

Chapter 1

Introduction

BACKGROUND

All of the world's major rivers have their headwaters in the mountains. Over half of humanity relies on the fresh water accumulating in the mountains for drinking, domestic use, irrigation, hydropower, industry, and transportation. Mountain areas constitute a relatively small proportion of river basins, yet they provide the greater part of the river flows downstream. These 'water towers' are crucial to the welfare of humankind. As demand increases, the potential for conflict over the use of mountain waters grows. Careful management of mountain water resources must therefore become a global priority in a world moving towards a water crisis in the next century.

The Hindu Kush-Himalayas (HKH) are the largest storehouse of fresh water in the lower latitudes and as such are important water towers for nearly 500 million people. They are the source of major river systems: the Indus, the Ganges, the Yarlung-Tsangpo, the Brahmaputra, the Nu-Salween, the Yangtze, and the Mekong. These mountains are also called the 'Third Pole' as they contain the largest mass of ice and snow outside the earth's polar regions. Located at the highest elevations on earth, with the permanent snowline at about 5,000 m, the mountain peaks of the HKH extend close to 9,000 m. These peaks contain many glaciers, including some of the longest outside the polar regions. Availability of water at such great heights has also made human life possible at higher elevations than elsewhere, with human settlements beyond even 4,000 m and temporary and seasonal settlements with unique cultures and traditions even close to 6,000 m.

The extreme variability of climate and precipitation patterns, as well as extremely inadequate knowledge on the hydrology of the HKH rivers and streams and the complex interrelationships between ecology and hydrology in the region impose serious scientific and technical limitations on the development of HKH waters. In general, hydrological data are restricted and not available freely for research in the HKH. Even spatial data and maps are not easily available. Such limitations make it difficult to improve the knowledge base that is essential for dealing with existing uncertainties associated with variability in climates and precipitation. In addition, unknown factors concerning the impacts of global warming and climate change complicate the problem.

Water, as one of the region's most important natural resources and one that is critical for the survival of mountain people, cannot and must not be ignored. At this point, it has been so widely politicised that it has become an emotional issue. Persuading the HKH countries to look at water issues objectively and dispassionately has been a difficult task. Unfortunately, the mistrust and conflicts that exist in the region concerning transboundary river waters have accumulated over the last 50 years and are difficult to dispel, particularly because facts and figures are either not available or non-existent. The issue is complicated since, in many cases, the headwaters of major rivers lie in disputed territories. These factors do not encourage a comprehensive approach to data collection, research, and planning for the overall development of water in the region.

In line with this context, the programme of the International Centre for Integrated Mountain Development (ICIMOD) on water during its first ten years was confined to publication of technical reviews on issues concerning the hydrological aspects of regional waters and organizing meetings to initiate regional dialogue in order to establish a regional research network on hydrology. ICIMOD took particular care not to undertake an independent programme on water at the regional level, and most activities were undertaken in collaboration with national institutions and other agencies. Many activities took place within the framework of the International Hydrological Programme (IHP) of the United Nations Educational Scientific and Cultural Organization (UNESCO) and the Operational Hydrological Programme (OHP) of the World Meteorology Organization (WMO).

A major achievement was the successful launching of the Hindu Kush-Himalayan Flow Regimes from International Experimental and Network Data (HKH-FRIEND) project in close collaboration with the International Hydrological Programme (IHP) of UNESCO. This project has already been endorsed by six of the eight HKH countries (with the exception of India and Bhutan). ICIMOD's past work on hydrology and climate have gained credence at regional and international levels. Its interaction, linkages, and collaboration with relevant national and regional institutions, professional societies, international agencies and programmes, and universities and institutions in developed countries concerned with hydrology, water resources, and climate have grown considerably. Key activities, including an International Conference on Ecohydrology in 1996, were undertaken. Another outcome is the new project, Regional Flow Regime Estimation for Small Hydropower Agreement (REFRESHA), which is being implemented jointly with the Institute of Hydrology of the United Kingdom (UK).

ROLE OF COMMUNITY INSTITUTIONS

Mountain communities have developed diverse strategies for the management of water. Strategies have varied in accordance with local climates, bio-geophysical conditions, available technical know-how, and particular needs for water, whether for household consumption, irrigation, or other uses. These indigenous systems of water management vary widely from the mainly arid west to the largely wet eastern parts of the HKH. Strong community participation and management of such systems are important common features throughout an otherwise highly heterogeneous area. Local ingenuity and skills have been applied over the ages to store and use water to meet year-round needs and to develop agricultural systems.

A 'Regional Consultative Meeting on Water Harvesting for Mountain Households in the HKH' was organized by ICIMOD from 9-14 April, 1997, in Chengdu, Sichuan (China), in collaboration with the Institute of Mountain Hazards and Environment. The meeting

emphasised that, as water is a scarce commodity for the nearly 140 million people in the HKH region, improved water-harvesting practices are critical for ensuring the availability of drinking water for mountain households, production of food grains, providing sufficient biomass, and for improved living conditions. Efficient water use and harvesting methods also improve the condition of other natural resources, thereby improving the reliability of water supply systems. People's active participation in all aspects of water use, harvesting, and management has contributed to the equity and sustainability of local systems.

In view of the need for rapid and substantial improvements in the management of local water resources in mountain watersheds, the Regional Meeting called on ICIMOD and other collaborating partners to undertake a variety of activities. It also identified the need for research and dissemination of information in a number of areas: people's institutions related to water harvesting and their planning, implementation, maintenance, sharing, raising resources, resolving conflicts, and women's role in water harvesting. Inventories of water harvesting technologies and assessment of costs, benefits, and potentials for replication are needed. It was also recommended that databases should be developed on different aspects of hydrology, meteorology, geomorphology, geology, and biology. The environmental impacts of different water-harvesting systems were also recommended for study.

The roles of different organizations in local-level water harvesting and their capabilities in terms of meeting new challenges require investigation. In this respect examination of a decentralized policy on water harvesting was also recommended. Training at both technical and farmer levels to include exchange visits and study tours to share information about different aspects of water harvesting and improve awareness about sustainable water harvesting systems was to be organized.

The meeting discussed critical issues of governance, institutional mechanisms, equity, and micro-level responses to macro-problems. Emphasis was placed on integrating new approaches and priorities with traditional knowledge to meet local needs and build capacities/capabilities at all levels. In this context, ICIMOD's role as a facilitator in bringing together different countries, different professionals, and different policy-makers was accentuated as a way of promoting linkages.

Following the 1997 Chengdu Meeting, a regional project on Sustainable Water Harvesting Technologies and Management Systems was launched by ICIMOD with support from the Ford Foundation. The main focus of this project is on assessing and improving ways of meeting the needs for water for the households of marginalised mountain farmers, including those living in the cold arid and rainshadow areas of the HKH. In order to take stock of the existing situation vis a vis water harvesting, five policy reviews and six case studies (including three case studies from the cold arid and rainshadow areas) were undertaken in collaboration with national institutions in five HKH countries. These studies were presented at the Regional Workshop in March 1999.

THE WORKSHOP

The Regional Workshop on 'Sustainable Water Harvesting and Management in the Hindu Kush-Himalayas' was organized to discuss the findings of the six case studies carried out in the rainshadow areas and mid-hills of India, Nepal, and Pakistan and five country reviews on policies/ programmes and institutions in Bhutan, China, India, Nepal, and Pakistan. It was held at ICIMOD headquarters from March 14-16, 1999. All the papers discussed in this meeting have been presented in Volume 2 of this document.

The main objective of this workshop was to identify ways to improve and sustain local water-harvesting systems in selected mountain areas of the Hindu Kush-Himalayan region. More specifically this workshop was held to:

- develop a better understanding of the technical, organizational, and managerial aspects of Local Water Harvesting Systems (LWHS) in micro-watersheds of selected mountain areas;
- evaluate the extent to which local water-harvesting systems have an impact on and are influenced by gender and environmental considerations;
- assess the prevailing policies for water and other related areas in terms of their impact on water harvesting and management practices and identify where changes are needed to improve and sustain LWHS; and
- collect information on future directions for water-harvesting practices, policies, and management systems.

SUSTAINABLE WATER HARVESTING AND MANAGEMENT AND ICIMOD

Dr. Mahesh Banskota, Deputy Director General of ICIMOD, in his welcoming remarks to the workshop, highlighted ICIMOD's activities in water resource development in the HKH Region.

'Sustainable Water Harvesting and Management in the Hindu Kush-Himalayan Region is clearly a subject of great importance to the people in the Region because of the daily struggle of mountain communities, particularly mountain women, to collect sufficient water. Although mountain areas have been referred to as water towers, it is indeed ironical to find that most mountain communities face enormous difficulties in getting sufficient water. It is therefore not surprising to find that relatively simple but durable systems that were used to tap multiple sources of water have worked reasonably well for a fairly long period of time. Yet, more recently, on account of different factors, these systems are simply unable to cope with the demands and are slowly falling apart, some due to sheer negligence, others due to conflicts, and still others because there is no more water in the system'.

'Each period has its dominant development clichés. Today they are liberalisation and privatisation. As the after effects are seen in terms of rising unemployment, some toning down of these clichés is already evident. It was the need for rapid development several decades ago that provided the rationale for rapid expansion in the state machinery, and yet it is these very same development needs that are today calling for retrenchment of the state to make more room for other stakeholders. Better governance and civil society are the latest buzz words. This debate has also coloured mountain waters to some extent'.

'Water harvesting, water management, water resource development, and, the most recent, sustainable water resource management are among the most commonly used terms in recent discussions. The prevailing water-harvesting systems have been described as either community-/farmer-based or government-managed. The characteristics of the former are a high degree of labour intensity, based on local resources and indigenous know-how, and they are easy to maintain even when there are frequent breakdowns. The highlights of the latter are extremely capital intensive, engineering dominated, and mostly based on non-local inputs. If the former is seen as having deep roots in the community with strong local commitment and ownership, the latter has been described as contract work in which the contractor or the builder 'comes, builds, and goes'. The builder is not to be seen after the project is 'handed

over'. Why has such a dichotomy continued to persist? The local systems are badly in need of a shot in the arm to prevent them from further languishing, while most government-operated systems are too costly and separated from the very people they are meant to help?

'If farmer-based systems have such strong roots in the community, why are the communities allowing these critical lifelines to fall apart? In other systems, there is certainly an advantage of better materials and, to some extent, even better technology, and the question is why this cannot find a better base within the community instead of being only externally driven? Surely there must be a better way to integrate the best of both these systems so that mountain women can have drinking water closer to their homes and mountain farmers can improve food security through assured access to irrigation water?'

'Although the water resources' programme at ICIMOD is quite recent, its key role in mountain development has always been recognised. The main question was to identify the most appropriate area for the centre to work in a meaningful manner. There were many aspects of the subject in which the Centre did not see a role for itself. Areas have now been narrowed down, and these have been identified in the Second Regional Collaborative programme of ICIMOD, covering the period from 1999 to 2002. The areas are local water-harvesting systems, a database on water resources, and mitigation and management of water-related hazards. The future research and training activities of the Centre will focus on these areas'.

'The Centre started the water programme with a small amount of seed money, and this has been successful in attracting additional resources from Ford Foundation to undertake activities such as those being reviewed at this meeting. Support has also been received from the Government of Japan, UNESCO/IHP, and a number of other organizations for work on the database, training, and hazard mitigation in the context of water resources. ICIMOD is also very pleased to announce that the Ford Foundation is considering providing support for the next three years to develop some of the ongoing research work in this subject. ICIMOD appreciated the strong and continuing support of the Ford Foundation for not only this programme but also for a number of other areas in natural resource management'.

WATER HARVESTING IN THE MOUNTAINS: PRIORITY AREAS AND ISSUES FOR ACTION

Dr. Ujjwal Pradhan from the Ford Foundation pointed out that in the past not enough attention had been paid to the problems of water for mountain communities in rainshadow areas. He stressed the need for research on small structures. He suggested that non-government organizations, governments, and communities should work together to supplement each other's efforts. He also emphasised the need to pay attention to promotion of local governance and local control for multiple uses of water. He stressed that policies, institutions, and power relationships at various levels that have a bearing on local water harvesting need greater attention.

It was necessary to de-mystify water-harvesting policies. It was also important to know how the policies impact households and communities and what kind of policies were needed. Policies change with time, and they will be forever evolving.

Similarly, it was important to know what kind of institutions were needed to respond effectively to the needs of mountain people at the household and community levels. It was important to incorporate local and customary laws in formulating policies for sharing local waters. Another important issue was that of integration, particularly by taking note of power

relationships at various levels. Bridging the gap between the interests of the state and those of a particular locality regarding the use and management of water resources was a major challenge both for policy-makers as well as for efficient implementation.

While looking for best practices in water-harvesting systems, it was just as important to look for failures. Assessment of both successes and failures was necessary if water management was to move in a sustainable direction in future.

A number of papers attempted to provide a regional perspective on different aspects of water harvesting. The book is divided into two volumes. Volume One contains the background information and a general overview of issues: water, water harvesting and practices, policies, and social dimensions of water harvesting. It also contains an annex table on hydropower potential (p27) and on the workshop (Annexes 1 and 2). Volume One also contains an annotated bibliography on water harvesting. This bibliography provides useful information for general readers as well as researchers interested in various aspects of local water harvesting in the Hindu Kush-Himalayan countries.

The policy reviews and case studies undertaken in five countries of the HKH can be found in Volume Two. The papers included in this volume are edited versions of individual papers dealing with national policies on water and water harvesting in the mountainous regions of these countries and were prepared by authors from these countries. Volume Two also contains six case studies on local water-harvesting technology and management. These case studies were carried out in two diverse climatic and water regimes of the HKH. Three are on the populous middle mountain regions of the HKH; viz., Tehri Garhwal (India), Kabhrepalanchok (Nepal), and Mansehra, NWFP (Pakistan), and the other three case studies are on the cold arid and rain-shadow areas of Ladakh (India), Mustang (Nepal), and Balochistan (Pakistan).

POLICY REVIEWS

Water harvesting and conservation have to go together. Water harvesting and protection of water bodies should be important components of national water policies. National water policies, along with specific and deliberate water policies for specific areas of hardship caused by water shortage, should be evolved through national-level dialogues and debates among NGOs, local level communities, national experts, and stakeholders. The following section highlights water-harvesting policies in the HKH countries.

In **Bhutan**, there is no specific policy for water harvesting at present. However, there are guidelines for water harvesting for irrigation and drinking water. Regarding irrigation development, the Land Act stipulates that, while harvesting water for irrigation, it should not cause damage to others' land, house, or plantation. Use of water jointly harvested should be shared among the beneficiaries of the system either through mutual understanding or through existing practice. There was no formal policy to guide the development of the drinking water policy. However, the rural water supply and sanitation unit of the Health Division formulated several guidelines to facilitate their activities. The overall goal of this programme was to improve public health by reducing the incidence of water borne and filth borne disease through provision of safe drinking water and adequate sanitation facilities (Volume 2, Chapter 1).

Mountain regions in **China** account for 70 per cent of its territory. Water scarcity is prominent in these areas. Water scarcity coincides with a high incidence of poverty. The

Chinese Government places importance on and has introduced many relevant policies for water harvesting (Volume 2, Chapter 2).

Water harvesting in mountain areas has received high priority. Investments have been made in water-harvesting projects. The national policy of China addresses the problem of poverty through water harvesting and seeks to ensure water supplies for domestic use as well as for agricultural purposes. In 1984, a specific policy on poverty alleviation was introduced and water harvesting is an important component of it.

In **India**, the National Water Policy (1987) is considered to be a landmark in development of the water sector. It was the first time a policy for planning, developing, and conserving scarce water resources in an integrated manner and on an environmentally sound basis was formulated. Notwithstanding, the policies for rainwater harvesting differ among the mountain states of India (Volume 2, Chapter 3). The National Water Policy is general and does not deal with water harvesting in specific areas. As the water sector is on the State list, states have formed their own policies on water harvesting. The Government of Himachal Pradesh has recently issued a notification making harvesting rainwater mandatory for drinking and domestic purposes in all new constructions and existing buildings in the state.

In **Nepal** the Ministry of Housing and Physical Planning published a National Policy on Drinking Water Supply in 1998. There is no separate policy for rainwater harvesting and use. The 9th plan of Nepal has pointed out that, in remote areas where viable sources of drinking water are not available, harvesting and using rainwater will be promoted. However, there is no specific policy for harvesting rainwater (Volume 2, Chapter 4).

In **Pakistan**, there is no specific policy on water harvesting. However, in Balochistan substantial subsidies on pumps and electricity have had an adverse impact on groundwater levels. There is a national water development policy, but it does not specify rainwater harvesting (Volume 2, Chapter 5).

CASE STUDIES

Chapters 6 to 11 in Volume 2 cover case studies in particular areas of the countries for which policy reviews were carried out. These case studies review local water-harvesting practices and were presented at the workshop. The break down is as follows—not necessarily in chapter sequence but rather according to a mix of geographical area and climate.

There were two case studies each from India, Nepal, and Pakistan. Three case studies were from relatively wet areas – where rainfall was above 1,000 mm per annum. In **India** a watershed in the **Tehri Garhwal** district of **Uttar Pradesh** (Volume 2, Chapter 6) was examined; in **Nepal**, **Kabhrepalanchok** (Kabhre) district lying directly east of Kathmandu was the site (Volume 2, Chapter 7) In **Pakistan** a small watershed in **Mansehra** district in the **North West Frontier Province** (NWFP) was covered (Volume 2, Chapter 8). In terms of elevation, all three were located at lower altitudes (i.e., below 1,500 m). Rainfall decreased from east to west throughout the HKH region and based on this one could conclude that Balochistan (Pakistan) in the west was much drier than Kabhre (Nepal) in the east. The three others case studies were from relatively dry areas with desert-type conditions: **Ladakh** (in north **India**); **Mustang** in central north **Nepal**, and **Balochistan** (in **Pakistan**), (both the former being in the rainshadow (Trans-Himalayan) — and hence classifiable as cold deserts (Volume 2, Chapters 9, 10, and 11).

In general, all the case studies noted that less difficulty was encountered in harvesting drinking water. Drinking water supplies for both people and livestock had so far been sufficient and could be collected quite easily. However, in all the study areas, women had to spend a lot of time fetching drinking water.

On the other hand, there were major problems in all areas regarding water supply for irrigation. The problems differed in nature as well as in severity from case to case. Most water-harvesting systems focussed on meeting irrigation needs, and this was where there were complex institutional arrangements for ensuring sufficient water in critical planting seasons.

The **Tehri Garhwal** case study area identified many interesting practices in local water harvesting, and these included the use of plants for purifying water and the separation of water sources for different social groups. While there has been a significant expansion in the use of modern systems (including the use of lift pumps to supply water), traditional systems were still very important for most of the people in the watershed (Volume 2, Chapter 6).

The case study area from Nepal's middle hills was about an area east of Kathmandu in **Kabhre district** (Volume 2, Chapter 7). There appears to have been many interventions in the past to improve local water-harvesting systems, for both drinking and irrigation. The most recent case of community involvement in water harvesting was the establishment of a micro-hydro electricity plant for which a fairly elaborate community organization had been put in place. External resources played an important role in various interventions. The main issue appeared to be the need for an increase in local resources to support present and future water-harvesting activities.

The unique feature of the **Mansehra** case study area was that it had neither an informal nor a formal community-organized water distribution system. Although group involvement in various water-harvesting activities occurred in Mansehra, decisions about quantities of water to be used and when and how to use it were made by the person controlling the water source. Those living upstream considered it their right to irrigate their fields first. If there was any excess water, then downstream households could irrigate their fields. Upstream farmers could divert any amount of water to their fields at any time they wished. This practice has given rise to an inequitable water distribution system. This has forced downstreamers to adopt cropping systems that need less water. Some farmers have been forced to leave their lands fallow (Volume 2, Chapter 8).

The **Ladakh (India)** case study area highlighted the existence of a fairly complex traditional institutional system for irrigation. There are many different systems extant and these vary from watershed to watershed. Given the limited growing season and the desert-like conditions, water supplies were used to maximise the area under irrigation. In short planting periods, water had to be distributed to the fields quickly. Individual decisions were confined to their own lands. Water allocation, distribution, and its supervision and monitoring involved a concerted effort on the part of the community. For a few weeks the entire community was mobilised to manage water distribution. The future of such systems was questioned not from the perspective of a failure in the technology of water harvesting, but because of the increasing difficulty in mobilising community members to participate in traditional water-harvesting systems (Volume 2, Chapter 9).

In the Trans-Himalayan area in **Mustang**, Nepal (Volume 2, Chapter 10), the institutional mechanisms for water harvesting were equally complex and well organized. Although similar to those found in Ladakh, there were also many variations. Interestingly, one point raised was that the prevailing system had not been modified or redesigned in spite of increased demands for irrigation arising out of the introduction of horticulture and tree farming. The priority in the prevailing irrigation system was for the production of cereal grains.

A highlight from the **Balochistan** case study area was that increased access to groundwater had resulted in greater sedentarisation of the community with substantial increases in income for those owning land and having access to groundwater. Sufficient supplies of water led to a reduction in seasonal migration, lessened the work of women compared to the previous nomadic lifestyle, and also resulted in an improved quality of life for the community. The main worry was the excessive mining of groundwater and its sufficiency in future. There were important questions about sustaining water supplies (Volume 2, Chapter 11).

CONCLUSION

The workshop concluded that water for domestic use, close to the household, was decreasing throughout the HKH region. Sustainable development of local water-harvesting systems was considered a promising method of providing water for domestic use in future. The workshop discussions evaluated the existing water-harvesting structures and social organizations in different mountain areas. The main recommendations focussed on the issues described in the following passages.

Integrating Indigenous Knowledge and Technology with Modern Practices

In order to improve and expand the practical applications of indigenous knowledge and technologies for sustainable water harvesting, planning, and management, research was needed. It was widely recognised that such technologies should be integrated into modern technologies. Specialised training at the local level, in the integrated application of traditional and modern technologies, was necessary.

Interdisciplinary Research and Increased Interaction among Stakeholders

It was recommended that research should be integrated and interdisciplinary, integrating bio-physical and socioeconomic concerns. The need for interaction among scientists, local people, and policy-makers during all phases of research and application was stressed.

It was also recommended that women should be trained and made responsible for operating and maintaining water-harvesting systems.

Empowerment and Institutional Development

Increased autonomy of local communities was necessary in order to involve them in all levels of decision-making. It was acknowledged that this type of empowerment was crucial for sustainable mountain development. This would enhance community responsibility for and control of local water resources and their development. It was agreed that institutional

development was necessary at all levels — national and local for development and in management and coordination of water-harvesting plans and policies.

Regional Institutions and Cooperation

It was agreed that international involvement and regional cooperation were essential for sustainable water resource development. Cooperation in research, development, training, information exchange, sharing of experiences, technologies, and methodologies was essential.

It was recommended that guidebooks on water harvesting should be published in local languages (especially those translated from Chinese into English) and distributed to different mountain areas in the region.

There is a situation of acute water scarcity in most rural mountain households in the HKH region: it is a situation of scarcity amidst plenty. Water is not available where it is most needed. In the past, mountain households have displayed great wisdom in not only harvesting water but also in using it prudently. Today, this is no longer the case and water has become an important issue. It underlies the rampant poverty, deteriorating environment, and increasing communal disharmony. As the previously accessible sources of water disappear, communities are forced to harvest rainwater. The potential for harvesting rainwater is vast, and this was clear from the various discussions held. Finding efficient ways to use the water available will be a key factor in sustainable development of mountain areas. Harvesting and storing rainwater properly will be important components in future.