WATERSHED MANAGEMENT CASE STUDY: NEPAL

Review and assessment of watershed management strategies and approaches

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Preface

On the occasion of the International Year of Mountains, and in response to the clear consensus reached by the international community regarding the need to ensure harmonious and sustainable development of mountainous areas and watersheds, FAO and its partners in the subject, undertook a large-scale assessment and global review of the current status and future trends of knowledge about and techniques for integrated watershed management.

The objective was to promote the exchange and dissemination of experiences on integrated watershed management techniques, identify constraints to the implementation and development of those techniques during the decade 1990 to 2000 and capture relevant new paradigms and approaches. The lessons learned from diverse experiences are being used to define a new generation of integrated watershed management projects.

Experts from four continents contributed to the assessment, which yielded four main outputs: i) a review of experiences in watershed management, based on questionnaires sent to active partners in the field; ii) substantive reports of four regional workshops in Nairobi (Kenya), Kathmandu (Nepal), Arequipa (Peru) and Megève (France); iii) four case studies from the Mediterranean basin, Nepal, Bolivia and Burundi; and iv) an international conference in Sassari, Italy.

Watershed management concepts and approaches were reviewed and different experiences assessed. The results of this exercise are presented in several documents, which include the proceedings of workshops and reports on the four case studies.

The conservation, use and sustainable management of watershed resources in order to meet the demands of growing populations have been a high priority for many countries over the past decades. In this respect, integrated people's participation in watershed management has become widely accepted as the approach that ensures sound sustainable natural resources management and a better economy for upland inhabitants, as well as people living in downstream areas.

Watersheds in Asia, particularly in Nepal, are characterized by diverse biophysical settings and socio-economic situations. "Within one river basin, and over a short vertical interval, one can observe the manifestation of alpine as well as tropical watersheds. Similarly, within one river basin there exist arid, semi-arid and humid watersheds" (Upadhaya, 2003).

The 1980s decade could be considered to be the "warming up phase" for watershed management in the Himalayas in general and Nepal in particular. It witnessed the launching of a series of global, regional and national initiatives in the form of workshops, seminars, debates, etc. about watershed management concepts and practices.

The 1990s witnessed the expansion phase of watershed management. Projects gained credibility by focusing on the poor and marginalized groups and by being environmentally friendly, more science-based and integrated. They encompassed many objectives, including conservation and sustainable management of natural resources for enhanced rural livelihoods, and protection of downstream infrastructures.

These developments in watershed management approaches and practices are important to Nepal. With very limited resources the country is affected by strong natural and human-induced erosion and sedimentation processes while agricultural production is marginal, and hardly meets particularly high population demands. Although farmers have adapted their production systems in the past, they are increasingly confronted by the need to further invest in the land and consider long-term sustainability, particularly in upland areas.

This case study provides an in-depth analysis of Nepal's views, efforts and achievements in watershed management. Its primary objective is, on the basis of the findings made from the analysis, to make recommendations for the next generation of watershed management projects and programmes. It contributes valuable information and inspirations from a country strongly marked by the mountain ecosystems and processes that affect communities living in them.

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Acronyms

asl	above sea level
AusAID	Australian Agency for International Development
CBO	community-based organization
CBS	Central Bureau of Statistics
CDG	Community Development Group
COFO	Committee on Forestry (FAO)
DANIDA	Danish International Development Agency
DCC	District Coordination Committee
DF	Department of Forests
DM	dry matter
DNPWC	Department of National Parks and Wildlife Conservation
DPR	Department of Plant Resources
DPRS	Department of Forest Research and Survey
DSCO	District Soil Conservation Office
DSCWM	Department of Soil Conservation and Watershed Management
DSWC	Department of Soil and Water Conservation
EIA	environmental impact assessment
ETP	evapotranspiration
FAO	Food and Agriculture Organization of the United Nations
FINNIDA	Finnish International Development Agency
GDP	gross domestic product
GIS	Geographic Information System
GLOF	glacier lake outburst floods
GTZ	German Agency for Technical Cooperation
ICIMOD	International Centre for Integrated Mountain Development
IRD	integrated rural development
IUCN	World Conservation Union
JICA	Japanese International Cooperation Agency
LSGA	Local Self-Governance Act
M&E	monitoring and evaluation
MFSC	Ministry of Forests and Soil Conservation
MPFS	Master Plan for the Forestry Sector
NGO	non-governmental organization
NPC	National Planning Commission

NRCC	National Resource Conservation Commission
OM	organic matter
SDC	Swiss Development Corporation
SWCA	Soil and Watershed Conservation Act 1982
SCWM	soil conservation and watershed management
TDN	total digestible nitrogen
UAKWMP	Upper Andhi Khola Watershed Management Project
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
VDC	Village Development Committee
WM	watershed management

Introduction

CONTEXT

About 25 percent of the world's population lives in the uplands of the Asia and the Pacific region. Population pressure, compounded by improper use of land and other natural resources, has led to the progressive degradation of upland areas throughout the region. This degradation is causing adverse effects in the adjoining lowlands, where another 25 percent of the world's people reside. In view of the scarcity of land and the growing demand for goods and services for a growing population, the countries of the region are increasingly concerned about the problems of watershed degradation. For several decades, the conservation, use and sustainable management of watershed resources have been high priorities in many countries of the world. Integrated watershed management (WM) is now considered an appropriate approach to ensuring sound sustainable natural resources management, improving the economic conditions of watershed inhabitants and reducing poverty among rural people.

At FAO's Fifteenth Regional Conference for Asia and the Pacific (held in March 1980 in New Delhi) there was consensus that countries should take a collective approach to WM.

Over the years, several countries have developed different approaches and methodologies for integrated WM, but these experiences have had mixed results. FAO has therefore been emphasizing the need to refine integrated WM policies and programmes by introducing a more effective intersectoral, multidisciplinary and participatory approach. This need has been expressed at many international fora, including the Earth Summit in 2002 and FAO Committee on Forestry (COFO) meetings.

In pursuit of this end, FAO decided to conduct an in-depth analysis of WM achievements, gaps and lessons learned in order to improve future WM programmes. This paper presents a case study from Nepal with the aim of sharing experiences of integrated WM from that country.

PURPOSE

The purposes of this study are to provide an in-depth analysis of aspects of Nepal's WM endeavours, based on the ideas, views and experiences of acknowledged authorities, and to present pragmatic recommendations for the future. Its primary objective is to make recommendations for the next generation of WM programmes and projects by assessing and identifying the nature and extent of achievements and gaps in state-of-the-art WM programmes and concepts in Nepal. It also sets out to:

- share information and contribute to a better understanding of the current status of WM in Nepal;
- collect and present lessons learned and principal issues emerging from experiences in Nepal, with particular focus on the 1990 to 2000 period;
- identify guidelines for the formulation and implementation of the next generation of WM programmes in Nepal.

METHODOLOGY AND CONTENT

The methodology adopted for this case study consisted of collecting and reviewing available secondary sources of data/information, such as project documents, evaluation reports and workshop proceedings. A wide range of professionals, including policy-makers, planners, field practitioners and officials, were consulted. A regional workshop was conducted to promote the sharing, dissemination and exchange of information on WM achievements and existing gaps, to provide support for the development of effective WM.

This paper provides some background information on Nepal, outlines the evolution and status of WM in that country, and discusses achievements, opportunities, lessons learned and gaps. It also suggests how future WM endeavours should be directed in order to achieve successful results.

1. Country overview

COUNTRY DESCRIPTION

Nepal is a mountainous country of 147 181 km^2 situated in the Central Himalayas of South Asia. It is landlocked and lies between India (to the east, west and south) and China (to the north). It is one of the least developed countries in the world, with an annual per capita income of less than US$236.

Nepal's economic growth is hampered by the lack of economic opportunities and infrastructure. These problems are further exacerbated by growing poverty and environmental deterioration, which are caused by the country's excessive dependence on the use of natural resources. About 91.4 percent of the economically active population is engaged in agriculture and allied activities.

Administratively, Nepal is divided into five development regions, 14 zones and 75 districts. The districts are further divided into Village Development Committees (VDCs) and a few municipalities.

THE LAND

Nepal has five main geographic zones (Map 1): high Himalaya, high mountain, middle mountain, the Siwalik, and Terai. Terai areas are fertile, while the Siwaliks are very fragile and prone to landslides. Middle mountain areas are semi-stable, but heavily populated and cultivated. High mountain areas consist of very steep slopes and deep valleys. About 59 percent of the total land area is steep to very steep slopes, 22 percent is moderate to steep, and 19 percent is plain (Terai).

The landscape of Nepal is the result of the ongoing collision between two massive continental plates – India to the south and Asia to the north (ICIMOD, 1992). The basic physiographic structure of the country is made up of a succession of east–west ranges that form an echelon from south to north, punctuated by distinctive depressions (see Figure 1). Nepal is subdivided into five major physiographic regions (see Map 1) with distinct bedrock, geological, climatic and hydrological characteristics. Soils and land use within these regions are significantly dissimilar.

More than a third of the country's land surface lies between 305 and 1 524 m above sea level (asl), and another 22.6 percent lies between 1 524 and 3 048 m. Land of more than 3 048 m asl covers 27.5 percent, while lowlands of less than 305 m asl account for 11.3 percent of the total surface.

The Gangetic plain – the Terai – was formed as a result of the accumulation of alluvial deposits from the Himalayas and constitutes a vast piedmont adjacent to and south of the Himalaya Range. These fertile sediment soils cover 14 percent of the total land area (2 122 km^2). The Terai constitutes a disrupted northwest to southeast strip along the southern edge of Nepal, with elevations ranging from 60 to 330 m asl and slope gradients from 0.2 to 1.0 percent.

The Terai region is subdivided into the following three units:

- ***Active alluvial plains:*** Frequently flooded, these cover 1.3 percent of Nepal's land area. Their soils are generally coarse and lack significant weathering. Given the risks of monsoon floods, these lands are not intensively managed (instead they are used for grazing and low-risk crops).
- ***Recent alluvial plains:*** Known as the "bread basket" of Nepal, the recent alluvial plains cover 7.9 percent of the country's land area. Soils are fertile and stable, and water tables never far from the surface.

- ***Older alluvium:*** The older alluvium (4.9 percent of the total land area) is made up of coarse-textured soils on higher slope gradients. Areas of local uplifting, particularly in the western Terai, have discouraged settlement.

Most of the lands of the Terai have already been settled. A year-round growing season, good soils, water availability and a relatively well developed infrastructure with easy access to markets are positive features for the future of agriculture.

The Siwaliks or Siwalik foothills are situated north of the Terai and form a continuous strip of between 120 and 2 000 m asl along the Terai, running in the same northwest to southeast direction. Covering 13 percent of Nepal's total land area (1 879 km^2), the Siwaliks are very fragile and prone to landslides. Altitudes are mainly less than 300 m asl and rarely exceed 1 000 m asl.

Within the mountainous landscapes of the Siwaliks, slopes are too steep and/or unstable and soils too shallow to support any type of agriculture. The most important agricultural lands are found in the Dun valleys. The Siwalik ranges are made up of very rugged and sometimes broken terrain with deep gullies. Bedrock types and extensive shale areas are not suitable for forest growth. However, the north-facing, gently sloping sandstones support highly productive mixed tropical hardwood forests.

Geomorphic instability with frequent landslides, particularly in mudstone and shale areas within the Siwalik mountains make road construction and maintenance extremely expensive.

Map 1: Physiographic regions of Nepal

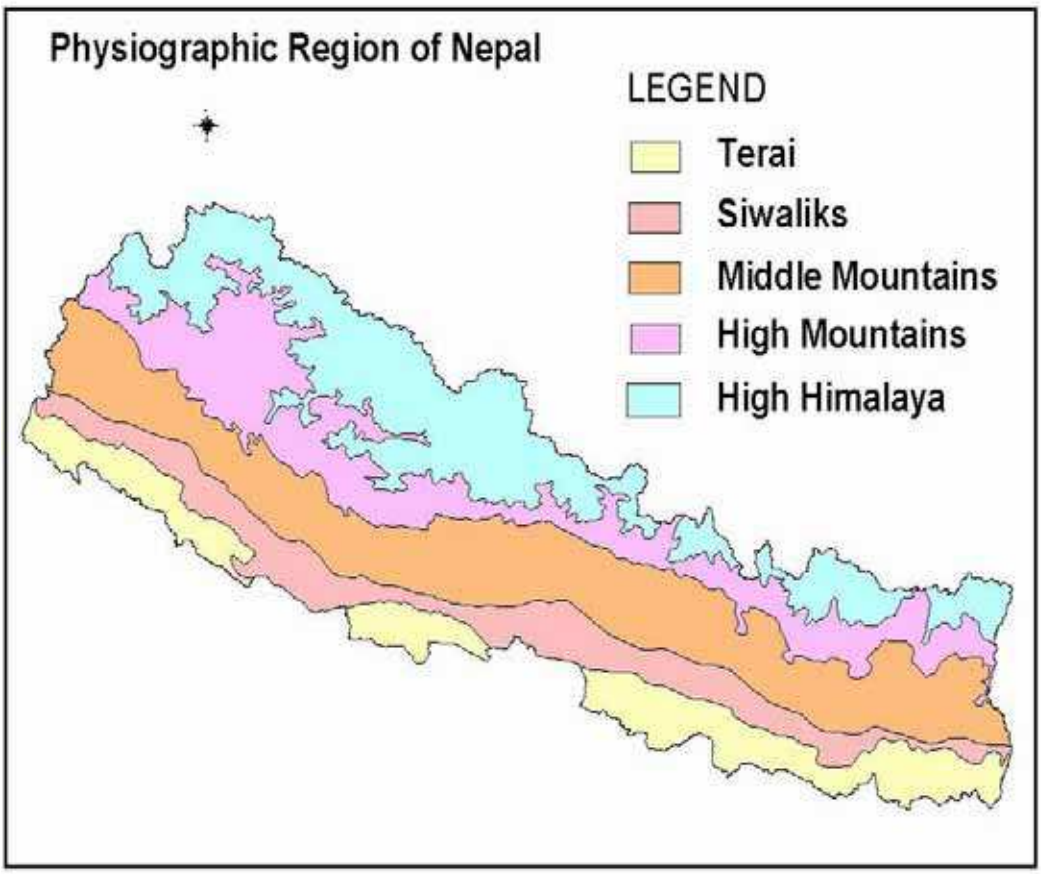
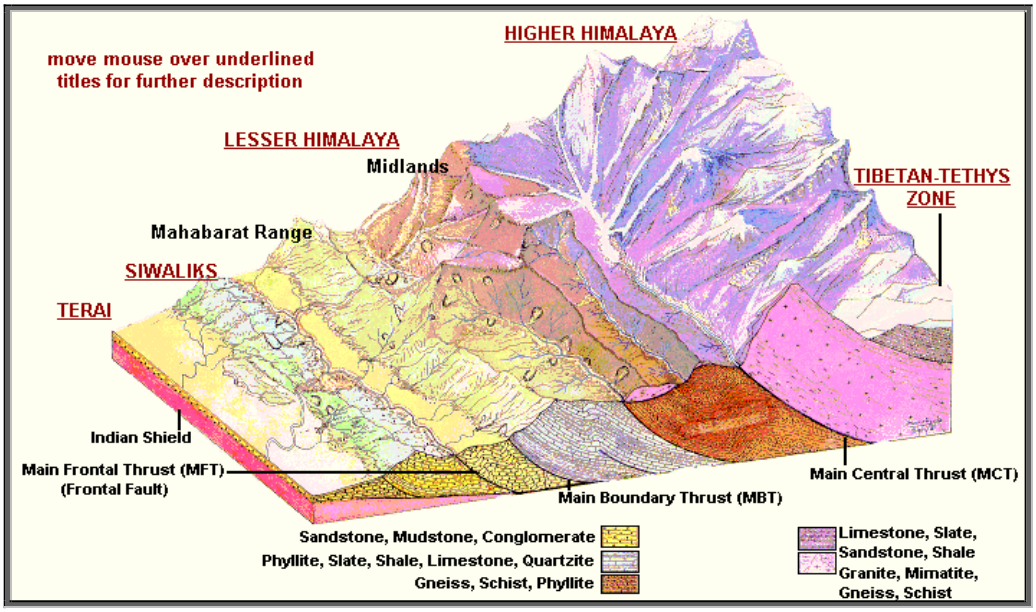


Figure 1: Physiographic profile of Nepal



Source: CIDA and Canadian International Water and Energy Consultants, 2001.

The middle mountains, also called the southern mountain belt of the lesser Himalayas, lie between 200 and 3 000 m asl and are home to the Mahabarat range. They run along and north of the Siwalik foothills and occupy 29.5 percent (4 350 km^2) of the national territory. Altitude ranges of up to 1 000 m between valley bottom and hilltop are common, with ranges of up to 2 000 m occurring throughout the southern boundary of the middle mountain region. However, slopes are gentler than they are in the Siwaliks. A significant proportion of the moderately sloping hills are under sophisticated terrace cultivation.

The middle mountains are heavily populated and cultivated.[1] Except for those managed by user groups, forests are generally not well managed and are heavily exploited for fodder, fuelwood, litter and timber. There are also a few unexploited forests in the middle mountains. Pastures are overgrazed and highly degraded.

The high mountains, which are sometimes called the midlands, constitute a very irregular strip running north of the middle mountains, between 1 000 and 4 000 m asl and covering 19 percent (2 899 km^2) of the county's area. They consist of very steep slopes and deep valleys in which a wide array of tropical to cool temperate conditions occur. Altitudes in the order of 2 000 m asl are common, while areas of gently sloping land are less common than they are in the middle mountains.

The most intensively cultivated lands are those adjacent to valley bottoms or at higher elevations where soils suitable for cultivation are found. The region is isolated, which explains why farmers are very dependent on subsistence production. Forests are in better condition than they are in the middle mountains, largely because of difficult access and less severe human and animal pressure, despite some mismanagement.

The high Himalayas, which lie above 4 000 m asl cover 23 percent (3 447 km$^{2)}$ of Nepal's total land area. Most of the region below 4 300 m asl still bears natural forests. On the south side of the Himalayas, forests may be lush because of the high rainfall conditions, whereas dry forests and grassland steppes occur in the rain-shadow, behind the main mountain range.

[1] The soils are suitable for terracing and the climate permits two crops per year.

This area is underpopulated owing to a lack of cultivable land and to cold winters. Where conditions permit cropping, small but very dense pockets of population are found. Monsoon grazing and medicinal forest plant collection are the major activities in these areas.

Soils

The soils of Nepal are highly variable and derive mainly from young parent material. They are divided into the following categories (FAO):

- ***Alluvial soils:*** These are found in the Terai valleys and the Dun valleys[2] of the middle hills. Alluvial soils are divided into three broad groups: i) new alluvial soils deposited in the floodplain areas along river courses, which contain more sand and silt than clay; ii) less recent alluvial soils, which cover the greater part of the Terai; and iii) older alluvial soils, which are deficient in nutrients.
- ***Sandy and alluvial soils:*** Relatively fertile sandy and silty alluvial soils are found in the Kathmandu and Pokhara valleys, together with some deposits of peat mare (diatomaceous clay). The Kathmandu valley is also a source of dark clay/silt clay soil, which is rich in humus and potash (with limited calcium) and is collected from deep underground pits and used to fertilize vegetable crops.
- ***Gravely soils:*** A mixture of gravel and pebbles constitutes the coarse-textured gravely soils, which retain little moisture and are not useful for agriculture. Deposited by the rivers that originate in the Churia hills, these soils have high lime contents. Some coarse-textured soils are also found in the high mountain area.
- ***Residual soils:*** These are found mostly on mountain ridges and slopes. Those of the Churia hills are very young, coarse and dry for most of the year. Residual soils on the middle hills have medium to low nutrient contents and are less productive owing to moisture and climatic limitations.
- ***Glacial soils:*** These are found in the high Himalayas and are mainly rocky and covered with snow and/or ice for most of year.

The nutrient status of soils differs from place to place, depending on slope and erosion. Large portions of soil nutrients are washed away by erosion, mostly during heavy rains. Agricultural soils are undergoing steady degradation and are not as fertile as they once were (ICIMOD, 1992).

Levels of organic matter (OM) on cultivated soils below 2 000 m asl range from 0.5 to 3.0 percent and average slightly less than 1.0 percent. Forest soils here tend to have 1 to 2 percent higher OM contents. Over 2 000 m asl, climatic and vegetation changes result in higher soil OM contents for both cultivated and forest soils (2 to 3 percent higher). New forest clearings in the Terai may have 4 to 5 percent OM contents, but these drop to less than 2 percent after a few years of cultivation.

Biodiversity[3]

Nepal's biodiversity is very rich and diverse, with:

- more than 5 400 species of vascular plants, of which 245 are endemic and 700 medicinal;
- 175 species of mammals;
- 850 species of birds;
- 170 species of fish;
- 600 species of butterflies, 50 species of moths and 180 species of dragonflies.

[2] Wide, flat and fertile valleys.
[3] Information from Nepal's report to the United Nations Conference on Environment and Development (UNCED), 1992.

These species are protected in national parks, wildlife reserves and conservation areas that cover 12 percent of the country's land area. Two national parks – the Sagarmatha and the Royal Chitwan – were classified among the United Nations Educational, Scientific and Cultural Organization's (UNESCO) World Heritage Sites in 1979 and 1987, respectively (Government of Nepal, 2002).

Limited attempts have been made to conserve biodiversity outside parks, reserves and protected areas. It is assumed that about 20 bird species have probably become extinct in Nepal. Some other bird species are at risk and there is a great need for forest management. The destruction of vegetation and the urbanization that have taken place in the Kathmandu valley may have accelerated the disappearance, migration or extinction of 33 species of birds.

THE CLIMATE

Most of Nepal lies within the subtropical monsoon climatic region, but owing to its diverse topography and elevations, the country experiences a wide range of climates. The orientation of mountains, deep valleys and slopes is responsible for the existence a number of micro-climatic regimes within short distances from south to north.

The climate of Nepal is strongly determined by its physiography (see Table 1). The lower altitudes of the *Terai* and the *Dun* valleys are subtropical, whereas the *Hills* are warm, temperate. The *Siwalik* ranges are mostly subtropical but warm temperate in the higher elevations. Similarly, the *Hills*, generally warm temperate, are subtropical in the river valleys and cool temperate in the higher ridges. The *Mountains* between 3 000 m and 4 000 m are alpine, and above 4 000 m, they are arctic.

Table 1: Climatic data

Stations	Temperatures (C⁰)		Precipitation (mm)		Mean annual ETP
	Maximum	Minimum	Mean annual	Minimum annual	
Terai region/S. 705 (110 m)	42.4	+ 2.0	1 673	701	1 612 mm
Inner Terai/S. 406 (720 m)	40.1	- 0.6	2 064	900**?**	1 153 mm
Hill (valley**) region/**S. 803 (918 m)	35.3	+ 2.6	3 577	3 208	1 061 mm
Hill (slope**) region/**S. 809 (1 097 m)	36.0	+ 0.9	1 750	900?	1 000 mm
Mountain region/ S. 601 (2 744 m)	30.5	-10.0	256	50?	676 mm

ETP = evapotranspiration. ? = Estimated values S. = Station
Source: Gyawali, 2001.

There are three main seasons: i) the wet season between June and September; ii) winter with some precipitation between October and February; and iii) the dry season between March and May. Mean annual precipitations range from 250 to 4 500 mm. Intense monsoon rainstorms occur from June to September along the front of the Himalaya range that stretches from Bhutan to Pakistan, respectively east and northwest of Nepal. Because the monsoon generally arrives from the south, the southern flanks receive more rain than the northern ones. The heaviest precipitations occur along the Siwalik foothills, with a dryer rain-shadow to the lee of these regions.

DRAINAGE AND HYDROLOGY[4]

Nepal is drained by some 6 000 rivers and tributaries (Map 2) that feed the Ganges River. Most of the country's four major river basins (Map 2) originate from the snow-capped Himalaya.[5] These rivers are, from west to east:

[4] Information for this section from Gyawali, 2001; and AQUASTAT, FAO's Information System on Water and Agriculture.
[5] A large portion of the Arun basin extends into Tibet, as shown in Map 3.

- the Mahakali river basin, which is shared with India and has an estimated average flow of 15 billion m^3/year;
- the Karnali river basin, which has an estimated annual outflow of 43.9 billion m^3;
- the Gandaki river basin, which has an average outflow of 50.7 billion m3/year;
- the Kosi river basins, which has an estimated average outflow estimated of 47.2 billion m^3.

Six smaller southern river basins – the Babai, the West Rapti, the Bagmati, the Kamala, the Kankai and the Mechi – originate in the middle hills and flow into India, where they meet the four main rivers of Nepal before joining the Ganga. These produce some 65 billion m^3 of water, which flows into India. Many other basins, similar in character to the southern ones, originate in the middle hills, but meet the main stems of the four major rivers within the territory of Nepal and are traditionally classified as part of the major basins.

Nepal's watersheds vary greatly in size, from large basins to micro-watersheds. They have different characteristics owing to the fact that their rivers and streams originate from different physiographic regions. The Siwaliks watersheds are geologically fragile, prone to erosion and subject to rapid deterioration. High erosion rates, landslides and stream-bank cutting are aggravating sedimentation and flood hazards on agricultural lands in the plains. In addition to suspended load, the rivers in the Terai region transport high volumes of bed load, thereby degrading agricultural lands. Riverbeds in the Terai region may rise at annual rates of 15 to 30 cm, and satellite imagery clearly shows that the Sapta Koshi River in eastern Nepal has shifted about 125 km west of its original course in 250 years.[6]

Map 2: Drainage network of Nepal

Source: CIDA and Canadian International Water and Energy Consultants, 2001.

Watershed deterioration is further aggravated by improper land-use practices, particularly in fragile landscapes. An assessment of Nepal's districts' watersheds is given in Table 2 and Map 3.

The high Himalayas provide a perennial source of water from melting ice and snow. The Mahabharat Mountains are characterized by their springs and waterfalls. The Siwaliks watersheds are fed by monsoon rains, and the many streams that drain the Terai, originate in the Siwalik foothills. These are in spate during the monsoon season, but have very little or no flow during the rest of the year. Their waters are harnessed more or less effectively to service the irrigation schemes of the rich Terai

[6] Between 1729 and 1979 (Joshi, 1985).

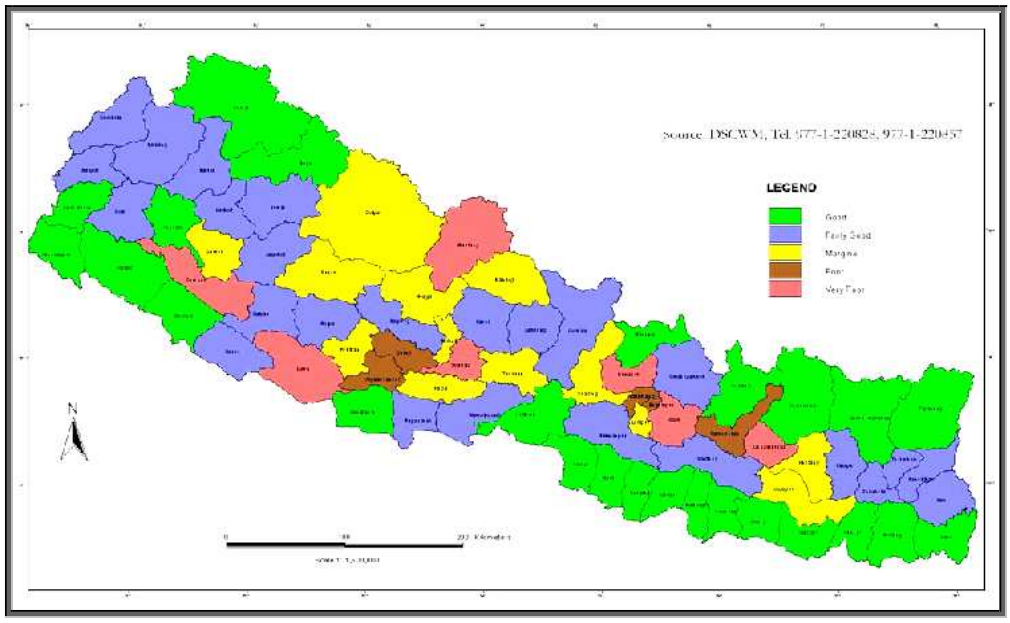
agricultural lands. Almost all of the rivers in the plains are widening and changing their courses as a result of excessive sedimentation.

Table 2: Assessment of district watershed conditions in Nepal

Watershed condition	Number of districts	Percentage of the country
1. Very poor	07	10
2. Poor	05	03
3. Marginal	13	19
4. Good	25	35
5. Very Good	25	33
Total	**75**	**100**

Source: DSCWM, 1983.

Map 3: Watershed conditions in the districts of Nepal



Source: DSCWM, 1983.

Very few hydrology gauging stations exist, and only 156 of the country's 6 000 rivers and streams are gauged (Sharma, 1977). Owing to this lack of data, and the uncertainties it generates, the total annual flow of Nepal's rivers is roughly estimated at between 150 billion and 200 billion m^3 (Gyawali, 2001; and AQUASTAT), 70 percent of which occur from June to September.

About 90 percent of the surface outflow runs through the four major river basins (Mahakali, Karnali, Gandaki and Kosi). As indicated in Table 3, maximum instantaneous flows for each river can be much larger than mean monthly flows.

Although seasonal variation in flow is important throughout the country, the largest rivers show the least variation in flow owing to the seasonal buffering provided by snow and glacial storage. Snowmelt is a particularly critical element for stream flows during the pre-monsoon dry season, and has been estimated at 10 percent of the total annual stream flow for Nepal (Sharma 1977).

It is estimated that 10 to 20 percent of the total annual precipitation is retained as deep and shallow groundwater (Sharma). The northern mountain area with its impervious granitic rock formations

retains less water. The highest recharge occurs in the unique "Bhabar" zone in the foothills of the Siwaliks, and feeds the aquifers of the Terai.

In spite of its valleys and mountains, the Nepal Himalaya has a remarkable lack of lakes, the largest of which do not exceed 500 ha in surface area and 25 m in depth.

Table 3: Basin statistics

Basin	Basin area km²	Elevation range		% basin > 5 000 m	Station No.	MMF m³/s	MIF m³/s
		Min.	Max.				
Surnagad (Mahakali)	188	1 110 m	2 650 m	0	170	7.03	373
Karnali – Chisapani	42 890	330 m	7 000 m	16	280	1 400	21 702
Karnali – Upper	19 260	630 m	6 700 m	54	240	499	4 270
Rapti	5 150	218 m	3 560 m	0	360	123	5 730
Kali Gandaki – Seti Beri	6 630	546 m	8 125 m	21	410	263	3 520
Kali Gandaki – Trisuli	4 110	475 m	7 300 m	33	447	186	2 280
Bagmati	585	1 280 m	2 715 m	0	550	15.66	856
Sapta Kosi – Sun Kosi	4 917	580 m	7 000 m	6	680	797	7 360
Sapta Kosi – Arun	28 200	415 m	8 500 m	88	604	415	3 050
Sapta Kosi – Tamur	5 640	280 m	8590 m	21	690	337	6 700

MMF = mean monthly flow. MIF = maximum intensity flow

Source: Alford 1992. – arranged by S. Rouchiche 2004.

EROSION AND SEDIMENT TRANSPORT[7]

The land surface of Nepal is very dynamic, and landslides, debris torrents and floods are frequent erosion features. Erosion and sediment load are associated with the presence of low-strength rock formations, together with extremely active natural, geological forces, which characterize the country. Bedrock incision in the upper Himalayas is exceptionally high, with geologic material crumbling under high river down-cutting, which results in extreme mass wasting.

Erosion is also caused by poor land and resource management, and is correlated to deforestation and rangeland degradation. It has been suggested that the primary causes of erosion are the increased marginalization of rainfed agricultural lands (Gilmour, 1991; and Wymann; 1991).

Surface erosion is high, especially at lower elevations where it is closely linked to rainfall duration and intensity, both of which are high during the monsoon period. Together with rill and gully erosion, surface erosion has worsened in cultivated areas, especially on the steeper slopes of the Siwaliks.

Exceptionally high flows and the massive destruction of slopes and floodplains are caused by cloudbursts or glacier lake outburst floods (GLOFs). Temporary landslides can block entire valleys and result in catastrophic flooding events that are similar to GLOFs.

The drainage corridors of the Himalayas transport large volumes of water, which carry large quantities of soil material. Sediment load in rivers is exceptionally high owing to the presence of low-strength rock formations, wide ranges of altitude and high monsoon rainfall. The Karnali watershed (Map 3), for instance, produces more sediment per square kilometre than most of the larger sediment producing watersheds in the world.

Usually, a combination of processes is responsible for making sediments available to transport. The main sources of sediment are:

- soil surface, rill and gully erosion over the whole watershed;

[7] Information for this section from Gyawali, 2001; and CIDA and Canadian International Water and Energy Consultants, 2001.

- slope instability (landslides) and mass wasting (mass movement) in headwater streams;
- stream bank erosion and the remobilization of channel deposits in the lower segments of rivers;
- special features, such as GLOF and cloudburst, generating slope and bank instabilities, which are followed by channel sediment storage and subsequent mobilization for many years;
- road and other infrastructure construction.

Two types of mass are transported down the drainage corridors: suspended load (silt) and bed load. Data on either are very hard to come by, and their importance has only recently been realized when it was found that the inflow of silt into reservoirs in the Indian Himalaya averages four times the designed inflow (Tejwani, 1986). A study by Carson (1985) showed that these rivers transport six times more matter as bed load than as silt load. As a result, Nepalese rivers debouch into the Gangetic plains in alluvial fans formations, creating inland deltas with channels that shift as the riverbed rises. Similar but less dramatic movements have been traced for the Gandaki and the Karnali rivers (Singh, 1973; and Zollinger, 1979).

Photograph 1: Example of bed load transport

2. The agriculture sector

Agriculture accounted for 52 percent of Nepal's gross domestic product (GDP) during 1984/85 and 1993/94 (FAO, 1997). The population density in cultivable land is among the world's highest (seven people per hectare). Agricultural lands are highly fragmented, and it is estimated that more than 93 percent of Nepal's population make their living from the land.

Only 18 percent of Nepal's geographical area is cultivated, and the potential for expansion is very limited given the country's topography, climatic conditions and modest soil fertility. The Terai region has the largest share of total cultivable land (59 percent), followed by the hills (23 percent) and the mountains (4 percent). Most food and cash crops cultivation takes place in the Terai plains and the rich valleys of the middle hills. The Terai produces about 75 percent of the country's rice, 65 percent of its wheat, 82 percent of its oil seeds and almost all of its cash crops, including tobacco, sugar cane and jute (FAO/WFP, 1987). Nepal produces 85 to 90 percent of its foodgrain requirements. The total animal population increased from 15 712 400 units in 1992 to 17 651 900 in 2000 (FAO Database, 2002).

Agriculture, forestry and related sectors have to absorb much of the growing labour force every year, and account for 82.2 percent of rural and 34.4 percent of urban employment. While 42.5 percent of the population lives below the poverty line in terms of minimum calorific requirements, about 97 percent of the absolute poor live in rural areas. The rate of poverty in the hill and mountain areas is nearly double that in the Terai.

Since the mid-1970s emphasis has been on land-use specialization according to regional and ecological differentiations: i) subsistence farming, horticulture and livestock production in the mountains; ii) horticulture in the hills; and iii) cereals and cash crops in the Terai. However, in spite of the agrarian nature of the country, and the Government's commitment to support this, there is increasing concern that agricultural production is declining. Some terraces are being abandoned following substantial losses of fertility. Marginal farmers are being forced to rely increasingly on livestock, which they maintain by exploiting forest resources.

PRODUCTION SYSTEMS[8]

Nepal is a managed landscape, with most of the land being used for cropping, livestock rearing and forestry. Farmers are active in five main interdependent production systems: irrigated rice, rainfed agriculture, home garden cultivation, livestock production, and forestry. These are found in all of the tropical, subtropical, warm temperate and cool temperate agro-ecological zones. The main production systems and their relative importance in each physiographic region are detailed in Table 4, together with an additional category (other), which corresponds to non-productive lands (ice, snow, rock).

Irrigated rice (Khet)

According to the *Irrigation Master Plan* (Government of Nepal, 1989), more than 923 000 ha (i.e. 35 percent) of Nepal's cultivated land is irrigated, at least on a supplementary basis. The most prestigious grain crop in the country, rice, is grown wherever arable lands below 1 800 m asl can be irrigated. The main patterns of rice cropping are rice-fallow, rice-cereal,[9] rice-winter crop, and maize-rice.

[8] Information for this section comes from ICIMOD, 1992.
[9] Mostly winter wheat (after LRMP, 1986).

Nepalese farmers have learned over the years to live and cope with the periodic catastrophic debris torrents that destroy Khet near rivers and steams. They have developed effective land reclamation methods in response to this.

Irrigated cropping systems that are intensive and use mineral fertilizers and compost are being adopted increasingly for higher-yielding wheat and rice varieties. This results in deficits of compost for other traditional cropping systems.

Table 4: Proportions of production systems in each physiographic region

Physiographic region	Irrigated rice	Rainfed cultivation	Home garden*	Grazing/browsing and degraded forest	Closed forest	Other	Total area** ha
Terai	50%	6%	-	6%	26%	12%	2 110 000
Siwaliks	7%	5%	-	16%	68%	4%	1 886 000
Middle mountains	7%	15%	-	54%	22%	2%	4 443 000
High mountains	1%	6%	-	45%	40%	8%	2 959 000
High Himalaya	-	0.2%	-	31%	2%	67%	3 349 000

* There are 3.5 million households in Nepal with average home gardens covering 25 m^2. Nationwide, this amounts to 9 000 ha of productive gardens. **The totals are gross areas taken from LRMP, 1986. Actual total areas are somewhat less.
Source: ICIMOD, 1992.

Rainfed agriculture

Rainfed cultivated land (*bari*) accounts for 64 percent of the total cultivated land (Government of Nepal, 1989). Of this, 61 percent is in the hills, where agriculture is terraced on slopes ranging from 15 to 24 degrees. Terrace plots (see Box 1) are small. Each farmer owns four or five such plots, which are generally unconnected in order to reduce the risks deriving from potential catastrophic destruction of land and/or crops. Maize, the dominant crop, is usually followed by a cereal crop, pulse or mustard.

Box 1: Terracing

Terraces, with their ability to reduce erosion and facilitate cultivation, are a critical aspect of upland management in Nepal. Different production systems within various climatic zones support distinct terrace forms. Irrigated rice terraces are flat and bunded, rainfed terraces tend to be gently sloping outwards or sideways to join other terraces at different levels.

Regardless of their surface, terraces are an accurate reflection of local soil and regional climatic conditions, cropping preferences, local productivity and the profitability of the farming system they support. In the middle mountains, terracing is essential for any cultivation on slopes of more than 2 degrees. Higher in the mountains, rainfall intensity drops and the terrace system becomes less sophisticated on ever-steeper sloping terrain. In these areas, soil conservation techniques on rudimentary terraces are sufficient, while in areas of high-intensity rainfall and low soil infiltration, such as the Siwaliks, terracing is virtually impossible. Ditching and draining are critical parts of any terrace system, and more than any other single feature influences the overall stability of mountain slopes.

The construction of new terrace systems is a major undertaking that is rarely seen. Some new terracing does occur, however on rare occasions, but it is not the norm for Nepal. Rather, thousands of hectares of abandoned terraces can be seen throughout the country, as a direct result of declined soil fertility. The prospect for maintaining terrace systems is directly linked to the farmer's ability to sustain soil fertility. Consequently, the lack of terrace management that is apparent in many areas of Nepal reflects the overall decline in productivity of the marginalized areas of most farms.

Source: ICIMOD, 1992.

The traditional fertility management system for rainfed fields[10] is under considerable stress. Farmers are diverting more and more fertility resources, particularly compost, to rice and wheat at the expense of barley, millet and maize on rainfed land. The decline of land fertility is most strongly felt on marginal rainfed fields owned by poorer farmers.

The severe shortage of compost that has resulted from changes in cropping patterns and priorities, together with forest land degradation, has led to between 10 and 20 percent of rainfed cultivated land in Nepal being temporarily fallowed or even abandoned.

Home garden cultivation

Many Nepalese farmers cultivate highly productive small gardens around their homesteads where they grow vegetables and perennial horticultural and agroforestry tree species. Kitchen gardens have also expanded around major urban centres to supply high-value goods to local markets. Although small in area, these gardens are an important element of the country's overall production system Table 4). However, farmers and other people in Nepal do not consume large quantities of vegetables and fruits, so horticultural markets are poorly developed.

Livestock production

Livestock breeding is an integral part of Nepalese farming systems, as most nutrient movements between these systems are facilitated by livestock. Virtually all lands are grazed to some degree, and the existence of many overgrazed areas is leading to environmental degradation.

The livestock population exceeded 17 million units in 2000, having increased substantially since 1992 (see Table 5). Livestock is concentrated in the hills, where 48.8, 57.1, 44.8 and 57.2 percent, respectively, of the cattle, buffalo, sheep and goat populations are distributed.

Table 5: Animal populations and distribution

	Cattle	Buffalo	Sheep	Goats	Total
Livestock population*					
1992 population (units)	6 300 000	3 100 000	912 000	5 400 000	15 712 400
2 000 population (units)	7 000 000	3 500 000	851 900	6 300 000	17 939 500
Difference 2000–1992 (units)	+ 700 000	+ 400 000	- 60 500	+ 900 000	1 939 500
Livestock distribution by geological zones**					
Mountain (16 districts)	11.8%	9.1%	40.1%	14.1%	-
Hills (39 districts)	48.8%	57.1%	44.8%	57.2%	-
Terai (20 districts)	39.4%	33.8%	15.1%	28.7%	-
Total	**100%**	**100%**	**100%**	**100%**	**-**

Sources: * = FAO Database, 2002; ** = Agricultural Statistic Division, Government of Nepal, 1996/97.

Table 6: Proportional fodder demands from crop waste and forest lands

	Livestock (units/ha)	Total TDN (tonnes/ha)	TDN from farm (tonnes/ha)	TDN from forest (tonnes/ha)	DM from forest (tonnes/ha)
High mountain	6.1	6.7	1.7	5.0	20.0
Middle mountain	4.5	5.0	2.4	2.6	12.9
Terai	3.4	3.8	3.2	0.6	1.5

TDN = total digestible nitrogen. DM = dry matter.

[10] Farmers traditionally applied 10 to 20 tonnes of compost per hectare for rainfed cultivation.

Source: LRMP, 1986.
Table 6 shows that the demand on forests to meet fodder needs increases at higher elevations. The proportions of livestock feed provided by forests are 18.75 percent for the Terai, 52 percent for the middle mountains and 74.6 percent for the high mountains. Forest-based fodder resources therefore supply the bulk of nutrients for agricultural production.

Pasturelands vary from subtropical grasslands at lower elevations to alpine meadows on ridge tops in the middle hills and high mountain valleys of the inner Himalayan range. Owing to enormous grazing pressure and an increase in livestock population, pasturelands have undergone a tremendous change, and their carrying capacity is unable to meet the demands of the livestock population, as indicated in Table 7.

Table 7: Carrying capacities of different pasturelands

Type of pastureland	Area (km^2)	Productivity TDN (tonnes/ha)	Carrying capacity (livestock units/ha)	Stocking rate (livestock units/ha)
Subtropical and temperate	6 293	0.58	0.54	7.07
Alpine	10 141	1.54	1.42	0.64
Steppe	1 875	0.06	0.09	1.19

Sources: Miller, 1987; Rajbhandari and Shah, 1981.

In the subtropical and temperate pastureland, the livestock stocking rate is 13 times higher than the carrying capacity, meaning that these pastures support 13 times more livestock than they can feed. In the steppe area, the stocking rate is almost 20 times higher than the carrying capacity. In the alpine zone, however, because of difficult access the stocking rate is 45 percent of the carrying capacity.

Most villagers, particularly the poor, are totally dependent on grazing and browsing lands, which they tend to exploit heavily. Erosion rates of more than 200 tonnes/ha/year are common on grazing lands below 1 000 m asl. The selective elimination of highly palatable species by livestock alters, sometimes irreversibly, the plant community. Fire is a common tool used extensively throughout most forests in Nepal to boost a flush of green forage after the dry season.

SOCIO-ECONOMIC SETTING

Population and human development[11]

Nepal has a population of 23.2 million people (2001 census), which is growing at an alarming rate of 2.2 percent. Its distribution is: 48.5 percent in the Terai; ii) 44.2 percent in the hills; and iii) 7.3 percent in the mountains. The average population density is high (157.73/km^2) and ranges from 330.78/km^2 in the Terai, to 167.44/km^2 in the hills and 32.62/km^2 in the mountains. The 2001 census indicates that the highest population growth occurs in the Terai, and the lowest in the mountains. About 53.7 percent of the population is literate.

The rate of urbanization is low compared with other developing countries, and some 85 percent of the population lives in rural areas with limited access to health and education services.

The human development index for Nepal (0.463) is still very low, even by South Asian standards. The deprivation in access to employment is much higher than the deprivations in health and education. Residents in the hills and the Terai have higher levels of human development than residents in the mountains.

[11] Information for this section comes from Government of Nepal, 2002.

Difficulties facing Nepalese farmers

Land degradation is a symptom of the poor socio-economic conditions. Attempts at rehabilitation have often failed in the long term, because the underlying causes of degradation have not been properly addressed.

As in other countries, particularly mountain areas, one major underlying cause of degradation in Nepal is poverty. Most Nepalese farmers have become poorer and agree on one point: their farms do not provide enough cash to improve their livelihoods and farming systems. Over recent decades there has been an ever-increasing need for more productive systems to support increasing populations. At the same time, more marginal lands have become impoverished and have been abandoned as farmers run out of fertilizing material, labour and capital to service them (Jodha, 1992).

There is a critical point when the combination of increased inputs and labour requirements mean that farms cannot compete with alternative employment outside agricultural production. In the most marginal agricultural areas, off-farm investments become more lucrative than on-farm ones. Out-migration and off-farm jobs have become significant options that influence some farmers' decisions and strategies. Unless their farms become more profitable, and returns from their hard labour increase (rather than decreasing as has been the case in the last decades), farmers will be strongly motivated to quit their farms. Communal rangelands and marginal rainfed lands are the domain of the poor, whose needs must therefore be met by alternative development plans, not only on compassionate grounds, but also because most serious environmental degradation is a direct result of their activities.

3. The forestry sector

Forest resources play a crucial role in the livelihoods of rural populations. The share of forestry in Nepal's GDP is about 15 percent. As natural forests are not evenly distributed with population density, accessible forests tend to be overused. Linkages between forestry and agriculture are very strong, and can make agriculture more productive and sustainable; 75 percent of the country's energy requirements are met by fuelwood, and 42 percent of the total digestible nitrogen (TDN) required by Nepal's livestock is supplied by forests, which are under heavy pressure, particularly in the hills. Owing to excessive pressure on forests to meet households' energy, construction and fodder needs and to generate household income from forest product commercialization, a number of forests are decreasing in both quantity and quality.

Nepal's biodiversity can be found in the dense tropical monsoon forests of the Terai, the deciduous and coniferous forests of the subtropical and temperate regions, and the sub-alpine and alpine pastures and snow-covered peaks of the Himalayan mountain range. The mid-hills (1 000 to 3 000 m asl) have the greatest diversity of ecosystems and species in Nepal. This is because of the vast variety of terrain types and the occurrence of subtropical to temperate climatic zones, which support e a rich flora and fauna. Nearly 32 percent of the country's forests occur in the middle hills.

FOREST COVER[12]

Natural forest and shrub formations cover 5.5 million ha, representing 37.4 percent of the country's land area (see Table 8). An additional 15.7 percent of the national territory is shrublands, grasslands and uncultivated areas that are considered to have good potential for development into forest or pasture. More than a quarter of the forest area is degraded to highly degraded, while 15 percent is in good condition. Almost two-thirds of the natural forest stands are predominantly small-sized timber. Natural forests suffer a lack of regeneration.

Table 8: Distribution of Nepal's natural forests (ha)

Distribution by crown cover	Conifer	Hardwood	Mixed	Total	Percent
10–40%	230 000	876 000	311 000	1 417 000	26%
40–70%	511 000	1 903 000	772 000	3 186 000	59%
70–100%	186 000	428 000	207 000	821 000	15%
Total	**927 000**	**3 207 000**	**1 290 000**	**5 424 000**	**100%**

Source: Adapted from Government of Nepal, ADB and FINNIDA, 1988.

Natural forests are generally distributed according to the following altitudinal zones:

- Below 1 000 m asl: tropical forests, predominantly of *Shorea robusta,* or *Acacia catechu* and *Dalbergia sisoo* along rivers. In the foothills of western Nepal, *Shorea* is replaced by *Terminalia/Anogeissus* forest formations.
- Between 1 000 and 2 000 m asl: subtropical forests that include *Pinus roxurghii, Alnus nepalensis*, *Schima wallichii* and *Castanopsis* sp.
- Between 2 000 and 2 700 m asl: lower temperate forests consisting of *Pinus wallichiana* and several oak species.
- Between 2 700 and 3 000 m asl: upper temperate forests composed of *Quercus semicarpifolia* forests along with *Rhododendron arboreum*, *Acer* spp., *Pinus wallichiana,* etc.

[12] Information for this section comes from FAO, 1997.

- Between 3 000 and 4 200 m asl: sub-alpine forests composed of *Abies spectabilis, Betula utilis, Juniperus indica* and *Rhododendron* spp.
- Up to 4 500 m asl (the alpine zone): no tree formations, but rather shrub formations of juniper–rhododendron associations, which include *Juniperus recurva, J. indica, J. communis, Rhododendron anthopogon* and *R. lepidotum*.

Nepal has been striving to improve its degraded forests and grasslands in the Terai and the middle hills with plantations. As a result, a number of districts now have substantial human-made forests comprising both indigenous and exotic species. The average rate of government and community planting was 5 260 ha per year in the period 1992 to 1996 period, but reliable figures for private plantations are not available. The most planted species in the Terai are, in order of importance, *Dalbergia sissoo, Eucalyptus camaldulensis*, *Acacia catechu*, *Tectona grandis* and *Albizia* sp. In the mountains, *Pinius roxburghii* is the most planted species, but in recent years a growing number of species are being used, including *Alnus nepalensis, Ficus* sp. and *Prunus cerasoides*.

Trees are often planted (with limited success for rehabilitation) on very marginal dry-prone (shale) sites with low to very low fertility, which have little potential for the production of wood and non-wood forest products. Forests are still degrading more quickly than they are expanding through planting. Moreover, it is recognized that the majority of plantings are pine stands that have little or no value in terms of fodder production and that acidify forest soils.

Forest degradation and deforestation

The total forest area was estimated to have declined from 6.4 million ha in 1964 to 5.5 million ha in 1985. An estimated 103 968 ha of forests in the Terai and the Siwaliks were cleared between the 1950s and the 1980s under the government's settlement programme (Government of Nepal, ADB and FINNIDA, 1988). Illegal felling also contributed to deforestation in the Terai. Forest cover in the Terai and hill areas is reported to have decreased at annual rates of 1.3 and 2.3 percent, respectively, between 1978/79 and 1990/91 (Government of Nepal, 1999). On average, the forest area nationwide has decreased at an annual rate of 1.7 percent.

Besides forest conversion to agricultural land, other major causes of deforestation and degradation are fire, overlogging (for fuelwood and timber), heavy lopping of trees for fodder, overgrazing and litter collection. The intensive removal of forest litter[13] can seriously alter the forest floor hydrology, resulting in higher runoff and erosion, and seriously disrupting the chemistry of forest soils.

However, in spite of their significantly reduced area, forest lands are still among the most important and valuable natural resources in Nepal. Protected areas cover 18.33 percent of the land area (Government of Nepal, 2002).

LEGAL/INSTITUTIONAL FRAMEWORK FOR SUSTAINABLE FOREST MANAGEMENT AND SOIL CONSERVATION AND WATERSHED MANAGEMENT

The Nepalese Government's forestry agency is the Ministry of Forests and Soil Conservation (MFSC), which is responsible for policy formulation and planning for sustainable forest management, wildlife, soil conservation and watershed management (SCWM), and biodiversity and plant resources management. The Ministry has five departments, each with specific management responsibilities that affect forests:

- Department of Forests (DF);
- Department of Soil Conservation and Watershed Management (DSCWM);

[13] Mainly for bedding and compost.

- Department of National Parks and Wildlife Conservation (DNPWC);
- Department of Plant Resources (DPR)
- Department of Forest Research and Survey (DPRS).

DF is in charge of the management, demarcation, control and conservation of national forests, as well as the conservation and utilization of private and community-managed forests.

Forests in Nepal can play an important role in mitigating erosion, which justifies the merging of forestry and soil conservation functions into a single government ministry. DSCWM is entrusted with encouraging rehabilitative activities in degraded forests, as well as developing and disseminating SCWM techniques.

A strategy for protecting Nepal's forests from degradation and encroachment was formulated in the Master Plan for the Forestry Sector (MPFS) in 1988 (Government of Nepal, ADB and FINNIDA, 1988). Nepal approved a National Forest Policy (NFP) in 1989, which provides guidelines for legal, institutional, and operational movements and the development of the forestry sector to meet new challenges.

The Forest Act 1993 and the Forest Regulations 1995 provide the legislative and regulatory basis for implementing the policies formulated in the NFP and the MPFS. The latter outlines broad strategies for the sustainable management of the country's forest resources, in line with its economic, social and environmental goals. The user group concept was incorporated and promoted in the MPFS.

The current community forestry programme emphasizes the formation of user groups as new community social organizations. This concept was developed further by the Decentralization Act (1992), which strengthened the role of user groups as local development organizations. The Forest Act 1993 enshrined the concept of user group or community forestry. More than 10 000 forest user groups have been recognized and more than 600 000 ha been placed under user group management. It is estimated that as much as 3.5 million ha of Nepal's forests could eventually be placed under community management.

Strategies for sustainable forest management have been incorporated in successive five-year plans, including the ninth plan (for 1997 to 2002). The highest priority is to increase forest production and productivity while meeting goals for the conservation of forests, soil, water, flora, fauna and scenic beauty. Principles of decentralization are applied in the forestry sector through the adoption of participatory forestry as the priority forest management approach.

The MPFS spells out the following long-term objectives for the development of the forestry sector:

- to meet the basic needs of the people for fuelwood, timber and other forest products, and contribute to food production through effective interaction between forestry and farming practices;
- to protect the land against degradation by soil erosion, floods, landslides, desertification and other effects of ecological imbalance;
- to conserve ecosystems and genetic resources;
- to contribute to the growth of local and national economies by developing forest management and forest-based industries and creating opportunities for income generation and employment.

The medium-term objective of the MPFS is to support decentralization and promote people's participation in forest resource development, management and conservation. It also aims to develop the legal framework needed to enhance the contributions of individuals, communities and local and national institutions to forest resource development.

4. Key resource issues[14]

EXCESSIVE PRESSURE ON NATURAL RESOURCES

Agricultural intensification and marginalization

As already mentioned, agriculture is becoming more intensive and, at the same time, undergoing continual marginalization – as illustrated by the expansion of "bari" land on to steeper slopes. The main issues facing marginal rainfed agricultural lands are soil erosion, loss of fertility and, ultimately, land abandonment.

Obstacles to forest management

As with grazing land, the greatest obstacle to better forest management is the absence of any form of secure tenure for villagers. Community forestry and leasehold forestry provide two options that are conducive to the improvement of fodder production and the upgrading of agricultural soil fertility.

Although community forestry appears to be able to manage tree production, successful fodder tree and grass pasture management processes are still lacking.

Forest expansion appears to be mainly pine plantations, while existing information suggests that the quality and diversity of the forest has declined.

Forests play an integral part in agriculture (particularly in terms of soil fertility) and the livelihoods of local people. As forests are not receiving adequate inputs, the long-term sustainability of current production capacities is in question.

EROSION AND EROSION MANAGEMENT

Deforestation, pastureland degradation, and poor agricultural practices, together with natural phenomena such as floods, landslides, cloudbursts and GLOFs, are thought to lead to annual soil losses of 20 to 25 tonnes/ha.

Loss of topsoil through surface erosion is recognized as one of the most serious problems facing agriculture, particularly on poor farmers' marginal lands in the hills region. The increased degradation of already exhausted upland soils results in further loss of nutrients; farmers are now concerned about soil erosion because it washes away the compost and fertilizer that they apply to their fields. Adequate management of surface drainage and storm runoff above and within terrace systems is therefore critical for the management of soil erosion, and subsequently for soil fertility.

SOIL FERTILITY

There is growing awareness that soil fertility is becoming one of the major issues governing poverty and future production capacity, particularly in the middle mountains. The management of soil fertility is particularly critical because input availability is limited and the demand for biomass production continues to increase. Livestock plays an important role in nutrient management, but feed shortages limit the production of manure.

[14] Information for this chapter comes from ICIMOD, 1995.

As manure supplies are insufficient, forest litter is used extensively to supplement organic matter in agriculture. This depletes forest soil nutrient contents, without providing enough inputs to sustain agricultural crop rotations. Moreover, as pine becomes the most common tree species in forest plantations in the hills, pine needle litter, which is nutrient-poor, is gradually becoming dominant. This is resulting in soil acidification, which is the most serious threat to soil fertility. The inherited parent materials in the middle mountains are frequently acidic, and the addition of acid-producing organic matter is simply compounding the problem.

The problem of soil fertility is widespread, with the poorest conditions being found in forests and grazing lands. Only irrigated areas have adequate fertility conditions, thanks to the nutrient inputs provided by sediments in irrigation water. Soil fertility declines, and the impacts of these on all production systems, are a widespread and major concern.

5. Watershed management in Nepal

EVOLUTION AND STATUS

A systematic approach to WM was first adopted in Nepal in 1966, when the United Nations Development Programme (UNDP), FAO and the Government of Nepal jointly initiated a pilot project called Survey and Demonstration for the Development and Management of the Trishuli Watershed, which was implemented through the Department of Forests. This project lasted for four year, and carried out diversified activities related to WM. Its aim was to serve as a demonstration scheme for identifying the most suitable approach to mountain area development (Bajracharya and Aung, 1966).

In 1974, following the recommendations of a high-level Nepalese team that had visited various soil conservation projects in India, the Government of Nepal established the Department of Soil and Water Conservation (DSWC) under the Ministry of Forests. It was responsible for the effective implementation of soil and water conservation in Nepal. The soil conservation functions of the Department of Forests, those of river training of the Department of Irrigation, and of farm and water management of the Department of Agriculture were transferred to DSWC (Government of Nepal, 1974). DSWC initiated the field testing of various technical methodologies and institutional set-ups at priority sites in selected watersheds and at river training projects. Within five years it had:

- gathered the technical expertise necessary for combating watershed degradation;
- established an institutional mechanism to address resource management issues through increased inter-agency cooperation; and
- developed a procedure for involving local communities in the planning and implementation of watershed programmes (Upadhaya, 1985).

After the inception of integrated rural development (IRD) projects in 1982, soil and water conservation activities were implemented under a two-pronged strategy of dispersion and concentration. In IRD projects, a wide range of soil and water conservation activities were dispersed simultaneously throughout the project districts, while watershed project activities were planned and implemented in a more concentrated manner. However, activities were not properly integrated, and project results were disappointing. This led the government to recognize the need to adopt an integrated and holistic approach to WM. In 1980, it transferred DSWC's responsibility for flood control to the Department of Irrigation, which was renamed the Department of Soil Conservation and Watershed Management (DSCWM) in order to emphasize its roles and responsibilities in integrated WM, particularly in upland areas.

In the meantime, some donor-assisted projects,[15] were working in relatively large watersheds to develop participatory and integrated WM models. However, these projects tended to ignore the users of watershed resources, and many line agencies sidetracked project activities. One of the lessons learned from this experience was that the impacts of WM are not made visible by spreading activities over a wide area.

In the mid-1980s, sub-watersheds were considered the appropriate unit for WM interventions, and it was recognized that local people must be involved in the planning and management of watershed resources (TDR, 1988). The 1988 Master Plan for the Forestry Sector (MPFS) also emphasized the importance of people's participation and integrated approaches in WM. Thus, local people started to be actively involved in sub-watershed activities.

[15] Such as the Swiss- and German-assisted Tinau Watershed Management Project and the United States Agency for International Development (USAID)-funded Resource Conservation and Utilization Project.

At present, DSCWM (of MFSC) operates WM programmes in 55 of Nepal's 75 districts. A number of bilateral and multilateral donors[16] support SCWM activities in different parts of the country.

POLICY AND OBJECTIVES

The main policy and objectives of DSCWM are to: i) maintain linkages and networks for WM; ii) develop appropriate technology; iii) ensure stakeholder participation; iv) carry out watershed interventions at the sub-watershed level; v) minimize ecological disturbances; vi) plan and protect watershed resources; vii) disseminate and institutionalize the WM approach through extension activities; and viii) give priority to Siwaliks and marginal lands.

Achievements

- Nepal's MPFS of 1988 recognizes SCWM as a primary programme for the forestry sector.
- The eighth, ninth and tenth five-year plans included SCWM policies and interventions, and allocated budgets for their implementation.
- Such domains as roads, irrigation and hydropower now include WM in their respective programmes.

Opportunities

- The government's hydropower development policy allocates 1 percent of funds at the construction phase to community development activities in affected areas, as indirect compensation. Part of these funds can be utilized for WM.
- During the power production phase, the government transfers 10 percent of the revenue generated from electricity sales to District Development Committees (DDCs) to carry out development activities at the local level. DDCs can be persuaded to allocate a percentage of these funds to managing the watersheds of the hydropower system.

Lessons learned

- When given low priority at the policy level, SCWM is not granted sufficient resources, and this impedes the formulation and implementation of sound programme plans on the wide scale.
- Policies that are developed without the involvement of all stakeholders do not obtain the wide acceptance and participation of those stakeholders.

Gaps

- There is no comprehensive, WM policy. Instead, WM issues are dealt with sporadically under broad-based forestry, agriculture, irrigation, and hydropower development policies.
- Policy-makers often lack knowledge on the need and importance of WM, and this is reflected in policies that lack broad-based vision. This constitutes a hindrance to the incorporation of people's needs and aspirations in the formulation of SCWM policies and programmes.
- There is no institutionalized effort to evaluate the strengths and weaknesses of SCWM policy as a way of predicting outcomes.
- There is no mechanism for regular dialogue and policy review and evaluation.

[16] Such as the Danish International Development Agency (DANIDA), the Japanese International Cooperation Agency (JICA), the German Agency for Technical Cooperation (GTZ), the Australian Agency for International Development (AusAID), CARE International in Nepal, SNV and the Swiss Development Corporation (SDC).

INSTITUTIONS AND LEGISLATION

The institutional development of WM in Nepal started with the inception of the DSCWM as the principal authority for WM functions. It gradually expanded with the establishment of District Soil Conservation Offices (DSCOs), which mobilize user groups to take the initiative in planning and implementing WM interventions.

The 1982 Soil and Watershed Conservation Act (SWCA) and its 1985 Regulations were promulgated specifically for the conservation and management of watershed resources. Other legal tools that contribute to the systematic institutionalization of WM in Nepal include the Forest Act (1993), the Water Resources Act (1992), the National Parks and Wildlife Conservation Act (1973), the Environmental Protection Act (1996), and the Local Self-Governance Act (LSGA) (1999), and their respective regulations.

Achievements

- DSCWM has developed an organizational structure that accommodates multidisciplinary staff from forestry, agriculture, agro-engineering, civil engineering, ecology, geology, etc.
- Numerous WM user and community development groups have been trained in community-level WM activity planning and implementation.
- Partnerships have been built with local non-governmental organizations (NGOs) and community-based organizations (CBOs), and SCWM activities are implemented jointly in some districts.
- After it was enacted, the SWCA declared the Shivapuri Watershed Area[17] a protected watershed.

Opportunities

- The SWCA provides a legal mandate for declaring critical watersheds protected watershed areas.
- In 1984, under the SWCA, a National Resource Conservation Commission (NRCC) was constituted to coordinate WM concerns at the central level. The act also provides for District Coordination Committees (DCCs) to coordinate activities at the district level.
- The LSGA has paved the way for decentralized governance and implementation processes, which means that SCWM activities can now be implemented through local government bodies.
- Natural resource management agencies, such as the forests, agriculture and livestock services, have established field offices throughout the country. These offices can be used for disseminating SCWM information, and their field-level technicians can conduct training and implement activities.
- Additional technical staff can be employed in DSCOs for specific projects, when project funding allows.
- The environmental impact assessment (EIA) guidelines for the forestry sector (2003) stipulate that a certain percentage of funds for development works should be dedicated to mitigation measures.
- The National Wetland Policy (2003) recommends that watershed conservation measures be implemented in the upper areas of wetlands in order to minimize the exploitation of watershed resources.

Lessons learned

- It is difficult to establish effective coordination when staff transfers break the personal relationships on which it depends, and the local district leadership tends to assign priority to the interests of the DDC chairperson (Bogati and Hartmann, 2001).

[17] Now known as Shivapuri National Park.

- A lack of integration and coordination leads to frustration and loss of interest among qualified and experienced professionals. This is aggravated by frequent transfers of technical staff, which have a negative effect on the implementation of SCWM programmes.
- Local CBOs and NGOs can be promoted as partner institutions in implementing, extending and replicating SCWM activities. The Upper Andhi Khola Watershed Management Project (UAKWMP) has worked successfully and cost-effectively with local NGO partners.
- The implementation of acts and regulations related to WM has been inefficient owing to overlapping responsibilities, lack of resources and poor coordination.

Gaps

- The DSCWM is not sufficiently organized to tackle the ever-increasing problems of soil erosion and watershed degradation. The department faces an acute shortage of the qualified personnel required to plan, manage and implement programme activities that are based on dynamic approaches to WM (Singh, 1999).
- Increased investment in planning, extension, training, and monitoring and evaluation (M&E) is needed in order to support the expansion of DSCOs.
- At present, the NRCC and DCCs constituted under SWCA are not functioning, and both central- and local-level coordination are difficult to achieve.
- SWCA focuses heavily on protected watershed management by granting regulatory prerogatives to the implementing agency, which are often in conflict with the needs and requirements of user groups. This is not an effective way of implementing the participatory approach to WM activities.
- There is no legal framework for institutionalizing WM user groups. As a result, such groups are unable to guarantee continuity.

WATERSHED MANAGEMENT PLANNING

The government has followed the sub-watersheds approach to integrated WM since the ninth five-year plan (1997/98 to 2001/02). Each district is divided into a number of functional sub-watersheds of 15 to 25 km², which are prioritized according to the following system: first, the erosion potential of each sub-watershed is assessed on the basis of land-use and land system characteristics, and the sub-watersheds are ranked according to erosion severity; then they are ranked according to population density; the most critical sub-watersheds are selected on the basis of a composite ranking of erosion severity and population pressure; and the SCWM programme is then implemented in the most critical sub-watersheds. Box 2 gives examples of WM concerns that other sectors are taking up.

Box 2: Effective SCWM: including WM in other sectors

Some donor-funded forestry projects include a WM component, e.g. the-AusAID-funded Community Resource Management and Livelihood Project. In addition, government sectors, particularly those for hydropower, irrigation and roads, have started to incorporate WM as a component in their regular programmes. Namsiling Community Development Centre, a local NGO in Ilam district of eastern Nepal, now implements its activities according to a sub-watershed approach. And the World Conservation Union (IUCN) has formulated a sub-watershed management programme in the Churia region of Ilam.

Achievements

- Systematic guidelines for prioritizing and planning sub-watersheds have been developed.
- A number of sub-watershed plans have been prepared and implemented.
- The concept of sub-watershed management planning has been adopted in other sectors.

Opportunities

- A core group of planning experts at the central level has the capacity to coach and train district- and project-level staff in preparing sub-watershed management plans.
- NPD and UNDP have recently prepared the poverty index maps of several districts. This information is valuable for prioritizing sub-watersheds and preparing specific area-focused soil and watershed management plans.

Lessons learned

- Given the difficulty of delineating sub-watersheds of 15 to 25 km^2 in the field, projects and DSCOs have been forced to work in much larger watershed areas.
- Working in sub-watersheds has resulted in SCWM treatments covering only very small areas (2 to 3 percent of the districts concerned).
- Many of the sub-watershed management plans that have been prepared require expensive technical measures, and cannot be implemented when there is a lack of adequate resources.
- Sub-watershed management plans that do not include social parameters such as poverty information fail to address poorer people's needs and problems. This is one of the stumbling blocks for replicating SCWM interventions.
- Sub-watershed management plans will not achieve the necessary level of coordination unless development organizations implement their activities according to watershed boundaries.
- Owing to a lack of resources, sub-watersheds are rarely treated comprehensively, i.e. according to a coherent upstream–downstream approach.

Box 3: DSCWM programme activities

Land-use planning: WM plans, sub-watershed management plans, and technical services for land-use development.

Land productivity conservation: on-farm conservation, grass plantations, fodder/fuelwood/fruit tree plantations, agroforestry, and greenbelt/shelterbelt establishment.

Natural hazard prevention: gully treatment, landslide treatment, torrent control, riverbank protection, and degraded land rehabilitation through bioengineering methods.

Infrastructure protection: slope stabilization, roadside erosion control, trail improvement, canal protection, and water source conservation.

Community soil conservation: extension education, demonstration plots, training, study tours, local-level workshops, and exhibitions.

Source: Adapted from DSCWM, 1998.

Gaps

- No comprehensive sub-watershed management planning approach that includes erosion, land degradation, land potential and other relevant elements has been formulated.
- The base maps used for land-use and land system information are out of date.
- The technical approach to sub-watershed management is based entirely on a desk methodology, which has not been verified in the field.
- Other than population density, very few socio-economic data (such as poverty and gender aspects) are used. Furthermore, the data collected may be analysed but are not reflected in activity plans. Thus, participation is limited to formulating "wish lists" that take little account of the WM concept.

- Watershed prioritization methods place too much emphasis on the biophysical elements, which results in marginalized and poor people receiving inadequate attention. This also hampers the replication of WM activities.

PROGRAMME PLANNING

A programme approach to SCWM has been followed since the MPFS was adopted in 1989. At present, programme activities are broadly grouped into five categories (see Box 3). A budget-controlled decentralized planning method is practised. After consulting with users and village leaders, DSCOs prepare annual programmes that are based on the budget ceilings provided by NPC.

DSCWM compiles and adjusts the programmes and budgets of all district offices and projects, and submits them to MFSC. MFSC, the Ministry of Finance and NPC discuss and finalize plans and budgets for the succeeding year.

Achievements

- Technical programme activities that adhere to SCWM guidelines have been embedded in the annual planning process.
- More than 90 percent of the planned targets are accomplished each year.
- The annual programme planning process reflects local needs through bottom-up planning, as envisaged by the LSGA.

Opportunities

- The LSGA has provided the opportunity for planning SCWM activities with the participation of DDCs, VDCs and users. This makes it possible to share knowledge and skills, as well as materials and human and financial resources for WM.
- The government's three-year rolling budget system provides the opportunity for planning SCWM activities on a multi-year basis.

Box 4: Upstream–downstream linkages

Some 15 years ago, farmland on the banks of a gully in Rangoli Khola (Rakhi VDC, Kaski district) was being eroded and silt was being deposited downstream. The farmers concerned owned land both on the hillside and in the valley. Local people approached the Begnas Tal Rupa Tal Watershed Management project for technical and financial support to rehabilitate the gully. They reached an agreement with the project for gully protection activities. In addition to technical assistance, the project agreed to cover 60 percent of the costs, while users contributed the remaining 40 percent. Sixteen check dams were constructed across the gully, and grass and trees were planted. Grazing was strictly prohibited. Users cut and carried the grass for their livestock, and generated cash income from selling grass slips and cuttings to other farmers. It took about four years to achieve complete rehabilitation. Springs in the lower section of the gully were rejuvenated, and downstream siltation ceased completely. Meanwhile, users were able to collect fuelwood from the growing vegetation. Both short- and long-term benefits were therefore derived from a single activity. The reasons for this success are related to upstream–downstream linkages: the farmers concerned owned land on the hillsides and in the valley, and a single activity provided both short- and long-term benefits

Source: DSCWM, 1995.

Lessons learned

- WM activities are increasingly popular because they address a wide range of issues that help to fulfil people's basic needs for food, fodder and fuelwood.
- Because the foreign assistance expected for the MPFS (71 percent of the total budget) was over-ambitious and was not acquired (Government of Nepal, ADB and FINNIDA, 1988), the government was not able to fulfil its commitment to implement the MPFS and the periodic plans.
- A one-year programme cycle is too short, and fails to integrate civil structures and plant cover interventions for the effective implementation of SCWM activities.

Gaps

- Sub-watershed management plans are seldom referred to during the annual planning process or when community development plans are drawn up. This results in a mismatch between annual plans and sub-watershed plans.
- The planning process does not encompass such important tasks as site selection, choice of SCWM measures and tentative cost estimates. During implementation, technicians look for sites that might match the allocated budget.
- SCWM activities are launched on a co-financing basis, but there is no cost-sharing mechanism for activities other than terrace improvement. In addition, users' contributions are not reflected in annual plans, even though they are quite significant.
- Programme planning does not explicitly provide for impact assessment. This constrains the selection of activities that are suitable for different ecological zones.

TECHNICAL INTERVENTIONS AND IMPLEMENTATION

Achievements

- Technical guidelines and selected measures for the SCWM programme have been prepared.
- Innovative interventions to conserve and utilize water have been successfully implemented. These include harvesting runoff water to feed a dam in the Churia region.
- On-farm conservation activities have enabled many farm households to cultivate a wide range of improved varieties of cereals, fruits, vegetables and cash crops.
- A bioengineering technology package has been developed and implemented.
- Degraded lands have been reclaimed through low-cost rehabilitation measures in a variety of ecological zones. Most of these rehabilitated lands have been converted to community forestry.
- The rehabilitation of burrow pits in Kulekhani has considerably reduced sedimentation in the nearby hydroelectric reservoir.
- The most important achievement is the successful use of SCWM technical interventions to conserve and rehabilitate the nationally important Shivapuri watershed as a municipal water supply for Kathmandu.

Lessons learned

- The most successful SCWM activities, now and for the future, are the use of plants to control landslides and gullies, community forestry, conservation farming, and irrigation rehabilitation.
- SCWM activities that involve check dams and changes to river courses are unlikely to succeed unless they are implemented alongside appropriate bioengineering measures.
- The inclusion of community forestry in WM programmes has had a positive effect on the overall development of communities in the Siwaliks. Upstream areas are being managed as community forests, and runoff harvesting ponds have been constructed in the foothills. As a result,

downstream flooding and sedimentation at the micro-watershed level have been reduced, and water retention capacity and duration have increased.
- Intensive SCWM activities over a long period (ten to 12 years) have brought about fundamental land-use changes, which have significantly increased the productivity of forests and agricultural land (Buffum *et al.,* 2000).
- In terms of both sustainability and affordability, SCWM techniques that are based on plant cover are more effective than those that involve civil structures. The effectiveness of plant cover as a conservation measure to rehabilitate degraded land has been reported in review and evaluation studies (e.g. DANIDA, 1998; Government of Nepal and European Commission, 2002; Pariyar *et al.,* 2002).
- It is possible to keep a balance between short- and long-term benefits, and doing so is advantageous to local people.

Opportunities

- Bioengineering training modules have been developed, and professionals and technicians are being trained to apply bioengineering measures in SCWM.
- Indigenous technology and knowledge on SCWM have been documented.

Gaps

- SCWM in Nepal demands specific technologies that suit the country's geological conditions, topographic variations, climatic features and available resources. The technologies that are being developed for the Middle Mountains do not suit the rest of the country. Some of those developed for the Siwaliks and Terai regions have not yet been tested and evaluated.
- SCWM interventions have not been as effective as expected because of a lack of integration (Sthapit and Bendtsen, 2000).
- Many of the SCWM measures prescribed involve high levels of technical inputs, which result in significant expense and, therefore, limited replication by the people.
- Because SCWM activities are scattered over large areas without proper integration their desired benefits are diluted.
- Although some indigenous technology and knowledge have been documented, there are still gaps in the identification and application of such technologies.

THE PARTICIPATORY APPROACH TO WATERSHED MANAGEMENT

The importance of people's participation has been recognized since the DSCWM was established in 1974. The department adopted a consultative planning approach during its initial period. Since then, active people's participation has been emphasized, and local people are encouraged to participate in all stages of planning, implementation, monitoring and evaluation, and benefit sharing. The trend of involving people in SCWM activities has evolved over a long period and over five stages (see Box 5).

Achievements

- People's participation in WM has been encouraging. Local people now contribute about 80 percent of inputs and labour (King *et al.,* 2001).
- Guidelines for people's participation in SCWM were prepared in 1992 and have been institutionalized at the programme implementation level.

Lessons learned

- The participatory approach is suitable for collective WM activities because it builds rapport between agencies and local people.
- Although the participatory approach is successful, there is still scope for improvement, particularly in innovative farming systems, increased soil fertility, food security at the household level and market outlets for farm products (FAO, 2001).
- Technicians and local people tend to lose patience with the time-consuming participatory integrated WM process.
- The participatory approach has helped engender local ownership, mobilize local resources and strengthen local institutions.
- Since SCWM adopted the participatory approach it has become detached from mainstream development, and more attention is now paid to the rural development programme.
- Participatory programmes that take little account of poverty and gender aspects do not address the needs of marginalized groups, women and the resource-poor.
- Public auditing has increased people's confidence in SCWM by enhancing financial transparency and aiding decentralization and bottom-up planning (Government of Nepal and DANIDA, 2003). It has also been effective in building trust and ownership among beneficiaries (Winrock, 2002).

Box 5: Evolution of participatory WM in Nepal

Stage I (1974–1980): Awareness of soil conservation was first raised. The government implemented small-scale activities in pocket areas, with little involvement of local people.

Stage II (1981–1985): People became involved in assessing needs and discussing the implementation of field activities.

Stage III (1986–1990): Information on SCWM activities was shared with local elected bodies – VDCs and DDCs. CBOs received assistance for implementing activities.

Stage IV (1991–1994): Guidelines for people's participation were developed, and almost all SCWM activities were implemented through user groups. Sub-watershed management planning was institutionalized.

Stage V (1995–2000): User groups became the focal point for implementing SCWM activities. Efforts were made to institutionalize the groups through formal registration and their development into cooperatives.

Source: Wagley and Bogati, 1999.

Opportunities

- The LSGA and the current (tenth) five-year plan provide opportunities for institutionalizing and strengthening the participatory approach.
- Based on the guidelines for people's participation, projects have developed different participatory models to suit local conditions. These models provide opportunities for selecting the most adequate options for different environmental and socio-economic situations.

Gaps

- Most professionals and technicians lack knowledge of the fundamentals of the participatory approach.

- No comprehensive study has been carried out to find the best mechanism for involving local people in SCWM activities that are appropriate for their specific environmental and socio-economic conditions.
- The participatory mechanism does not address issues related to legitimacy, resources, attitudes and withdrawal from programme activities.

MONITORING AND EVALUATION

Initially, M&E of SCWM involved comparing accomplishments with targets. SCWM programme activities have now been reoriented to produce quantitative and qualitative results, and this change is expected to be cost-effective and time-efficient. Input and output indicators have been developed to show results and impacts in relation to objectives.

Achievements

- An M&E system for SCWM, which focuses on assessing the performance of implementing personnel, has been developed.
- M&E guidelines have been prepared for the district level.
- Indicators for selected SCWM activities have been developed and documented, in collaboration with NPC.

Lessons learned

- The M&E system fails to indicate fully the achievements, the suitability and the value of SCWM, as it is limited to measuring physical endeavours in terms of the work plan, budget and targets.
- The M&E systems that projects have developed are complicated and not compatible with the government system. Diversification of M&E systems among projects and the government has added to field staff's workload.

Opportunities

- There is a full M&E system for SCWM.
- Professional and technical staff have, been trained to carry out systematic M&E.

Gaps

- Guidelines for monitoring social and cultural factors are lacking.
- M&E concentrates on managerial and financial aspects, but not technical ones.
- Technical indicators for selecting programme activities that are suitable for local conditions have not been adequately identified and updated.
- The contribution made be people's participation is not recorded.
- Dissemination of M&E information is lacking at all levels.
- M&E does not determine the effectiveness or relevance of activities. It provides neither information on past efforts, nor suggestions for future improvements.

EXTENSION AND EDUCATION

Conservation extension and education aim to create community awareness. Activities are categorized into demonstrations, production of conservation extension material, study tools and training, audiovisual sources and exhibitions.

Achievements

- SCWM extension and education have been institutionalized in all districts.
- A wide range of extension and education materials, such as pamphlets, leaflets, booklets, comics and posters, have been produced and distributed.
- Audiovisual materials, such as documentary films and videos, have been produced and publicized.
- School programmes have been successfully conducted, even in remote parts of Nepal. A conservation education curriculum for grades 7 and 8 has been developed and is being taught as an extra-curricular class.
- Farmer field schools have been set up in some districts.

Lesson learned

- The farmer field school is an effective extension approach.

Opportunities

- There is capacity for training all district staff, including those at the mid-level, in order to involve them in extension programmes designed to improve people's knowledge, skills and practices in conservation.
- Many individual farmers have adopted improved and innovative land-use practices. Their plots can be utilized for effective extension and demonstration.
- Other green sector line agencies have also developed effective SCWM-related extension materials and training.

Gaps

- SCWM encompasses multidisciplinary and multisectoral approaches, messages and themes. However, professionals and technicians are unable to disseminate them effectively.
- The SCWM extension section is too small; it lacks the necessary staff to deal with the wide range of extension activities needed in order to reach large numbers of widely spread target groups.
- Extension activities are carried out on an ad hoc basis.
- Extension materials are developed to meet general needs, rather than real needs.
- The extension programme has focused only on generating awareness, and has made no effort to promote the adoption of technology.

RESEARCH AND DEMONSTRATION

SCWM research information is important for sustainable WM. The government has institutionalized research and demonstration as an integral part of SCWM.

Achievements

- The SCWM research and demonstration section has established site-specific soil erosion and soil loss demonstration plots in the middle hills.
- Soil losses from different land uses have been documented, and suitable prescriptions made to minimize them.
- The research and demonstration section has developed a simple methodology for assessing sedimentation rates in lakes and reservoirs.

Lessons learned

- Much useful research information can be compiled from regular SCWM field activities.
- Lake sedimentation research conducted by the research and demonstration section has not been properly utilized by the agencies concerned.

Opportunities

- There is a full research and demonstration section for SCWM.
- Guidelines on participatory action research have been developed.
- The International Centre for Integrated Mountain Development (ICIMOD) and other agencies have established research and demonstration plots in many parts of Nepal. These can be utilized for SCWM.

Gaps

- Research information and experiences from the field are neither documented nor disseminated.
- WM activities are increasing, but appropriate research and demonstration efforts are not keeping pace.
- Demonstration plots are not properly maintained, making it difficult to express the quantitative and qualitative impacts of SCWM activities.
- There is only limited knowledge about: i) the technical relationship between SCWM practices and their effects; and ii) improved ways to identify and quantify social values and benefits.
- The research and demonstration section is understaffed and underequipped, which reduces its ability to carry out research.
- Linkages among appropriate research, demonstration, extension and education services are very weak.
- Professionals lack adequate knowledge of how to carry out systematic research.
- There is virtually no global- or regional-level networking of existing research and knowledge.
- Research and demonstration are a low priority and receive inadequate resources.
- No systematic plan for research and demonstration has been developed.

INCOME-GENERATING ACTIVITIES

SCWM in Nepal has promoted income-generating activities as a way of achieving sustainability and supporting the government's poverty reduction strategy.

Achievements

- Income-generating activities provide immediate benefits to the people, and are therefore increasingly popular.
- The incomes of the poor, women and marginalized groups have increased considerably as a result of income-generating activities, saving and credit schemes, and supportive skills training and literacy classes (Pariyar *et al.,* 2002).

Lessons learned

- SCWM activities are oriented more to integrated rural development (IRD) than to SCWM itself.
- Training in the skills required for income-generating activities has been effective in specific areas. The activities provide both income generation and services to local communities (CARE Nepal, 2001).

- The inclusion of diversified income-generating activities to support livelihoods has increased the number of stakeholders and created a need for additional coordination work.

Box 6: Empowering marginalized groups

Geeta and Jamuna are two sisters from the marginalized community of Putali Bazar, Ward No. 3 in Syangja district. They decided to raise awareness about social ills and traditions in their community.

Jamuna was not able to attend school, but her sister Geeta studied up to class 8. Both sisters eked out a living by working on farms for Rs. 30 per day during the busy agricultural season.

One day they heard that UAKWMP, a project in Syangja district, was providing small grants to marginalized communities that successfully took part in its informal education programme, so they organized marginalized women's groups to join this programme. In addition, they also participated in a six-month education class on savings and credit, which was also run by the project. This encouraged them to form a savings and credit group for 32 women, which collected Rs. 70 000 from monthly savings and interest.

Three months after this group was formed, the project provided a grant for implementing income-generating activities based on the group's performance. The women invested this money in rearing pigs and goats and farming off-season vegetables. According to Pariyar et al. (2002), these activities increased the group members' incomes significantly.

Opportunity

- Government policy regarding development programmes is favourable to the incorporation of income-generating activities.

Gaps

- A large number of income-generating activities have been implemented without field testing or consideration of their cost–benefit ratios.
- Some of the income-generating activities that have been introduced are detrimental to the WM programme.
- Income-generating activity programmes have not reached the poor, marginalized groups and women.

6. Main recommendations

POLICY AND OBJECTIVES

- Develop a long-term comprehensive policy that is specific to WM and involves the participation of all stakeholders. Such a policy should include a vision, mission and strategic directions for the next generation of WM programmes. It should also clearly define the scopes and mandates for WM.
- Develop a policy that strengthens coordination among relevant sectors and upstream–downstream linkages, so that benefits can be shared.
- Develop a mechanism for investing a proportion of the revenue generated from the sale of water resources and services (drinking-water, hydropower, irrigation) in WM.

INSTITUTIONS AND LEGISLATION

- Redefine and harmonize the roles of national-level government agencies in SCWM, in order to reflect the requirements of the LSGA and to focus planning, technical and monitoring capacity wherever appropriate.
- Develop a local government support unit in DSCWM and establish linkages with DDCs, municipalities and VDCs to share knowledge, skills and technology, as well as WM functions at the local level. Budgetary provision would be required at both the central and local government levels.
- Develop partnership strategies to involve NGOs, particularly in social mobilization and local capacity development, and explore opportunities for involving private enterprises in delivering SCWM services. This will help to extend SCWM endeavours to wider areas.
- Develop networking and alliance building among user groups, with district-level federations to help them institutionalize their efforts.
- Revamp NRCC and DCCs in order to establish effective coordination among different line agencies, local governments and locally based organizations, and to avoid possible conflicts and duplication of activities.

WATERSHED MANAGEMENT PLANNING

- Reconsider and evaluate the sub-watershed planning process in its entirety, i.e. consider whether a focus on specific sub-watersheds is the most appropriate approach. Alternatives that support the SCWM approach of bottom-up planning should be investigated further (i.e. micro-watershed planning).
- Incorporate additional, updated maps, a procedure based on Geographic Information Systems (GIS) and relevant national data (i.e. on livestock, soil types, geology, morphology and potential or actual productivity).
- Incorporate sociological data, such as poverty and gender indices and aspects. Ensure that a sufficiently flexible approach can be followed (according to local conditions and the availability of data).
- Apply interactive processes in developing sub-watershed plans with users, local governments, local NGOs and line agencies.

PROGRAMME PLANNING

- Use the integrated sub-watershed management plan to guide the formulation of SCWM annual plans in order to ensure upstream–downstream linkages.

- Prepare site-specific annual plans that contain basic technical and socio-economic information. Primary stakeholders should agree to plans prior to their finalization.
- Apply a multi-year programme cycle that is in line with the rolling budget system, in order to achieve the effective integration of civil structures and plant cover interventions.
- Prepare and enforce pragmatic cost-sharing models for all SCWM activities. NPC should acknowledge the estimated contributions of users in its annual plans.
- Broaden programme planning to incorporate impact assessment.

TECHNICAL INTERVENTIONS AND IMPLEMENTATION

- Develop a mechanism for testing and evaluating pilot technologies that could benefit various regions of the country, and support the development of appropriate technologies.
- Implement SCWM activities through suitable programme packages consisting of interlinked activities, such as gully control, water source protection and on-farm conservation.
- Develop regenerative technological packages that provide tangible benefits. Promote simple, low-cost measures, preferably through bioengineering, that ensure the replication of SCWM measures by people with no or only very limited external inputs.
- Incorporate indigenous knowledge, technology and skills in WM interventions, and optimize the use of locally available resources.
- Emphasize modern SCWM technology whenever and wherever appropriate.
- Integrate community forestry into WM programmes in order to build on synergic effects and enhance the livelihoods of poor and marginalized groups.
- Emphasize the balance between short- and long-term benefits, as well as that between production and conservation objectives.

THE PARTICIPATORY APPROACH TO WATERSHED MANAGEMENT

- Train professionals and technicians on conceptual aspects of the participatory approach, and work to change attitudes in favour of people's participation.
- Carry out studies to evaluate the participatory models that have been adopted by different projects, and develop an adequate mechanism for involving local people in different environmental and socio-economic conditions.
- Develop a mechanism to address issues related to legitimacy, resources, attitudes and withdrawal from programme activities, and incorporate it into people's participation guidelines for implementation.

MONITORING AND EVALUATION

- Incorporate M&E into programme plans, and allocate resources for it.
- Develop and update technical indicators that help the selection of appropriate programme activities for different localities.
- Develop a participatory M&E system.
- Incorporate gender and social equity monitoring into WM objectives.
- Develop a uniform reporting system to provide feedback.

EXTENSION AND EDUCATION

- Capitalize on the opportunity for enhancing extension staff's capability to disseminate messages.
- Strengthen the SCWM extension section to cover larger target groups and cater to their real needs.

- Develop a systematic extension plan and programmes that focus on the adoption of SCWM technology.
- Promote farmer field schools and farmer-to-farmer visits.

RESEARCH AND DEMONSTRATION

- Emphasize appropriate research that contributes to the development of WM technology.
- Use participatory action research techniques to improve the programme.
- Strengthen the research and demonstration section so that it can undertake systematic research and link up with extension and education.
- Persuade the concerned agencies to consider the results of sedimentation research for appropriate restorative programmes.
- Cooperate to establish global and regional networks for the dissemination of research and knowledge. FAO could play a lead role in this aspect.
- Develop a systematic research and demonstration plan for SCWM.

INCOME-GENERATING ACTIVITIES

- Place more emphasis on rapid-return production-oriented activities, such as on-farm conservation, fruit tree planting, grass plantations, cash crops, mushroom growing, etc.
- Adopt a positive discriminatory policy in favour of the very poor, marginalized groups and women.
- Focus on a few proven income-generating activities instead of implementing large numbers on a trial and error basis.
- Emphasize income-generating activities in gender mainstreaming and the empowerment of poor and marginalized groups, and select activities that support SCWM.

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