CHAPTER 1
Introduction

The pattern of development in the Hindu Kush-Himalayan (HKH) region varies considerably from country to country and area to area. However, the overall picture in this formidable mountain range is rather bleak with only very few exceptions. Usually, underdevelopment, poverty, inaccessibility, and lack of physical infrastructure are prevalent. Energy, a key ingredient for improving living conditions and fuelling the development process, is generally in short supply, and the inhabitants have to rely on local natural resources of fuelwood and other biomass to meet their daily needs. In many mountain areas, there are few areas in which trees can grow, or the existing forest has been depleted to an unsustainable level, resulting in soil erosion and other severe environmental problems.

More recently, electricity, especially for lighting, has come to be regarded as a necessity rather than a luxury, and people living in remote areas are demanding access to electric power. Similarly, mechanical power is needed for normal tasks such as milling and oil expelling, to reduce the drudgery of daily chores, and to improve productivity. Consequently, more appropriate and modern energy generation systems are needed to meet the increasing demand in remote and underdeveloped mountain areas.

Mini- and micro-hydropower (MMHP) appears to be an appropriate resource for meeting the energy needs of people in the HKH region. Potential energy resources from hydropower are far greater than present or projected demand. By using small power plants established to fulfill the demands of individual communities, it is possible to avoid the problems and costs associated with transmission and transport of energy to remote, inaccessible areas with small populations. Private Installations set up on the initiative of beneficiary communities or local entrepreneurs in a decentralised manner are particularly effective, and the equipment is also indigenous and low-cost. Experience in Nepal and elsewhere has clearly demonstrated that such plants, especially in the micro range (up to 100kW), can be economically viable if certain support is provided and the entrepreneur(s)/owner(s) are able to manage, operate, and maintain the plants properly. The four manuals for micro-hydropower (MHP) plants prepared for ICIMOD, of which this is one, are intended to provide some of the necessary support and information to enable such plants to be properly selected, sited, designed, installed, managed, operated, maintained, and repaired. They address much of the need for information identified through various studies and consultations.

1.1 Applicability of MHP

There are many areas in the HKH region that are inaccessible and underdeveloped, and where the population is scattered, poor, and mostly unaware of technological progress/ benefits. Isolated micro-hydropower (MHP) plants are usually the least-cost option for providing energy in such areas. This is mainly because other options for the supply of energy, such as grid extension and diesel power, are more expensive and difficult to install or operate. Since small water streams are usually available in most of the HKH region, it is quite easy to construct MHP plants to meet the energy needs of a small village or cluster of settlements. These needs may be for electricity, mainly for lighting during the evenings, or for motive power to be used for agro-processing, wood working, and/or other small-scale industries. The size of plant needed for these applications may range from 200W to about 200kW. In the lowest range, up to five kW, the end-use would only be electricity for lighting, since running processing equipment at such a low power would be difficult. In the medium range (5–50kW), the plant may provide energy for agro-processing or industry only, electricity only, or a combination of both; while larger-sized plants (40–200kW) usually only generate electricity, which may be used for lighting and other domestic uses and/or for industrial applications. Thus the type of technology, level of sophistication of the equipment, and system of management and operation are rather different for power plants in the different ranges.

In the case of larger-sized plants, attempts have also been made to use electricity for cooking and heating (including water heating) especially to use the power available during off-peak hours. The use of electricity for heating (particularly cooking) can contribute significantly towards reducing the burning of wood and other biomass; and thus countering the negative impacts on environment and health from burning biomass. In addition to meeting the needs of an area, a properly designed, installed, and managed MHP plant can also contribute significantly towards employment/income generation, improved living conditions, and improved educational facilities.

1.2 About this Manual

This manual is one of a series of four, initiated and sponsored by ICIMOD, aimed at different MHP practitioners including surveyors, designers of schemes, manufacturers, installers, managers, operators, and repairers. The current volume has been prepared mainly as a source of information and support for those technicians and professionals who:

- undertake surveys of sites proposed for run-of-the-river type MHP installations;
- prepare feasibility reports covering:
  - physical feasibility, does the physical situation on site allow requisite power to be generated?

- technical feasibility, is the site suitable for accommodating the various civil engineering structures required for an MHP scheme?
- sociological feasibility, is the local community willing and able to take on the commitments of an MHP scheme?
- economic feasibility; can the MHP scheme generate enough income?

- and who design the layout of a scheme.

In writing the manual, it has been assumed that the target group is reasonably literate and has had some exposure to micro-hydro technology. The manual's users may not be qualified engineers, but they should have some basic engineering qualification (diploma/certificate level) and, more important, relevant experience.

The design of an MHP scheme is a complicated procedure, as all sites are different with different problems and needs. It is impossible to cover all the aspects of feasibility for all ranges of MMHP within a single manual. The information given in this manual is intended to be used for straightforward designs of MHP schemes in the range of up to 50kW at sites meeting the criteria laid down in the chapters. For more complicated and larger schemes, say above 50kW, a qualified engineer will have to make the design using more detailed manuals and books and site data.

As the title suggests, this manual only deals with the situation on site, especially the layout; i.e., the location and route of civil engineering structures such as the dam/diversion weir, intake, power canal (sometimes called headrace), forebay, penstock, powerhouse, and tailrace. The design and/or selection of the actual electro-mechanical equipment is beyond the scope of this manual; except that the type and size of the turbine may have to be decided upon at this stage. It is hoped that the information provided in this manual will enable professionals to survey the site, measure/estimate various parameters, decide whether the scheme is viable, and design the layout/location of the civil engineering structures. It is expected that a person having some survey qualifications and experience would not actually need additional training to enable him* to carry out the above tasks using this manual. Nevertheless, it would no doubt be more effective and beneficial if such a person were able to attend a training programme based on the manual before starting work.

* Note: Throughout this manual the masculine term is used to refer to persons whether male or female