especially in areas with irrigation facilities and links to markets. However, in order to sustain higher production levels, farmers are applying very high doses of pesticides and chemical fertilisers, which has a negative impact on ecosystems.
- **Black plastic composting** with the use of effective micro-organisms has enhanced the decomposition process and produced better fertiliser to address soil-nutrient needs.
- The **challenge in the middle mountain watersheds is to increase the income of smallholder farmers**, especially those cultivating rainfed land. Low levels of production and small landholdings are pushing young farmers to migrate to urban/semi-urban areas.
- **Issues of poor access, equity, and governance are still of concern and need proper attention.** The workload for mountain women remains higher than for men throughout the year, especially in fetching water, collecting fodder and fuelwood, and household work. In the Jhikhu Khola watershed, women typically work 3.8 hours longer per day than men, and 68% of water fetching is done by women. Roofwater harvesting saved women up to 27 minutes on average for each trip to fetch water in the Jhikhu Khola watershed. Similarly, fodder development on their private land can save women 60 to 90 minutes per day for fodder collection.
- **Dissemination and scaling up of the lessons is a major challenge.** Sharing of messages (success and failure stories) among villages through exchange visits, on-site training camps, farmer field schools, national workshops, farmer days, and similar, has been very effective. In addition, participatory action research proved to be effective in testing new technologies together with farmers. This approach strengthened farmers' behaviour to be research oriented in other areas, which is essential for improving livelihoods.

# Acronyms and Abbreviations

DAP	diammonium phosphate
DDC	district development committee
DSCWM	Department of Soil Conservation and Watershed Management
EC	electrical conductivity
EEC	European Economic Commission
EM	effective microorganisms
GOs	government offices
ICIMOD	International Centre for Integrated Mountain Development
IDRC	International Development Research Centre
NGO	non-government organisation
NRs	Nepalese rupees
NTU	nephelometric turbidity unit
PARDYP	People and Resource Dynamics Project
RWSSSP	Rural Water Supply and Sanitation Support Programme
SCDC	Spice Crop Development Centre
SDC	Swiss Agency for Development and Cooperation
SODIS	solar water disinfection
SRI	System of Rice Intensification
USD	United States dollar
VDC	village development committee

## Currency Equivalent

In this report all references to rupees (Rs) are to Nepalese rupees

Currency Unit – Nepalese rupees (NRs)

\$1 = NRs 56.75 (as of December 1996)

\$1 = NRs 71.40 (as of December 2006)

## Notes

- (i) The Nepalese calendar year (B.S.) runs from mid April to mid April. Unless otherwise stated, year ranges written in the form 2005/06 denote a single calendar year.
- (ii) In this report, \$ refers to US dollars.
- (iii) In this report, tons (t) refer to metric tons or tonnes (1,000 kg).

