

# Management of Water Resources in the Maloti/Drakensberg Mountains of Lesotho

The Kingdom of Lesotho is situated in the great highlands of the Maloti/Drakensberg mountains, which crown the southern African region and are the source of the Orange/Senqu river system.

The Maloti/Drakensberg region comprises two thirds of the 30 670 km<sup>2</sup> land area of Lesotho. The region under consideration in this paper is that lying above 2500 meters.

It was not until the end of the 19th century and the turn of the 20th century that people started moving into the hinterland of Lesotho to summer graze their animals. This summer-season-in and winter-season-out eventually led to people inhabiting the mountain region on a permanent basis, the movement being restricted to the valleys of the mountain rivers.

Permanent residency increased steadily as did the number of people and animals. The valleys and the lower slopes of the mountains were ploughed for cereal production and utilized intensively without adequate land-management practices.

The region discussed here is bordered in the west by the Kingdom of Lesotho, and in the east by the Kwa-Zulu/Natal province of the Republic of South Africa. The area has a fragile Afro-Alpine ecological system with unique species of flora and fauna.

The scale and complexity of managing water resources in the Maloti/Drakensberg region are enormous. Constraints are embodied in the socioeconomic, cultural, administrative, land-use, and land-tenure conditions as well as natural features such as terrain, climate, soil, vegetation cover and type, and geological formations. Indeed, this unique Afro-Alpine region of the subcontinent of Africa harbors a rich diversity of plant and animal species, which are threatened by land degradation. The main problem being land mismanagement. In developing and managing water resources in the region, threats to this fragility must be taken into account. This calls for a vision into the 21st century that has clear and well articulated objectives, which should be people-centered, and the primary emphasis being to address issues of poverty and deprivation, while at the same time taking into account environmental poverty and degradation. All the functions of water, including its relations to health, biomass productivity, habitat, and life regeneration, need to be addressed.

## CLIMATE AND HYDROLOGY

Mountains are regions with often low temperatures, low evaporation, and high precipitation. The Maloti/Drakensberg area of Lesotho is no exception with its altitude ranging from 2500 to a peak of 3482 m a.s.l. The area is characterized by temperatures ranging from a mean of -5°C in winter to a mean of 16°C in the summer months. The recorded extreme is -20°C at Letseng-La-

Terae weather station at 3050 m a.s.l.

The mean annual precipitation of the area is 1200 mm, the highest isohyet in the country. In winter, snow cover and icy waterfalls dominate the region; in springtime these become water flows. However, no conclusive studies have been taken to assess the contribution of snow to the overall river flows and water resources of the region. Most flows are encountered during the summer months of October to March, with about 85% of precipitation in the form of rainfall; snowfall can occur at any time of the year.

## SOCIOECONOMIC PRACTICES

The apex of the region is the Mount Aux Sources where some of major rivers originate, the Senqu/Orange flowing to the Atlantic Ocean in the west, and the Tugela flowing to the Indian Ocean in the east. The area is characterized by cattle, sheep, and goat-grazing. During the winter months these animals graze in the lowlands or lower valley regions where temperatures are less harsh. The major constraint in animal husbandry is communal grazing, which recently resulted in abandoning traditional practices whereby the area chief controlled and monitored the grazing practices of the stock owners.

A free-for-all attitude in land-resources management has led to accelerated degradation of the fragile ecosystems. During drought spells the bogs, fens, marshes and peatlands (wetlands) are invaded throughout the year by animals in search of green vegetation and the water-points available only in the wetlands. As a result all the wetlands in the region have been eroded and become gullies and lost their water-retention capacity. Rainfall is lost immediately as surface runoff, resulting in sharp short peaks.

Apart from animal rearing, the area is recognized for its scenic beauty, and recreational activities create revenue through ecotourism.

This "water-rich" catchment contributes significantly to all water-related economic activities downstream and, therefore, rehabilitation is of prime importance to the riparian or watercourse states of the Senqu/Orange river system. However, the region is gradually being encroached by permanent human settlements as opposed to the original partial residence of only in-between seasons animal grazing. The catchment is now traversed by tarmac highways, which have created new economic opportunities. The movement of goods and people through this fragile ecosystem have increased tenfold since the 1980s with the advent of the Lesotho Highlands Water Scheme. However, these have also been negative environmental impacts on the biodiversity of the Maloti/Drakensberg Afro-Alpine region. Misalignments of roads, littering, cultural habits, changes, etc. have been experienced and have negatively af-

ected the environment of the whole region.

## WATER RESOURCES

Management of the water resources of the Afro-Alpine Maloti/Drakensberg catchment is interrelated with and highly influenced by the management of the wetlands.

*Availability:* The highlands of Lesotho, which are characterized by low evaporation and relatively abundant rainfall, are the major source of water for the whole of the Senqu/Orange river system. As the main stem of the Senqu/Orange river leaves Lesotho, the mean annual runoff (MAR) is gauged to yield 112 m<sup>3</sup> s<sup>-1</sup> with a drainage basin of some 20 000 km<sup>2</sup>.

The whole of Lesotho lies within the Senqu/Orange river system. The whole drainage basin is some 1 020 000 km<sup>2</sup> with a mean annual runoff of 360 m<sup>3</sup> s<sup>-1</sup> as it discharges into the Atlantic Ocean at the border between South Africa and Namibia.

Lesotho, as a whole (highlands and lowlands), occupies only 3% of the Senqu/Orange river system, but yields 170 m<sup>3</sup> s<sup>-1</sup> of the water flow; contributing more than 47% of the total. The Maloti/Drakensberg mountains are the main watersheds of the region contributing freshwater to the river system, with a yield of 112 m<sup>3</sup> s<sup>-1</sup> (31%) out of the total 360 m<sup>3</sup> s<sup>-1</sup>.

*Utilization:* Freshwater resource utilization in Lesotho is minimal due to a number of circumstances. In 1950, transboundary utilization was feasibility by transfers from abundant regions to water-scarce areas in the lowlands of Lesotho and further on the west in the industrial areas of the Free State and Gauteng provinces of the Republic of South Africa initiated the concentration of the first hydrometric stations in the Maloti/Drakensberg region, and the first river gauging station was operational by 1956. The hydrometeorological data collected over the years constitutes a useful contribution in the planning and design of the giant Lesotho Highlands Water Scheme, which is presently transferring the clean highland water to the industrial heartland of the Republic of South Africa.

The Lesotho Highlands Water Project (LHWP) is intended to deliver 70 m<sup>3</sup> s<sup>-1</sup> to the Republic of South Africa through a series of dams and tunnels. In the process, the water transfer scheme will generate hydroelectricity before leaving Lesotho for consumption by local industries and citizens. Future domestic water supply and irrigation demands are also being considered, because of the recurring drought events and the water scarcity envisaged for Lesotho by the year 2050 as a result of population growth and other population dynamics.

In this context, the global policy and strat-

...ies to address these new constraints are to implement an integrated water-resources management (IWRM) approach within the development framework of the country.

Among other things, the new IWRM approach will address:

- drought-management strategies;
- flood-management plans;
- heavy snowfall management relief action plans; and
- regulatory and legal frameworks.

The proposed draft bill on Water Resources Policy and Strategies is intended to address these issues adequately and effectively. This will, therefore, ultimately call for the transfer of more water from the highlands to the lowlands. Indications are that by the year 2050 the lowland villages and towns along the main road running from south to north will be one global urban and peri-urban area as a result of urbanization and co-urbanization of the towns. Human movement or the shift from rural to urban areas in search of jobs, and from the highlands to the lowlands in search of readily available social and civil services along the main road connecting the towns to the capital city will increase. This is the major future challenge for the water resources planners, managers and politicians alike in meeting the water demands for the future generations in the next millennium.

#### IN SUMMARY

Water is the source of life, and mountain areas are the source of the high precipitation essential to the water supplies for river flow to the low-lying regions and, hence, to water discharge to lakes, seas, and oceans. Mountains are regions of low evaporation, with diverse ecological systems, and very fragile. Lesotho, with her majestically towering Maloti/Drakensberg, is the amphitheater of Southern Africa. Rampant land degradation and the encroachment of marginal lands by human settlement is threatening the lives of human beings and the biological diversity of the region, calling for exerted efforts to implement measures aimed at conserving our common heritage through integrated water-resource development, management policies and strategies, which can meet the demands of today while not sacrificing the needs of tomorrow.

Dams, channels, tunnels, and pipelines do not necessarily create new water, they are means of conveying it from one set of users to another. They can, in fact, even reduce available water resources through evapotranspiration. On the regional and watercourse system perspective, it is mandatory that we adopt the approach "we are all downstream".

**Sechocha Makhoalibe**  
**SADC Water Sector Coordination Unit**  
**Private Bag A440**  
**Maseru**  
**Lesotho**

#### Errata:

Correction to Fig. 3, p. 372, *Ambio* No 4, 1999.  
The y-axis caption should read: "Landings by gillnet fleet (tonnes)": i.e. not mill. tonnes.

# Abstracts

## Sustainable Management of Natural Resources in African and Asian Mountains

H. Humi

African and Asian mountains and highlands are ecoregions of particular importance for sustainable development due to their intensive land-use systems, their generally low economic productivity and integration, and the increasing rates of land degradation and mountain hazards. Opportunities for sustainable development exist, if ways to overcome land degradation can be found. The percentage of people who are engaged in subsistence agriculture can be reduced in favor of the secondary and tertiary sectors, protected areas can be better managed, access to remote areas improved, mountain waters utilized in a more integrated highland-lowland interaction, and mechanisms to manage conflicts developed. Research in support of sustainable development needs to focus on transdisciplinary approaches in order to develop appropriate technologies, improve land-management systems, and most importantly, create an enabling institutional environment. International cooperation is an essential tool for exchanging and communicating successful experiences from the local level to regional levels.

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## Rehabilitation of Degraded Mountain Ecosystems in Southwestern China: An Integrated Approach

Shi Peili and Li Wenhua

The degradation of the mountain ecosystems in southwestern China has been unprecedented in speed and scale over the past decades. Deforestation, overgrazing, water and soil erosion, loss of soil fertility and declining or poor crop yields are alarming indicators of unsustainability due to rapid population pressure. Under the conditions of shortage of arable land, more marginal and forest lands are being reclaimed for agricultural use, and this accelerates the degradation of the fragile mountain ecosystems. Moreover, inaccessibility and a low level of education are preventing development in mountain communities. Agroforestry provides a promising resource-centered technology to meet the twin goals of productivity and conservation. This paper discusses the indigenous agroforestry system practiced in southwestern China, and the promising economic and ecological benefits. People in southwestern China have accumulated abundant knowledge on the utilization of agroforestry technologies to rehabilitate degraded land and the multiple benefits that follow some indigenous practices. Integrating the agroforestry system and modern agricultural technologies can be an effective approach for the sustainable development of mountain ecosystems.

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## The Narmada Water Resources Project, India: Implementing Sustainable Development

A. Ahmad

This paper highlights the importance of water-resources development for food security and overall socioeconomic development. It describes the management associated with Sardar Sarovar (Narmada) Water Resources Project (SSP), which is under implementation in the Indian Narmada basin of the Satpuda and Vindhyan mountains. The SSP is an interstate multipurpose joint venture of four Indian States namely, Madhya Pradesh (M.P.), Gujarat, Maharashtra, and Rajasthan. The storage dam will submerge 37 533 ha of land and will result in displacement of more than 40 000 families—0.12 million people—from 245 villages in the States of M.P., Gujarat, and Maharashtra. The positive impacts expected from the project are: generation of 1450 mega watts (MW) power; irrigation of a 75 000 ha arid area in Barmer and Jalore districts of Rajasthan and a 1.8 million ha, mostly drought prone, area in Gujarat, environmental improvements etc. The ecosystem approach used in both human rehabilitation and environmental management works for environmentally sustainable development in the Narmada basin and is replicable in mountainous as well as nonmountainous areas.

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## Environmental Knowledge and Environmental Attitudes: Wedinoo, Morocco

A.B. Najib

There is a major omission in the considerable literature on environmental problems, and the threat these problems present in the South. Little is known about how the population in the South perceive these threats. Similarly, we have little understanding of people's attitudes towards environmental problems. This paper draws on studies carried out in 1993 and 1996. It draws on empirical material taken from a sample of households in the city of Goulmine, located in the pre-Saharan region of Anti-Atlas Mountains. The aim is to identify inhabitants' attitudes to environmental problems and the extent to which these attitudes and opinions correlate with actual household energy consumption. The results show a high level of concern about environmental issues, particularly among migrant groups. But closer analysis reveals an inconsistency between environmental concern and actual consumption of household energy. This is explained by the fact that certain energy sources have been, and still are, crucial in people's lifestyles and, thus, difficult to change. The paper concludes by suggesting that central, regional, and local authorities have both a responsibility and an opportunity to assist in environmental management. Moreover, it is suggested that environmental actions should become proactive, rather than reactive or responsive.

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