Annex 1. Workshop Programme

DAY ONE

CHAIRMAN	Dr. Li Wenhua
Opening and Welcome Remarks	Prof. Sun Honglie Vice-President, CAS Workshop Co - Chairman
Introduction	Dr. Colin Rosser Director, ICIMOD
Address	Kang Zhenghuang Vice-Governor, Sichuan
Address	Dong Zhiyong Vice-Minister of Forestry
Vote of Thanks	Dr. Li Wenhua Executive Deputy-Director, CISNAR Workshop Co - Chairman

SESSION 1

INTRODUCTION TO THE WORKSHOP

Workshop Programme — Dr. Kk. Panday, ICIMOD, Workshop Co-Coordinator

Watershed Management in the Asia Pacific Region Workshop, held in Honolulu, January 1985 — Dr. C. Gibbs

Experts Consultation Meeting on Watershed Management, held in Kathmandu, February 1985 — L. S. Botero

SESSION 2

SUMMARIES OF COUNTRY REVIEW PAPERS
Bangladesh, Bhutan, China, India, Nepal, Pakistan

CHAIRMAN — Dr. Colin Rosser

SESSION 3

WATERSHED MANAGEMENT EXPERIENCE IN THE HINDU KUSH - HIMALAYA REGION : AN OVERVIEW

CHAIRMAN — Dr. Colin Rosser

Presentation by — Dr. Kk. Panday

Discussion — Country Review Papers

DAY TWO

SESSION 4

PROBLEMS AND PRESSURES ON MOUNTAIN WATERSHEDS

CHAIRMAN — Dr. L. Ljungman

Forest Administration in South-West China — Dong Zhiyong

Livestock System Dynamics and Watershed Resources — Dr. P. Alirol

Watershed Management and Food Security — Dr. K. G. Tejwani

People's Motivations for Sustaining Upland Resources — Anis Dani and Dr. G. Campbell

Rational Utilisation and Protection of Plant Resources — Prof. Wu Zhengyi

Hill Farmers as Watershed Managers — Dr. M. Banskota

DAY TWO

SESSION 5

PANEL DISCUSSIONS AND GENERAL DISCUSSION OF SESSION 4 PAPERS

CHAIRMAN	Dr. C. K. Sharma
MEMBERS	Prof. K. Iwatsuki
	M. N. Venkatesan
	Dr. K. R. Qureshi
	Prof. Zhang Rongzu

SESSION 6

MEASURES FOR PROMOTING MORE EFFECTIVE ACTIONS IN WATERSHED MANAGEMENT IN THE REGION

Group Discussions

CHAIRMEN

Kumar Upadhyaya	Policy and Project Priorities in Watershed Management
Prof. J. Ives	Research, Monitoring, and Evaluation
Dr. R. V. Singh	Training, Institution Building, and Systematic Information Exchange

DAY THREE

SESSION 7

MANAGING THE MOUNTAIN WATERSHEDS

CHAIRMAN J. L. Maskey

Hindu Kush-Himalaya Erosion and Sedimentation in Relation to Dams Dr. V. Galay

Assessment of a Small Watershed Using Aerial Photography Brian Carson

Forestry and Watershed Mangement in the Indian Himalaya Dr. R. V. Singh

Forestry Management in the Nepal Himalaya Dr. K. Shepherd

Institutional and Organisational Framework Dr. C. Gibbs

SESSION 8

PANEL DISCUSSION AND GENERAL DISCUSSION OF SESSION 8 PAPERS

CHAIRMAN	M. N. Venkatesan
MEMBERS	Dr. Noor Mohammad
	M. M. D. Joshi
	Prof. Guan Junwei
	Prof. W. Haffner

SESSION 9

CONTINUATION OF GROUP DISCUSSIONS

Workshop Programme continued

DAY FOUR

FIELD STUDY

THEME : Practical Approach to Development with Conservation

Visit to the School of Forestry in Dujiang and Integrated Utilisation of Biogas Complex

Introduction of Wolong with Films

DAY FIVE

Visit to Wolong Nature Reserve

DAY SIX

SESSION 10

ROLE OF INTERNATIONAL AGENCIES IN INTEGRATED WATERSHED MANAGEMENT IN THE REGION

Panel Discussion on Aid Agency Experiences

CHAIRMAN Dr. K. R. Qureshi

MEMBERS L. S. Botero, FAO
L. Ljungman, World Bank

SESSION 11

WORKSHOP CONCLUSIONS AND RECOMMENDATIONS FOR THE REGION

CO-CHAIRMEN Dr. Li Wenhua, CAS
Dr. Colin Rosser, ICIMOD

Presentation and Discussion of Group Reports

Closing of the Workshop

Annex 2.

Workshop Organising Committee

Chairmen

Dr. Li Wenhua — Director
Commission for Integrated Survey of Natural Resources (CISNAR)
Chinese Academy of Sciences, Beijing

Dr. K. C. Rosser — Director
International Centre for Integrated Mountain Development (ICIMOD)
Kathmandu, Nepal

Workshop Coordinators

Dr. Kk. Panday — Convenor
Watershed Management Programme
International Centre for Integrated Mountain Development (ICIMOD)
Kathmandu, Nepal

Zhang Mingtao
Commission for Integrated Survey of Natural Resources
Chinese Academy of Sciences, Beijing, China

Annex 3.

Papers Prepared

Review Papers

1.	Watershed Management and Related Issues in Bangladesh with Particular Reference to Hill Areas	Omar M. Ali and S. Ruhulamin
2.	The Current State of Watershed Management in Bhutan	Binayak Bhadra and Philippe Alirol
3.	Watershed Management in Southwest China's Mountain Region	Li Wenhua and Zhang Mingtao
4.	Watershed Management in the Indian Himalaya	K. G. Tejwani
5.	Watershed Management in Nepal	M. M. D. Joshi
6.	Watershed Management in Pakistan	G. M. Khattak
7.	Watershed Management Experience in the Hindu Kush - Himalaya Region	Kk. Panday

Theme Papers

Problems and Pressures on Mountain Watersheds

8.	Hill Farmers as Watershed Managers : Dimensions of Hill Farming Systems and Environmental Change in Nepal	Mahesh Banskota
9.	Watershed Management and Food Security	K. G. Tejwani
10.	Livestock System Dynamics and Watershed Resources	Philippe Alirol
11.	Forestry and Watershed Management in the Western and Central Himalaya in India	R. V. Singh

12.	Hindu Kush - Himalayan Erosion and Sedimentation in Relation to Dams	Victor Galay
13.	Recent Debris Flow Activity in the Hengduan Mountains	Tang Bangxing, Liu Suging, Tan Wanpei, and Lin Shijian

Managing the Mountain Watersheds

14.	The Present Situation of Forest Administration in the Southwest Region of China and its Role in River Basin Management	Dong Zhiyong
15.	Forestry Management in the Nepal Himalaya	K. R. Shepherd
16.	The Relations Between Drainage Control and the Exploitation of Natural Resources	Wu Zheng Yi
17.	People's Motivations for Sustaining Upland Resources	Anis A. Dani and J. Gabriel Campbell
18.	Assessment of a Small Watershed Using Aerial Photography : An Example from a Remote Hill Region in Nepal	Brian Carson
19.	Institutional and Organisational Aspects of Watershed Management	Christopher Gibbs
20.	Recommendations of Expert Consultation Meeting on Watershed Management, February 1985	L. S. Botero

Supplementary Papers on the Hindu Kush - Himalaya
(Not Presented)

China

21.	Economic Plants of the Hengduan Mountain Region Region	Liu Zhaoguang
22.	The Rainstorm and its Runoff Over the Himalaya and the Transverse Mountains	Wu Xiangding Lin Zhenyao Zhang Yiguang, and Guan Zhuhua
23.	A Comparative Study of Geo - ecological Conditions and Environmental Problems Between the Himalaya and the Hengduan Mountains	Zheng Du

24.	Guidelines for the First - Stage Research of Watershed Management in the Dry Valleys of the Hengduan Region	Zhang Rongzu Sun Shangzhi, and Wu Sugong
25.	Exploitation and Utilisation of Natural Resources in the Hengduan Mountains	Li Mingsen and Sun Shangzhi
26.	Exploitation of Marshlands and Marsh Meadows Meadows and Rational Use of Grassland Resources in Ruoergai Region	Qiu Faying and Chen Qingheng
27.	Cutting of Forest and Soil Conservation in Alpine Coniferous Forests of West Sichuan	Ma Xuehua
28.	Geothermal Energy as a Key to Comprehensive Development of Energy Sources in Tengchong County of West Yunnan	Tong Wei and Zhang Mingtao
29.	River Basin Management and Resource Exploitation in the Hengduan Mountains	Cheng Hong and Ni Zubin
30.	Debris Flows and Their Prevention and Control in Jiuzhaigou Scenic Spots of the Hengduan Mountain Region	Liu Suqing Tang Bangxing Tan Wanpei, and Liu Shijian
31.	A General Introduction to Debris Flows and Their Comprehensive Control in Heisha River, Liangshan, Sichuan	Wu Jishan Tian Lianguan, and Zhang Youfu
32.	The Problems of Soil and Water Conservation in Southwest China	Guan Junwei
33.	Forest Felling and Regeneration in the Southwest Mountain District of China	Han Yufen
34.	Animal Husbandry and Watershed Management in the Himalaya - Hengduan Region	Huang Wenxiu
35.	Bibliography of Exploitation, Management and Utilisation of the Hengduan Mountains	Chinese Academy of Sciences
36.	Integrated Development of the Erhai Region	Zhang Mingtao and Chen Chuanyou
37	Runoff Effects of the Cutovers in the Alpine Forest Areas	Chen Chuanyou

Other Countries

38	Economic Factors Affecting Watersheds of Northern Pakistan	K. R. Qureshi
39.	Economics of Watershed Management in the Himalayan Region of India	S. L. Shah
40.	Managing Catchments, Reservoirs and Commands as a System in the Himalaya	M. N. Venkatesan
41.	Agricultural Development in Relation to Watershed Management Problems in Nepal	A. N. Bhattarai
42.	Plans, Policies and Programmes in Watershed Management in Nepal	P. M. Baisyat
43.	Planning for Combined Approaches to Integrated Regional Development and Watershed Management in Mountain Areas	P. Gueller
44.	International Cooperation and Assistance to Watershed Management in Nepal	K. P. Upadhyaya
45.	Research and Training in Watershed Management in Nepal	E. R. Sharma
46.	Range Management in Watersheds of Pakistan	Noor Mohammad
47.	Problems of Sediment Load in Water Resource Development of Nepal	C. K. Sharma
48.	Watershed Degradation in Nepal	K. B. Malla
49.	Watershed Management in the Indian Himalaya with Emphasis on Forestry Education and Training	K. M. Tiwari

Annex 4.
Summaries of Papers *

Reviews

WATERSHED MANAGEMENT AND RELATED ISSUES IN BANGLADESH WITH PARTICULAR REFERENCE TO HILLY AREAS

Omar M. Ali and S. Ruhulamin

In Bangladesh, though cultivation and high intensity rainfall form ideal conditions for erosion, no single institution is responsible for watershed management, and no district or national level plan exists. Uneven distribution of rainfall is compounded by uncontrolled shifting cultivation, high deforestation due to over - exploitation, population displacement from the Kaptai reservoir and immigration from plains areas. Steps toward settlement and afforestation are being taken by the Chittagong Hill Tracts Development Project, and the Forest and Agricultural Extension Departments. The establishment of a Department of Soil Conservation and Watershed Management has been proposed.

THE CURRENT STATE OF WATERSHED MANAGEMENT IN BHUTAN

Binayak Bhadra and Phillipe Alirol

Priorities for watershed management in Bhutan are institutional development, research, and training. Multi - sectoral policies to coordinate resource sectors are needed ; no institution is solely responsible for WSM and no data base necessary for policy analysis is presently lacking. Topsoil loss is estimated to be low, due to mild precipitation. Orchard and cash crop cultivation generally benefit the watersheds. The exception is cardamom cultivation in the south, which often encroaches on forest. Increasing animal pressures pose a threat to forests and pastures in northwestern Bhutan's inner valleys. Policies have been introduced to regulate logging and improve crop rotation, sloped terracing and pasture lands.

WATERSHED MANAGEMENT IN SOUTHWEST CHINA'S MOUNTAIN REGION

Li Wenhua and Zhang Mingtao

Watershed management, a key to successful integrated mountain development, is critical for the remote Himalaya - Hengduan Region's slow economy. The declining human - land ratio is a fundamental problem. Approximately four - fifths of the population practise agriculture; almost all suitable land is cultivated (0.5 - 2.5 per cent). Forests have been cleared for cultivation, grazing and firewood ; exploitation is 2.3 times forest productivity. During the last fifty years, various departments have conducted WSM projects, using incentives. WSM legislation has included a Forest Law, Grasslands Management Act, and Strategy of Water and Soil Conservation. However, no cross - sector coordinating organisation exists.

* Not all authors have had the opportunity to comment on the summaries presented here ; ICIMOD has tried to reflect as accurately as possible the major points raised by the authors.

WATERSHED MANAGEMENT IN THE INDIAN HIMALAYA

K. G. Tejwani

Erosion and land degradation in India have received government attention since the late 19th century. From 1980, all soil and water conservation programmes have been based on watersheds as units. While large - scale programmes have been undertaken, an accelerated pace and better performance are needed. Land use is to be optimised and productivity increased on a sustained basis in conjunction with population control. Other key issues for better watershed management, at national, regional, institutional and technological levels, include upland - lowland linkages, training needs, long - term planning, remedy versus prevention, and people's participation.

WATERSHED MANAGEMENT IN NEPAL

M. M. D. Joshi

Nepal's hill areas are experiencing heavy topsoil loss and decline in quality and quantity of forests. Marginal lands once supplying fuelwood and fodder are now cultivated ; animal productivity is decreasing. Road construction and irrigation development aggravate ecological instability. Large - scale afforestation activities to provide employment. Watershed Management Programmes include : those planned and implemented with defined boundaries; components of multifaceted Integrated Rural Development Projects ; sectoral projects addressing issues of forestry management; and those implemented to generate data. Environmental management research is conducted by several government agencies and university units.

WATERSHED MANAGEMENT IN PAKISTAN

G. M. Khattak

Watershed management programmes in Pakistan, launched on the assumption that soil erosion and reservoir siltation are mainly caused by defective land use, are executed as development projects, using incentives to ensure soil and water conservation and simultaneously increase local incomes. Success so far has been in afforestation and awareness of mountain farmers. Two main agencies have implemented WSM projects : the Water and Power Development Authority and the Forest Departments. The current need is for a planning and research unit, and intensive, comprehensive management incorporating range management, soil and water conservation, animal husbandry, horticulture, agronomy and social sciences. The major constraint is not financial, but inadequate institutional infrastructure.

WATERSHED MANAGEMENT EXPERIENCE IN THE HINDU KUSH - HIMALAYA REGION

Kk. Panday

The Region is paradoxically diverse, yet about 140 million mountain people share the increasing hardship of being unable to meet their subsistence needs. Although population growth is not an isolated cause of economic problems, it is an important catalyst by the pressure it places on the environment. Animal population, land use, and tenure also contribute to the Region's increasing upland and lowland watershed degradation. Efforts toward stabilisation have reflected diverse situational problems. Regional and international cooperation are vital for financing and provision of technology. A political will to take responsibility for natural resource management within a country is a prerequisite for successful WSM, which is only possible with comprehensive development components. Technologically, the Region is well equipped to start a new era of WSM. An unpleasant question lingers: Do we know too much to exploit, and too little to preserve and enhance, our resources ?

People and Watershed Management

HILL FARMERS AS WATERSHED MANAGERS : DIMENSIONS OF HILL FARMING SYSTEMS AND ENVIRONMENTAL CHANGE IN NEPAL

Mahesh Banskota

Although many types of hill farming systems in Nepal share similar problems -- including population growth, pressure to increase cultivated land, fragmentation of land holdings, and increasing marginalisation of small land holders -- significant physical and socio - economic differences cannot be overlooked. A synthesis of various dimensions (ecological, population, socio-economic and institutional) is needed a for comprehensive understanding of hill farming systems that includes not only the hill farmers, but other units of socio - political decision making. Evaluation of land use alternatives starts with farmer requirements ; the hill farmer is just an entry point into the bigger and more complex hill economy and environment. Better water management and human resource development are critical. Although agriculture remains predominant, the future of hill agriculture and farmers depends on off - farm alternatives.

PEOPLE'S MOTIVATIONS FOR SUSTAINING UPLAND RESOURCES

A. A. Dani and J. G. Campbell

People's participation should not be treated as an end, but as a means to achieve sustained resource use. This initial examination of local participation in WSM activities in the Region indicates that unplanned or spontaneous land use changes have as much relevance for WSM as planned participation. Security of resource tenure, local user group management, and full communication of project information to the people, are key variables for understanding and promoting people's sustained land use in upland areas. A radical reassessment of current land - based planning tools and approaches, which takes into account locally perceived needs and adaptation of existing behaviours, could maximise impact.

Livestock, Pastures and Watershed Management

LIVESTOCK SYSTEM DYNAMICS AND WATERSHED RESOURCES

Philippe Alirol

Livestock system dynamics involve modification of the environment, production and technical factors, and change of system outputs. Animal husbandry, a traditional way to increase watershed carrying capacity, converts biomass energy available in non - cultivable ecological zones and transfers it to farms. Farming system categories include sedentary mixed farming and migratory stock farming (transhumance and pastoral nomadism). In mixed farming systems, degradation is induced by human population growth and consequent increase in livestock, demand for fuelwood and agriland, and development activities. Livestock development priorities, usually given to mixed farming systems, should be given to transhumance and nomadism, which make wider use of watershed resources.

ANIMAL HUSBANDRY AND WATERSHED MANAGEMENT IN THE HIMALAYA - HENGDUAN REGION

Huang Wenxiu

The Himalaya and Hengduan ranges have four ecological zones demanding separate animal husbandry management. (1) In the agricultural lowlands (under 2,500 m) with cattle being 25 - 30 per cent of the total animal population, meat/milk and draught animals should be home - fed with limited summer grazing. (2) In the agricultural - pastoral transition areas (2,500 - 4,500 m), cattle, sheep and horses should be raised but their populations controlled. (3) In alpine meadows (4,500 m) grazing of yak and sheep should be controlled. In the region as a whole, measures eliminating inefficient animals and structurally improving animal groupings are needed both to increase animal production and protect rangelands. Development of oxen (40 per cent of the total

animal population) will be an important part of expected change from intensive to extensive management.

RANGE MANAGEMENT IN WATERSHEDS OF PAKISTAN

N. Mohammad

Range management in Pakistan has primarily concentrated on altitudinal trials of exotic and indigenous species of grasses, fodder shrubs and trees. The Range Policy Directive of 1962 needs updating to emphasise integrated multiple land use. Recommendations include : formulation of range watershed policy, conducting detailed resource surveys and analyses, raising of promising fodder crops, and planting of fruit trees and fast - growing fuel trees. The major constraints to rangeland development are institutional and socio - economic. There is an absence of both people's participation and an independent agency to undertake range management programmes.

EXPLOITATION OF MARSHLANDS AND MARSH MEADOWS AND RATIONAL USE OF GRASSLAND RESOURCES IN RUOERGAI

Qiu Faying and Chen Qingheng

Ruoergai Region, on the east margin of the Qinghai - Tibet Plateau, is an important animal husbandry base. Precipitation larger than evaporation capacity and long periods of low temperatures cause surface water to accumulate seasonally on marshlands and meadows. Drainage has been considered, but would threaten the balance of the hydrological cycle, and cause poor growth of plants, and exposure and expansion of sand dunes. The factors limiting animal husbandry are different forage supplies, pasture areas, and uses in different seasons. Thus, pasture should be rationally controlled and divided for rotational grazing. Draining should be limited, and exploitation, use and improvement of existing pasture should receive attention.

Agriculture and Watershed Management

AGRICULTURAL DEVELOPMENT IN RELATION TO WATERSHED MANAGEMENT PROBLEMS IN NEPAL

A. N. Bhattarai

Terrace cultivation, maintenance of forests, and mixed cropping are examples of traditional watershed management in Nepal. The population explosion has rendered these insufficient. Hill areas have had food deficits from the seventies. Rice, wheat and maize yields are increasing in the Terai, but decreasing in the hills due to difficult and expensive extension and input transportation. Agricultural development in integrated rural development and WSM projects is suffering from administrative, budgetary and coordination problems. Foreign aid has played a major role in producing agricultural manpower and infrastructure, however, a change from project to programme assistance is needed.

WATERSHED MANAGEMENT AND FOOD SECURITY

K. G. Tejwani

Deterioration of watersheds is linked to the continued decline in production of food crops, despite increases in cultivated area in mountain and hill zones. Deforestation and degradation lead to weakening or breaking of the linkages between forests/grasslands and food production, thus threatening food security in both uplands and lowlands. Water resource development for irrigation wherever possible may be one of the keys to ensuring food security. When water resources are developed for irrigation, farmers use fertilisers and improved varieties, and adopt plant protection and soil conservation measures voluntarily, which result in higher food production and conservation.

Forests and Watershed Management

RUNOFF EFFECTS OF THE CUTOVERS IN ALPINE FOREST AREAS

Chen Chuanyou

With China's economic development, forests of the Hengduan Mountains are decreasing. Field surveys where forests have been widely felled show increased sediment content in rivers, more frequent floods and debris flows, decreasing low water runoff and aggravated droughts. Experiments have proven that streams in forest areas have a modulation effect on floods produced by rainstorms. In southwest China, where alpine forest cover is less than 60 per cent, large area forest felling should be decreased, and vigorous action toward afforestation and regeneration taken. All forest on steep slopes along highways and river courses, along with forests on steep slopes with thin soil layer and alpine open forest, should be protected as "water source forest". Logging methods should be improved ; the slide method should be abandoned entirely and aerial tramways and river floating should be developed.

PRESENT SITUATION OF FOREST ADMINISTRATION IN THE SOUTHWEST REGION OF CHINA AND ITS ROLE IN RIVER BASIN MANAGEMENT

Dong Zhiyong

Management of this area is important for river control in China. Under conditions of abundant rainfall, soil erosion and mud - rock flows occur easily ; sufficient forest coverage is critical. Present forest resources cannot meet the needs of both conservation and timber production. The major constraint is lack of finance. Forest protection is mainly through local organisation. Wood processing industry has no regulations for regeneration or forest management. Suggestions include: promotion of local economy, closing hillsides to livestock and fuel gathering, extending afforestation with coordination in development of husbandry, agriculture and hydropower resources.

FOREST FELLING AND REGENERATION IN THE SOUTHWEST MOUNTAIN DISTRICT OF CHINA

Han Yufen

China's southwest mountain district has abundant, mostly virgin, forest resources. Due to high elevations, steep slopes and lack of transportation, forest enterprises are concentrated in certain areas, so both overcutting and severe waste of the resource exist. Light coniferous forests are capable of natural regeneration through flying seeds. To increase speed, aircraft sowing has been ecologically and economically beneficial since the late 1950s. Dark coniferous forests, if cut and not afforested by artificial cultivated seedling, often reduce to meadow. High quality seedlings, ecologically sound planting, and utilisation of container planting, raise survival ratios. To prevent water loss and soil erosion, means of timber collection must be improved.

CUTTING OF FOREST AND SOIL CONSERVATION IN ALPINE CONIFEROUS FORESTS OF WEST SICHUAN

Ma Xuehua

An important means to prevent soil slippage is forest coverage. Current logging and lumber transportation methods cause considerable problems. Suggestions include : using aerial tramways and ground cable logging instead of slide method logging, and using wooden slides instead of floating lumber in small rivers. Forest safety belts should include the upper limit of vertical distribution of forest, steep slopes (over 35 degrees), and road shelter and mountain ridge reserve forest belts.

FORESTRY MANAGEMENT IN THE NEPAL HIMALAYA

K. R. Shepherd

The Nepal - Australia Forestry Project, based on voluntary community participation, has generated local enthusiasm and spurred grazing

restrictions. The main local uses of forests are fodder, fuel and building materials, respectively. Maintenance of viable agricultural systems depends on nutrients from productive forest systems. As neither forested nor private non - cultivated land is fully productive, the only way the mixed farming system can survive is if productivity of these lands is increased substantially. The solution involves an integrated approach to community forestry.

FORESTRY AND WATERSHED MANAGEMENT IN THE WESTERN AND CENTRAL HIMALAYA IN INDIA

R. V. Singh

Forest areas in the western Himalaya are understocked, causing low productivity and ineffective soil and water conservation. Agriculture in the region is mostly rainfed; the farmers must maintain large number of livestock for manure. Agriculture and forest lands are increasingly converted to more profitable use : horticulture. Forest conservation in the region will not be possible until local demands for forest products needed to support agriculture, horticulture, and animal husbandry are met. The strategy for WSM in the region must be to avoid wastage in harvesting and wood utilisation, conserve existing forests, improve agricultural and grassland productivity, and reduce the population of poor quality livestock.

WATERSHED MANAGEMENT IN THE INDIAN HIMALAYA WITH EMPHASIS ON FORESTRY EDUCATION AND TRAINING

K. M. Tiwari

Destruction of civil and soyam forests in India's Himalayan states has occured despite the existence of scientific forestry education and training for over a century. Initially, forest management emphasised exploitation and revenue collection rather than conservancy. From 1950, road networks in hilly areas were established; forests were depleted for defense purposes, railway sleepers, tea chests, plywood, matchwood and pulp industries, and tea cultivation. The policy of forestry education in India is highly centralised, through the Forest Research Institute, Dehradun. The current challenge for forestry is to recreate forests to meet people's basic needs. Recommendations include : establishment of an Indian Forestry Academy ; international cooperation ; and training of farmers, development officers and legislators by all Forestry Training Colleges.

Institutional Aspects of Watershed Management

PLANS, POLICIES AND PROGRAMMES IN WATERSHED MANAGEMENT IN NEPAL

P. M. Baisyat

In 1974, the Department of Soil Conservation and Watershed Management was established, primarily to reduce floods and landslides. Since 1975, thirteen projects have directly involved soil conservation and WSM, covering one-third of the country, with bilateral and multilateral assistance. In 1982, a Soil and Watershed Conservation Act was passed. The Seventh Plan (1985-90) gives topmost priority to water resource and agricultural development ; a major government policy is to maintain water resources and environmental conditions by reducing soil erosion. Community participation is being encouraged through the government decentralisation programme. It is recommended that DSCWM expand throughout the country on district and regional levels.

INSTITUTIONAL AND ORGANISATIONAL ASPECTS OF WATERSHED MANAGEMENT

Christopher Gibbs

Understanding institutions and property rights is at the heart of watershed management. Because of the diversity and remoteness of watersheds, management must be adapted and decentralised to local levels. While costs are borne

upstream, many benefits accrue to downstream populations. The division of benefits and responsibilities between public and private interests upstream and downstream are an important foundation for institutional arrangements. Unless these arrangements create appropriate incentives for villagers and agencies, management implementation will probably fail. Building organisations with a capacity for learning is a necessary condition for WSM. Programmes should plan with the people they are aimed at, and learn how to be effective from experience in programme implementation.

PLANNING FOR COMBINED APPROACHES TO INTEGRATED REGIONAL DEVELOPMENT AND WATERSHED MANAGEMENT IN MOUNTAIN AREAS

P. Gueller

Problems of mountain development are generally tackled as comprehensive planning, as a reaction to unsuccessful approaches, or as practical tasks of government administration through link agencies. Functional integration of WSM into comprehensive rural development reflects the necessity to motivate broad segments of the rural population, to increase care for their natural environment. Isolated WSM schemes with narrow scope are unlikely to succeed. WSM must bridge operations on the various levels of government, to village administration and social organisation. WSM projects in Nepal have found a degree of integration by grouping engineering, agricultural, livestock, and forestry components. In the evolution and diversification of Nepal's rural development, both IRDPs and WSMPs have found extension and social mobilisation play a central role.

ECONOMIC FACTORS AFFFECTING WATERSHEDS OF NORTHERN PAKISTAN

K. R. Qureshi

Increasing exploitation of land to meet basic needs of the expanding population is resulting in widespread soil erosion, under all forms of land use in the region. Successful pilot watershed projects have encouraged terracing of agricultural land, causing acre yield and income increases of 25 per cent. Existing projects use various subsidy scales for land improvement and conservation, which limit the spread of conservation benefits. Watershed development needs to be integrated with national development. Insufficient attention has been given to the economic needs of the people, and to watershed development in the national budget. Alternative sources of funding, such as hydropower, need consideration.

ECONOMICS OF WATERSHED MANAGEMENT IN THE HIMALAYAN REGION OF INDIA

S. L. Shah

Watershed management projects have been implemented in the Himalayan Region for over a decade, with only partial success. Existing village level institutions are not functioning properly. Political and bureaucratic support both at the policy and field level are necessary. People's basic needs for fuel, fodder and drinking water should receive urgent priority. It has been found that when water resources are developed, conservation practices follow. Other recommendations are: to link subsidies with performance and adoption of technology, to secure long - term funding, to integrate the sectoral approach at the staff level, to consolidate fragmented land holdings, and to give equal importance to checking population growth rates and developing watersheds.

INTERNATIONAL COOPERATION AND ASSISTANCE TO WATERSHED MANAGEMENT IN NEPAL

K. P. Upadhyaya

Through diverse approaches, international donor agencies have contributed : increased awareness of the consequences of watershed degradation ; specifications for watershed management practices ; testing of the socio - economic and institutional mechanisms to promote community participation to implement conservation practices, development of a trained cadre of professionals and technicians ; organisation of on -

the - job training ; and establishment of demonstration watersheds. A review of various project evaluation reports reveals the need for increased time periods for design phases, clear understanding between national and community projects, long - term commitment, better financial flow, strengthening of planning cells, built - in evaluation and monitoring systems, better incentives, and use of NGOs and user groups.

MANAGING CATCHMENTS, RESERVOIRS AND COMMANDS AS A SYSTEM IN THE HIMALAYA

M. N. Venkatesan

The occurrence of floods in the Ganga - Brahmaputra basin has become an annual feature, bringing loss of life, property, and livestock, and aggravating reservoir siltation and ecological degradation. A multi - disciplinary Catchment Area Protection Authority is recommended to make use of flood waters; in the Ganga - Brahmaputra basin, it is estimated revenues from the sale of hydroelectric power will largely cover initial investments for construction of storage areas. High investment programmes for water resource development are required -- in the range of $500 billion for 30 years -- emphasising awareness of natural resource limitation and technical skill for resource utilisation.

THE RELATIONS BETWEEN DRAINAGE CONTROL AND THE EXPLOITATION OF NATURAL RESOURCES

Wu Zheng Yi

Rational utilisation and exploitation of mountain region biological resources are the key links for development of agriculture and territorial/national economies for developing countries. Especially with urbanisation, the mountains, valleys and flood plains are interconnected, though unified planning cannot be easily achieved. Measures to improve relations between utilisation and conservation include: depending on green plants ecosystems, building vegetation cover management systems, strictly protecting regeneration ability of biomass, and promoting multiple utilisation of resources for ecological, economic and social benefit. Human beings and Great Nature could and ought to gradually attain harmony.

Research and Technology for Watershed Management

ASSESSMENT OF A SMALL WATERSHED USING AERIAL PHOTOGRAPHY : AN EXAMPLE FROM A REMOTE HILL REGION IN NEPAL

Brian Carson

Land and human resources need to be considered concurrently ; use of aerial photography can achieve this. By integrating land inventory data, settlement infrastructure, land tenure, villager movement, and economic, political, social and religious spheres of the village on aerial photographs, the land manager is in an excellent position to suggest positive changes for successful and appropriate development at the village level. Also, within a few minutes, untrained villagers can pick out their own homes, farmland, and water sources. Once negatives are available, printing aerial photographs is cheaper and more rapid than making large scale topographic base maps.

RESEARCH AND TRAINING IN WATERSHED MANAGEMENT IN NEPAL

E. R. Sharma

The Seventh Plan (1985 - 90) highlights scarcity of forest products and soil erosion as research priorities. The main efforts of forest research at present are collection of data for a preliminary silviculture manual and species / provenance and elimination trials for fuelwood and timber. The Resources Conservation and Utilisation Project is monitoring hydrology and studying land use capabilities. The emphasis for future research activities must be on afforestation of marginal soil,

and the need for improved protection, production and management of forest. The major gaps identified in research at present include the impact and cost - benefit evaluation of erosion control measures.

GUIDELINES FOR THE FIRST - STAGE RESEARCH OF WATERSHED MANAGEMENT IN THE DRY VALLEYS OF THE HENGDUAN REGION

Zhang Rongzu, Sun Shangzhi and Wu Sugong

The dry valleys within the Hengduan Region are agriculturally important and have the most populated settlements of the area. All the dry valleys are semi - arid, and can be subdivided into hot - dry, warm - dry, and temperate - dry. Most are in rainshadow areas. Environmental deterioration has been brought about by expansion of cultivation, forest clearing, and promotion of goat pasture. Almost all ecosystems have had intensive and direct human influence. The first step of reforming the dry valleys should be conversion of misused land, especially steep slope farmland for regreening. Integrated research for economic, social, and environmental data collection is emphasised and recommended.

Geo - ecological Conditions and Watershed Management

RIVER BASIN MANAGEMENT AND RESOURCE EXPLOITATION IN THE HENGDUAN MOUNTAINS

Cheng Hong and Ni Zubin

The Hengduan Mountains are sparsely populated with little economic development. A high proportion of the region has vegetational cover. Human activities have not affected the environment except in the east and south ; forests have been overcut and slopes cultivated, causing soil erosion and siltation in rivers. The most important measures to be taken are : rational cutting of forest, improvement of timber stocking and transportation, readjustment of the structure of the agricultural economy, and slope reform.

HINDU KUSH - HIMALAYAN EROSION AND SEDIMENTATION IN RELATION TO DAMS

Victor Galay

In planning for dams in the Hindu Kush - Himalaya Region, it is essential to know sediment yields to estimate reservoir life, but pertinent data related to erosion processes is lacking. One of the most dominant erosion processes results from glacier lake outburst floods which cause enormous sediment loads due to mass wasting. The management of watersheds to reduce erosion and extend reservoir life cannot be effective until more research related to quantifying erosion processes is carried out. It appears that water resource projects for power production or irrigation should utilise low level weirs instead of high dams.

THE PROBLEMS OF SOIL AND WATER CONSERVATION IN SOUTHWEST CHINA

Guan Junwei

Soil and water loss are defined as destruction of soil body (soil, subsoil, base rock) by water, gravity, wind, animals, plants and humans. The main forms of such loss occuring in southwest China are : plant food and leaching loss, squamose erosion, gravity erosion, torrential erosion, and debris flow. Debris flow can be forecast according to rainfall variance and rate of flow, after laying rain gauges, weir dams, pressure recorders for soil, recorders for dynamic water pressure and moisture for each layer of soil and trailing. The forecast mainly depends on over - saturation of solid load. The study of dynamic prediction of debris flow has advanced the system of long - term debris flow dynamic forecast.

EXPLOITATION AND UTILISATION OF NATURAL RESOURCES IN THE HENGDUAN MOUNTAINS

Li Mingsen and Sun Shangzhi

To improve the economy and ecological environment of the Hengduan Mountains, the following measures should be considered : stabilise grain productivity and redistribute surplus, return

crop land with low productivity to forest or grazing land, cut forests rationally -- selection versus clear cutting -- and increase afforestation, establish artificial grasslands and improve animal community structure, develop cash crops (sugar, tobacco) and fruit orchards in valleys, conserve wild biological resources, develop artificial cultivation of medicinal herbs, flowers and wild animals, exploit ferrous and nonferrous metal and other mineral resoruces, develop diversified energy sources, advance processing and tourist industries, expand highway and education networks, and train local people.

DEBRIS FLOWS AND THEIR PREVENTION AND CONTROL IN JIUZHAIGOU SCENIC SPOTS OF THE HENGDUAN MOUNTAIN REGION

Liu Suqing, Tang Bangxing, Tan Wanpei
and Liu Shijian

Most debris flows in Jiuzhaigou area originate in rocky mountains and steep hillsides above forest line (2,000 - 3,000 m), with distribution primarily over forest cutting area. Aims for the area are protection of natural ecological environment and promotion of tourism. To combine prevention with control, engineering works such as blocking, sandpocket and gully stabilisation projects must be carried out consecutively with vegetation measures such as plantation and afforestation of cultivated areas. Closure of forest areas, and restriction of tree felling and livestock grazing, are further suggestions.

ECONOMIC PLANTS OF THE HENGDUAN MOUNTAIN REGION

Liu Zhaoguang

The Hengduan Mountain Region has the richest collection of alpine plants in the world, with over 4,000 species of economic plants. Important among these are medicinal plants (over 1,500 species). Essential oil plants containing volatile oils in their roots, stems, leaves and flowers, have many uses in light industry, food industry, chemical industry and medicine (over 400 species). Other oil plants, widely used in food industry, machinery, light industry, chemical industry and exploration, include 250 species, with over 100 having an oil content of more than 39 per cent. Other economic plants include starch and gelatinous starch plants, fibre plants, tannin plants, germplasm resources, wild fruit and flower resources, and the host plants of lac and white - wax insects.

WATERSHED DEGRADATION IN NEPAL

K. B. Malla

As many authors have stated, watershed degradation in Nepal is rated as high or very critical. Erosion is probably the most serious problem. Topsoil loss induced by grazing needs immediate attention. The most serious deforestation has occured in Nepal's southern plains through conversion for agricultural land. Programmes to increase sustained agricultural production are necessary to improve watershed conditions. Priority in formulating land use planning and policy making should go to ministries connected with natural resource management.

PROBLEMS OF SEDIMENT LOAD IN WATER RESOURCE DEVELOPMENT OF NEPAL

C. K. Sharma

The main cause of heavy sediment load and decrease of lean flow in Nepal are weak geology, heavy and intensive rainfall, glacial lake bursts, deforestation, seismicity, and human factors. The most conspicuous human factor is the cutting of river banks for roads and canals. While partially responsible for sediment load, human factors are the main cause of the reduction of low flow and increase in high flow. To control sediment in rivers of the region, special techniques of WSM for stabilisation of slides and lake bursts are necessary, with regional and international cooperation.

RECENT DEBRIS FLOW ACTIVITY IN THE HENGDUAN MOUNTAINS

Tang Bangxing, Liu Suging, Tan Wanpei
and Liu Shijian

In recent years, debris flows in the Hengduan Mountains have become frequent and destructive mainly due to excessive exploitation of biological energy. The debris flows are concentrated in river valley zones, with densely populated urban areas. Active periods occur in relation with change of atmospheric circulation, earthquakes and human activity. The most serious problems are siltation, breach of natural dams, and upward movement of debris flow. Debris flow countermeasures include: prevention through ecosystem protection and rational development of agriculture, forestry and animal husbandry ; avoidance of debris flow hazard zones; and engineering measures with emphasis on checking, discharging and stabilising for the short term and closing mountains to livestock grazing and fuel gathering for the long term.

GEOTHERMAL ENERGY AS A KEY TO COMPREHENSIVE DEVELOPMENT OF ENERGY SOURCES IN TENGCHONG COUNTY OF WEST YUNNAN

Tong Wei and Zhang Mingtao

Tengchong County in the southern Hengduan Mountains is without coal or oil, but is rich in hydropower reserve, with 85 minihydro stations in operation. Hydropower currently conflicts with water conservancy ; irrigation must take priority. Areas of water conservation forest have dropped sharply as forest fuels are primarily used for household and industry. Consumption of energy resources is increasing rapidly. Water loss and soil erosion have intensified. Comprehensive solution to energy source problems is urgent. Rapid development of forest and geothermal resources are suggested to allow rehabilitation of hydropower and water resources.

THE RAINSTORM AND ITS RUNOFF OVER THE HIMALAYA AND THE TRANSVERSE MOUNTAINS

Wu Xiangding, Lin Zhenyao, Zhang Yiguang,
and Guan Zhuhua

In China, a rainstorm is defined as over 50 mm of rainfall in 24 hours. In the plateau and mountain areas, major weather systems are shear line, vortex, and Bengal storm. June, July, and August are the rainiest months throughout the region. The rainstorms are concentrated on the eastern and southeastern parts of the Himalaya - Transverse Mountain area. Approaches for preventing or weakening rainstorm runoff damage are : afforestation, construction or reconstruction of flood control installation, and more research on rainstorm and runoff.

A GENERAL INTRODUCTION TO DEBRIS FLOWS AND THEIR COMPREHENSIVE CONTROL IN HEISHA RIVER, LIANGSHAN, SICHUAN

Wu Jishan, Tian Lianquan and Zhang Youfu

The Heisha River is a catastrophic debris flow gully in the mountainous region of southwest China. A control programme was devised according to the formative mechanism, activity laws, and damaging patterns of debris flow. Measures include: a flood - control reservoir, conservation forest on the upper reaches to regulate floods, silt arrest dams, check dams, revetments and longitudinal dikes, and soil and water conservation forest on the middle reaches. On the lower reaches, dikes, drain ditches and protection forest belts have been established. Since 1978, when these measures were completed, the hazards of debris flow have been controlled. However, current reservoir and dike siltation calls for strengthened management to close the mountains and facilitate afforestation.

INTEGRATED DEVELOPMENT OF THE ERHAI REGION

Zhang Mingtao and Chen Chuanyou

The Erhai Region consists of a series of parallel mountain ranges and large, flat valleys. Although cultivable land area is available, spring drought constitutes a great threat to agricultural production in the region. Even water supply for human and livestock consumption is problematic. Inefficient utilisation of water resources is hindering growth in production. Hydroelectric potential is facing investment constraints and rising costs of production. The only way to solve the water shortage in Erhai Region and its effects is cross basin diversion. By tapping new water sources, irrigation, regular functioning of power stations, maintenance of the Erhai Lake water level, and agricultural and industrial production needs may be met. Various government departments have put forward designs for the project. The most reasonable plan is diverting Yangbi River water to Erhai Lake, either by a converging or a diverging plan.

A COMPARATIVE STUDY OF THE GEO-ECOLOGICAL CONDITIONS AND ENVIRONMENTAL PROBLEMS BETWEEN HIMALAYA AND THE HENGDUAN MOUNTAINS

Zheng Du

The tropical fringe and subtropical zone of the middle and low altitudes of both the Himalaya and the Hengduan Mountains are characterised by monsoon climate though the precipitation ranges are distinct. Yak and sheep are grazed in the alpine belt, croplands are located in the valley belt, and the montane forest belt is used for grazing and cultivation in both mountain areas. Population growth, increasing economic development and related changes have brought about environmental problems such as slope instability, accelerated soil erosion, and expansion of scrub belt of dry valleys. Landslides, slope - slip, mud - flows and debris flows are frequent problems shared by the regions.

Annex 5.
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