

SUSTAINABLE MOUNTAIN AGRICULTURE

perspectives and issues

VOLUME 1

Editors

N.S. JODHA

M. BANSKOTA

TEJ PARTAP

Mountain agriculture, the dominant sector of mountain economies in the developing countries has suffered a serious decline or stagnation in the recent decades. In most parts of the mountains, the emerging scenarios indicate a widening gap between demand and supply of land resources and land-based products on the one hand and unsustainability of current resource use patterns and production activities on the other. These factors constitute the background to the studies reported in the present book. The focus of the text is on the understanding and identification of factors and processes contributing to the sustainability or unsustainability of mountain agriculture and related activities. Most of the involved issues are identified and analysed with reference to 'Mountain Perspective—Sustainability Framework' evolved by ICIMOD to examine the relevance of interventions to specific conditions of mountains.

The present book, in two volumes, synthesizes results of ICIMOD studies in the selected hill areas of India, China, Nepal and Pakistan, which were presented at an International Symposium on Strategies for Sustainable Agriculture in Mountain Regions. The themes covered are public policies and programmes, farmers' resource management strategies, some successful development initiatives, long-term issues in sustainability and zonation as a tool for designing development strategies for diverse mountain areas. Contributions from Andes mountain agriculture enrich the text which otherwise, is confined to the Hindu Kush Himalayan Region. This is an effort to identify approaches and options for sustainable development of mountain areas and mountain agriculture. The important message is to learn from the past and have a fresh look at the conventional development approaches to mountain areas.

SUSTAINABLE MOUNTAIN AGRICULTURE

Perspectives and Issues

VOLUME 1

Editors

N.S. JODHA, M. BANSKOTA and TEJ PARTAP



International Centre for Integrated
Mountain Development, Kathmandu



OXFORD & IBH PUBLISHING CO. PVT. LTD.

New Delhi

Bombay

Calcutta

MOUNTAIN AGRICULTURE SUSTAINABLE

Perspectives and Issues

VOLUME I

Editors

N.S. JODHA, M. BANIKOTA and TEJ PARTAP



© 1992 International Centre for Integrated Mountain Development, Kathmandu

Set ISBN 81-204-0620-6

Vol. 1 ISBN 81-204-0621-4

Vol. 2 ISBN 81-204-0622-2

Published by Mohan Primlani for Oxford & IBH Publishing Co. Pvt. Ltd.,
66 Janpath, New Delhi 110 001. Phototypeset by Laserwords, Madras, processed and
printed at Pauls Press, E44/11 Okhla Industrial Area, Phase II, New Delhi 110 020.

1-D1-10

CONTENTS

VOLUME 1

<i>Foreword</i>	vii
<i>Preface</i>	ix
<i>Editors' Note</i>	xi
<i>Acknowledgements</i>	xii
<i>The Contributors</i>	xiii

**PART 1: AGRICULTURE DEVELOPMENT IN MOUNTAIN AREAS:
PERSPECTIVES AND APPROACHES**

Chapter	1. Strategies for the Sustainable Development of Mountain Agriculture: An Overview <i>N.S. Jodha, M. Banskota and T. Partap</i>	3
Chapter	2. Mountain Perspective and Sustainability: A Framework for Development Strategies <i>N.S. Jodha</i>	41
Chapter	3. Mountain Agricultural Development Strategies: Comparative Perspectives from the Countries of the Hindu Kush-Himalayan Region <i>M. Banskota and N.S. Jodha</i>	83
Chapter	4. Mountain Agricultural Development Strategies: The Andean Perspective <i>M.E. Tapia</i>	115
Chapter	5. Mountain Farmers' Response to Development Efforts: Comparative Perspectives from the Countries of the Hindu Kush-Himalayan Region <i>S. Sharma and N.S. Jodha</i>	129
Chapter	6. Farming-Forestry-Livestock-Linkages: A Component of Mountain Farmers' Strategies (Nepal) <i>Y. Yadav</i>	141

PART 2:		LONG-TERM SUSTAINABILITY OF MOUNTAIN AGRICULTURE: SOME BASIC ISSUES	
Chapter	7.	Population Dynamics and Sustainable Agricultural Development in Mountain Areas <i>P. Sharma and M. Banskota</i>	165
Chapter	8.	Investment, Subsidies, and Resource Transfer Dynamics: Issues for Sustainable Mountain Agriculture <i>M. Banskota and N.S. Jodha</i>	185
Chapter	9.	Institutional Imperatives for Sustainable Resource Management in the Mountains <i>D. Bajracharya</i>	205
Chapter	10.	Infrastructural Development Imperatives for Sustainable Mountain Agriculture <i>B.B. Bajracharya</i>	235
Chapter	11.	Thinking Globally, Acting Locally: Technology for Sustainable Mountain Agriculture <i>R.E. Rhoades</i>	253
Chapter	12.	Biological Diversity as an Issue in Sustainable Development of Mountain Agriculture <i>T. Partap</i>	273
PART 3:		AGRO-ECOLOGICAL ZONATION APPROACHES TO MOUNTAIN DEVELOPMENT	
Chapter	13.	An Agro-ecological Zonation Approach to Agricultural Planning in Mountain Environments <i>B. Carson</i>	307
Chapter	14.	Comparative Methods for Characterizing Mountain Agro-ecosystems <i>P.A. Lundberg</i>	329
Chapter	15.	Geographic Information Systems (GIS) Technology Application in Agro-ecological Zonation of Mountain Environments <i>T. Partap, P. Pradhan, P.K. Kotta, S. Mya, Z. Karim and G. Nakarmi</i>	359
VOLUME 2			
PART 4:		MOUNTAIN FARMERS' STRATEGIES AND SUSTAINABILITY IMPLICATIONS	
Chapter	16.	Farmers' Innovations and Agricultural Technologies <i>A.K. Gupta</i>	393

Chapter	17.	Land-use Modification and Labour Shortage Impacts on the Loss of Native Crop Diversity in the Andean Highlands <i>K. Zimmerer</i>	413
Chapter	18.	Farmers' Strategies in the Mountain Areas of West Sichuan: China <i>Liu Yanhua, Wang Fei and Yu Dafu</i>	423
Chapter	19.	Farmers' Strategies in the Middle Hills of Nepal <i>S. Shrestha and B. Katwal</i>	447
Chapter	20.	Diversity of Farming Systems and Farmers' Strategies in the Mountain Valley of Chitral, Pakistan <i>Masood ul Mulk</i>	477
Chapter	21.	Diversity of Mountain Farming Systems in Himachal Pradesh, India <i>J.P. Bhati, R. Singh, M.S. Rathore and L.R. Sharma</i>	497
Chapter	22.	Andean Farming Systems: Farmers' Strategies and Responses <i>A. Camino</i>	517
Chapter	23.	Indigenous Farming Technologies and Environment: Experiences in Bhutan <i>A.K. Gupta and K. Ura</i>	539
Chapter	24.	Farmer-Managed Irrigation Systems in the Mountains of Pakistan <i>E.J. Vander Velde</i>	569
 PART 5:			
TRANSFORMATION OF MOUNTAIN AREAS: SOME INNOVATIVE APPROACHES			
Chapter	25.	Anti-poverty Focussed Programmes in the Mountains: Experiences in China <i>Gao Hongbin and Ye Xingqing</i>	591
Chapter	26.	The Experiences of an Area-based Development Strategy in Himachal Pradesh, India <i>L.R. Verma and T. Partap</i>	609
Chapter	27.	A Local Resource-Centred Approach to Rural Transformation: Agro-based Cottage Industries in Western Sichuan, China <i>Liu Zhaoguang and Wu Ning</i>	637
Chapter	28.	The Small Farmers' Development Programme in Nepal: Institutional Initiative in Poverty Alleviation <i>K.S. Sharma</i>	651
Chapter	29.	The Aga Khan Rural Support Programme: An Approach to Village Management Systems in Northern Pakistan <i>T. Husain</i>	671
Chapter	30.	Mountain Agricultural Technology Development and Diffusion: The Lumle Model, NEPAL <i>B. Pound, K. Budathoki and B.R. Joshi</i>	711

Chapter	31.	Mountain Agricultural Technology Development and Diffusion: The Pakhribas Model, Nepal <i>S.P. Chand and B. Thapa</i>	737
Chapter	32.	Agricultural Research Experiences of the Arid Zone Research Institute (AZRI) in Baluchistan, Pakistan <i>J.D.H. Keatinge and B. Roider Khan</i>	761
Chapter	33.	Agroforestry as an Option for Mountain Agricultural Development <i>J. Denholm and N.S. Jodha</i>	773
<i>Index</i>			791

FOREWORD

This document has been produced as part of the work programme of the Mountain Farming Systems Division of ICIMOD. Mountain Farming Systems is one of ICIMOD's four thematic research programmes.

The programme has now completed the first phase of work on Strategies for Sustainable Mountain Agriculture. To complete this phase, problem-oriented research work, in selected areas of the Hindu Kush-Himalayan Region, was conducted. The areas of the Region focussed upon were West Sichuan (China), Himachal Pradesh (India), the North West Frontier Province (NWFP) (Pakistan), and the Middle Hills of Nepal. The work involved thematic reviews of selected development policies and programmes, site-specific studies covering crop, livestock, and horticulture-dominated farming systems as well as other reviews covering specific topics such as underexploited plant genetic resources, mountain beekeeping, and innovative and successful initiatives in the field of agricultural technology and rural institutions.

Work was conducted in collaboration with national institutions and experts from the regional countries. During the course of the studies, different national workshops were held (in China, India, Nepal, and Pakistan) to discuss the findings in the countries where research was being conducted. The experience gained from these national workshops became the input for the International Symposium for Strategies on Sustainable Mountain Agriculture, held at Kathmandu from September 10–14, 1990.

In addition to papers based on the HKH Region, papers were presented on the Andean Region. This volume includes these papers as well as a number of papers selected from background material, produced through the auspices of ICIMOD, in order to give the reader a broader picture of the problems and concerns of Sustainable Mountain Agriculture.

In publishing this volume, ICIMOD is fulfilling a part of its mandate to facilitate the economically and environmentally sustainable development of mountain areas through the dissemination of relevant information. Since agriculture remains the principal occupation of the majority of the inhabitants of the Hindu Kush-Himalaya, it is understood that Mountain Farming Systems merit a great deal of study, especially within the context of long-term sustainability. ICIMOD hopes that this volume will serve to add to the understanding of these systems and to the long-term benefit of mountain peoples.

Several organisations have supported ICIMOD's endeavours in this particular study, and I would like to acknowledge the support of the Asian Development Bank (ADB) and the Ford Foundation in helping us to undertake this work. In addition, the UNDP, the Rockefeller Foundation, and the Swiss Development Cooperation facilitated the par-

icipation of various experts in the workshops held. His Majesty's Government of Nepal and a number of other organisations in Nepal have been generous in extending their logistical support. Finally, I would like to thank all those institutions—such as the Chinese Academy of Sciences, Agro-economic Research Centre, the University of Himachal Pradesh, the Agricultural Projects Services' Centre, Nepal, the Aga Khan Rural Support Project Pakistan, and the Planning Commission and Ministry of Agriculture of the Royal Government of Bhutan—which have given this search for Strategies for Sustainable Agriculture their valuable support.

DR. E.F. TACKE
Director, ICIMOD

PREFACE

Economic development has been a long, slow process for much of the developing world. This is especially so for the peoples who inhabit the mountainous region of Asia. In the two decades after World War II development strategies emphasised the importance of growth in per capita income and food production, in the expectation that the benefits of such growth would be universal, “trickling down” to the poorest communities. Growth was achieved, but there was little evidence of trickle down. Rapidly increasing food production was brought about by the Green Revolution but the benefits were mostly confined to the flat, well irrigated lands of Asia. Few of the new miracle varieties of rice and wheat were suitable for mountain environments and the technologies that went with them were inappropriate, if not damaging. Development thinking in the late 1960s and 1970s shifted to an emphasis on growth with redistribution and on satisfying certain “basic needs”—nutrition, health, water supply, shelter, sanitation and education. The new strategies accepted that poverty could not be eliminated solely by economic growth and required a direct attack, mobilising government and aid spending rather than relying on market forces. This has undoubtedly brought considerable benefits. Mountain people are now better served than at any time in the past by schools and primary health care centers, potable water supplies and veterinary clinics as well as by improved roads and access to markets. Yet, at the same time, the resource base on which these people depend has deteriorated at an accelerating rate. The roads and markets have been a mixed blessing, encouraging unbridled exploitation. Forests have been felled, the vegetation cover removed and steep slopes have become severely eroded. Together with exploitation, the impact of population pressure and inappropriate technologies have severely degraded the mountain environment.

Such resource degradation is not unique to the mountains although is perhaps more dramatically obvious there. Elsewhere in the world has come a growing realisation of the perils of the damage we are causing to our natural resources and environment. In 1987 the issues were given worldwide attention by the publication of the World Commission on Environment and Development report “*Our Common Future*”. In addition to illustrating the problems we face the Brundtland Report, as it is known, called for a new strategy of *sustainable development* as a basis for economic growth in the coming decades.

Following the publication of the report the concept of sustainable development has caught the imagination of policy makers, economic, social and environmental advisers and leaders of the non government community. Policy and programme proposals, project documents and plans are invariably replete with references to the need for sustainability. Yet few use the term precisely. It has come to mean all things to all men and women.

In the Brundtland Report sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Such a definition resonates with our ideals and our humanity but is not readily translated into a plan of practical action.

Today we are in urgent need of more practical, down to earth interpretations of sustainability. We need to be in a position to ask and answer, with precision, such questions as “Is this cropping system sustainable?” “Is this forest sustainable under the present pattern of exploitation?” “Is this watershed sustainable under the present regime?” “Is the current lifestyle of these people sustainable?” And, if the answers are “no”, how can the sustainability be improved? We also need to be aware that sustainability—the ability of the field or village or watershed to survive may involve costs. There may well be trade-offs in development between sustainability, economic growth and equity for instance. Designing a sustainable, but essentially static, resource management regime may be relatively easy. It will be considerably more difficult to design one that is sustainable yet also provides growing incomes that are equitably shared.

These are the formidable challenges of the 1990s and the 21st century. They are faced by all peoples of the world, but perhaps most acutely by mountain people. The concept of sustainable development faces its severest test in mountain environments. At the same time, the acute and dramatic nature of resource degradation in the mountains brings the issues into sharp relief. Success may well carry lessons for other environments elsewhere in the world.

This book addresses many of the central issues of sustainable agricultural development in the mountains. It provides innovative concepts, detailed case studies and thoughtful analysis. Readers will find a wealth of information, ideas and examples of practical experiences culled from a wide range of countries and mountain environments.

PROFESSOR GORDON R. CONWAY

Representative, India, Sri Lanka, Nepal
and Professor, Centre for Environmental Technology
Imperial College of Science, Technology and Medicine, London

EDITORS' NOTE

The work presented in this book covers various dimensions and issues relating to mountain agriculture in the overall context of development strategies, experiences, problems and prospects in the mountain areas with special focus on the Hindu Kush-Himalayan region. ICIMOD's work on the subject during the last three years supplemented by contributions from other institutions and experts in the International Symposium on Strategies for Sustainable Mountain Agriculture in September 1990, determined the overall scope of the book. Besides adding to the depth and variety of issues, this also increased the size of the book. For the reasons of comprehensive reporting on the subject and protecting linkages between different aspects covered by conceptual and empirical work extending to different geographical areas and relating to a range of thematic contexts, it was difficult to exclude some material to reduce the size of the book.

Concerned with the possible operational problems and convenience of readers, the whole book is divided into two volumes, published simultaneously. The thematic coverage of the two volumes is governed by closer linkages between the issues and evidence covered by different papers. Accordingly, Volume 1 focusses on agricultural development perspectives, approaches, and strategies in the HKH region. The long-term sustainability issues and use of agro-ecological zonation as a tool for development planning in mountain areas are other important aspects covered by Volume 1. Volume 1 consists of 15 chapters.

Volume 2 covers relatively more operational dimensions of the subject where micro-level or project-level realities, experiences and implications are reported and analysed. Chapters dealing with farmers' strategies and some innovative project initiatives are covered by Volume 2. Volume 2 consists of 18 chapters.

N.S. JODHA, M. BANSKOTA and TEJ PARTAP (editors)

ACKNOWLEDGEMENTS

Acuteness of environmental degradation and poverty in mountain regions of the developing countries is now well recognised. The problems are sharply manifested by the stagnation and decline of Agriculture the major activity of mountain people. Understanding of the factors and processes contributing to this decline and identification and adoption of possible solutions is a herculean task. This is more so due to specific conditions characterising mountains and general disregard of mountain regions in the past by researchers and policy makers alike.

To address the above problem ICIMOD attempted to mobilise available knowledge and evidence on different aspects of the problem through an International Symposium on Strategies for Sustainable Mountain Agriculture and subsequently present the relevant material through the two volumes before all those associated with development of mountain areas. We take this opportunity to thankfully acknowledge the help of all those who have contributed in this task.

Our thanks are due to the authors who not only managed to prepare and revise their contributions under tight time schedules but many of them presented their evidence and argument in the overall context of mountain-perspective sustainability framework suggested by us.

We would also like to thank Mrs. Greta Rana and Mrs. Archana Karki for their assistance in language editing. This made the job easier for the publishers. The secretarial assistance from Mrs. Sami Joshi and Reeta Rana deserves praise specially for the hardwork they did in typing the manuscript time and again for several months.

Finally we thank ICIMOD Director and all our professional staff colleagues. Their cooperation and involvement in programme activities from time to time saw successful completion of the project and production of this book.

N.S. JODHA, M. BANSKOTA and TEJ PARTAP (editors)

THE CONTRIBUTORS

Bajracharya B.B.

Centre for Economic Development and
Administration (CEDA)
Tribhuvan University
P. O. Box 797, Kirtipur
Nepal

Bajracharya D.

Division Head
Mountain Population and Employment Division
ICIMOD, G.P.O. Box 3226, Kathmandu,
Nepal

Banskota M.

Chief Programme Coordinator and
Programme Head,
Area Development Planning and
Implementation
ICIMOD, G.P.O. Box 3226, Kathmandu,
Nepal

Bhati J.P.

Department of Economics
Himachal Pradesh University
Shimla, India

Burathoki K.

Lumle Agriculture Centre (LAC)
P. O. Box 1
Pokhara, Kaski, Gandaki Zone
Nepal

Camino A.

Director
Fundacion Peruana
Para la Conservacion de la
Naturaleza (FPCN)
Chincho 858/A
San Isidro, Aptdo.18-1393
Lima, Peru

Carson, B.

Project Leader
Master Plan for Horticulture, HMG,
East Consultants Co. Ottawa,
Canada

Chand S.P.

Agronomist
Pakhribas Agriculture Centre (PAC)
c/o BICO, P. O. Box 106
Kathmandu, Nepal

Dafu Y.

Chengdu Institute of Mountain
Disaster and Environment
Chengdu, P.O. Box 417
Sichuan, China

Denholm J.

Mountain Farming Systems Division
International Centre for Integrated Mountain
Development (ICIMOD), G.P.O. Box 3226,
Kathmandu, Nepal

Fei W.

Chengdu Institute of Mountain
Disaster and Environment
Chengdu, P. O. Box 417
Sichuan, China

Gupta A.K.

Centre for Management in Agriculture,
Indian Inst. of Management
Vastrapur, Ahmedabad
India

Hongbin G.

Leading Group Office for the Economic
Development of Poor Areas
Beijing
China

Husain T.

Managing Director
Development Research and Management
Services
P.O. Box 2389
Islamabad, Pakistan

Jodha N.S.

Division Head
Mountain Farming Systems Division
International Centre for Integrated Mountain
Development
(ICIMOD), G.P.O. Box 3226, Kathmandu,
Nepal

Joshi B.R.

Lumle Agricultural Centre (LAC)
P. O. Box 1
Pokhara, Kaski, Gandaki Zone,
Nepal

Katwal B.

Agriculture Projects and Services Centre
(APROSC)
G. P. O. Box 1440
Ramshah Path
Kathmandu, Nepal

Karim Z.

Mountain Environment and Natural Resources
Information Services (MENRIS)
ICIMOD, G.P.O. Box 3226, Kathmandu,
Nepal

Keatinge J.D.H.

International Centre for Agricultural Research
in the Dry Areas (ICARDA)
P.O. Box 5466, Aleppo, Syria

Khan R.

Director
Arid Zone Research Institute
P.O. Box 362
Quetta, Pakistan

Kotta P.K.

Mountain Environment and Natural Resources
Information Services (MENRIS)
ICIMOD, G.P.O. Box 3226, Kathmandu, Nepal

Lundberg, P.A.

Chief Technical Advisor to Planning
Commission
HMG Nepal on Regional Development

Planning

United Nations Development Programme
(UNDP)
Pulchowk
Kathmandu, Nepal

Mr. Mulk M. Ul

Aga Khan Rural Support Programme
District Programme Office, (AKRSP)
NWFP, Pakistan

Mya S.

Mountain Environment and Natural Resources
Information Services (MENRIS)
ICIMOD, G.P.O. Box 3226, Kathmandu,
Nepal

Mr. Nakarmi G.B.

Geologist
Integrated Survey Section Topographic Survey
Branch
P. O. Box 1611, Min Bhawan, Kathmandu,
Nepal

Ning W:

Chengdu Institute of Biology
Academia Sinica
P.O. Box 416, 610015
Chengdu, Sichuan, China

Partap T.

Mountain Farming Systems Division
ICIMOD, G.P.O. Box 3226, Kathmandu,
Nepal

Pound B.

Director
Lumle Agricultural Centre
c/o BTO, P. O. Box 106
Kathmandu, Nepal

Pradhan P.

Mountain Environment and Natural Resources
Information Services (MENRIS)
ICIMOD, G.P.O. Box 3226, Kathmandu, Nepal

Rathore M.S.

Senior Research Fellow
Institute of Development Studies
B-124, Mangal Marg
Bapunagar, Jaipur
India

Rhoades R.E.

Professor and Head

Department of Anthropology
University of Georgia Athens
Georgia, 30602
USA

Sharma K.S.
Integrated Development Service
New Baneswor
Kathmandu, Nepal

Sharma L.R.
Agroecconomic Research Centre
Himachal Pradesh University
Shimla, India

Sharma P.
Mountain Population and Employment
Division
ICIMOD, G.P.O. Box 3226, Kathmandu, Nepal

Sharma S.
Mountain Infrastructure and Technology
Division
ICIMOD, G.P.O. Box 3226, Kathmandu, Nepal

Shrestha S.
Mountain Farming Systems Division
ICIMOD, G.P.O. Box 3226, Kathmandu, Nepal

Tapia M.E.
Proyecto de Investigacion
de Sistemas Agropecuarios Andenos (PISA)
INIAA, Box 110697
Lima 11, Peru

Thapa B.
Pakhribas Agricultural Centre
Dhankuta District
Koshi Zone, Nepal
c/o BTCO, P.O. Box 106
Kathmandu, Nepal

Ura K.
Planning Officer

Planning Commission
Royal Government of Bhutan
Thimpu, Bhutan

Velde E.J.V.
Professor
International Irrigation Management
Institute (IIMI)
Country Office, Islamabad, Pakistan

Verma L.R.
Mountain Farming Systems
ICIMOD, G.P.O. Box 3226, Kathmandu, Nepal

Xingqing Y.
Leading Group Office for the Economic
Development of Poor Areas
Beijing
China

Yanhau Liu
Institute of Geography
Chinese Academy of Sciences (CAS)
Beijing, 100012
China

Yadav Y.
Agricultural Projects and Services Centre
(APROSC)
Post Box 1440,
Kathmandu, Nepal

Zhaoguang L.
Director
Chengdu Institute of Biology
Academia Sinica
P. O. Box 416, 610015
Chengdu, Sichuan, China

Zimmerer K.
Assistant Professor
Department of Geography
University of Wisconsin, Madison
WI 53706, USA