

I. Introduction

The management of natural resources in the mountain environments has emerged as one of the most significant challenges to human understanding and organisational ability in the current century. Although the mountains and uplands constitute about 20 per cent of the surface of the earth, it is difficult to find an area not affected by their environmental characteristics. The most important influence that mountains exert emanates from their ability to act as orographic barriers to the flow of moisture bearing winds that result in high precipitation on the windward slopes and create rainshadows on the leeward slopes. Moreover, in the upper regions of many mountains large volumes of water are stored in the form of ice and these provide the necessary melt flows into the rivers during the hot, dry seasons. The vital cultural and ecological importance of these mountain waters further enhance their significance in satisfying the needs of all living creatures. Of somewhat less significance ecologically, but nonetheless of great economic importance, are the uses of the mountains for forestry, agro-horticulture, mineral extraction, livestock rearing, tourism, and recreation.

Over the last several hundred years, and in particular in the current century, the human impact on mountain environments has increased considerably. These interventions have both a stabilising and a disturbing impact on the mountain environment. The negative impact of such interventions is due to the relatively lower level of understanding of the particularities of the mountain society and habitat.

Large scale changes have occurred that have resulted in wide spread human misery. The impact of such changes is not restricted to mountain areas and they have concomitantly affected the plains. Hence, the disturbances in the mountain environment, as well as the urgent need to ensure a sustainable habitat, have attracted the attention of national and international institutions which have made the mountain environment an area of increasing concern.

As a result, the availability of funds for mountain development has increased substantially. Allocating funds, however, is the easier part of the task. It is not so easy to realise the objective for which the funds were provided. In this respect, the proper management of resources within the perspective of a mountain environment can make a positive contribution.

Notwithstanding the contribution it can make, the concepts and methods of natural resource management for mountain environments are in a rudimentary, evolving stage. Serious analytical and integrative contributions are needed to strengthen this vital area. Undertaking analytical reviews of management experiences in mountain development, in various countries, is a vital element in enriching the knowledge and skills in this field. The present review and analysis of the important issues of natural resource management in the Doon Valley, which is in the Himalayan foothills of the State of Uttar Pradesh in India, has been undertaken from this point of view.

Conceptual Framework for Natural Resource Management in Mountain Environments

Words such as environment or natural resource management, inspite of their widespread use, suffer from a lack of conceptual clarity. In a very broad sense, one can describe 'natural resource management' as a method for calculated institutional intervention in the process of both using and conserving these resources, based on updated environmental knowledge. The problems become more complex in the case of mountain environments, due to specific characteristics that have not been systematically analysed. Accordingly, natural resource management in the mountain environments cannot, at present, be a fully prescriptive guide to human activities. It is the accumulation of knowledge from various mountain areas and their several resource strategies that will provide the background for a more comprehensive prescriptive tool in future.

A comprehensive strategy for natural resource management in mountain environments might be based on a holistic and interdisciplinary understanding of both society and habitat within a dynamic framework. The intellectual challenge lies in the fact that the existing knowledge is evolving within specialised disciplines, or even sub-disciplines, while their application should necessarily be holistic and interdisciplinary. The various dimensions of the intellectual challenge, in the evolution of such management strategies for the mountain environments, can be classified as a search for the following types of specific parameters and the characteristics within them :

- specific socioeconomic parameters,
- specific environmental parameters,
- specific integrational parameters.

The framework within which human societies have evolved in the mountain environments has several peculiarities. Due to their relative isolation, limited accessibility, and low level of interaction with the societies in the plains, mountain societies have evolved in a different manner. To many, at the superficial level, these mountain societies appear to be stagnant. Yet, the reality is that most mountain societies have a long history of evolution and change that has no written records. It is necessary to understand the specific human and natural resource contexts of these evolutions.

Against the background of the isolated settlements in the mountains, each area has evolved specific socioeconomic parameters. These parameters are normally rooted in the specific environmental parameters of the mountain areas, because to a large extent they influence the socioeconomic organisations pursued by these societies. Developing further along the lines of the analysis presented by Jodha (1989), the environmental characteristics of the mountain areas can largely be understood through the orographic features, which lead to changes in altitude and variations in rainfall. The altitude and rainfall provide micro-conditions for vegetational as well as agro-climatic characteristics of the mountain areas. On a macro-scale this provides the basis for the rich genetic diversity of the mountains. In a geologically young and unconsolidated mountain range such as the Himalayas, the question of geological instability as another important ecosystemic characteristic

becomes an important element in natural resource management.

The environmental parameters, over thousands of years, have interacted with the socioeconomic parameters in the mountains. Specific climatic advantages of rainfall or cool environment have led to the growth of temperate forests that can appeal to the twentieth century tourist economy. They can also provide a basis that has agro-climatic advantages for the production of fruits and vegetables that have commercial value and can be sold to markets in the plains. The production of apples, potatoes, etc. in the mountains can be taken as an example. On the other hand, orographic characteristics can lead also to difficulties in transportation, thus limiting the potential for marketing these fruits and vegetables at various times of the year. A comprehensive and minute understanding of these specific parameters becomes, therefore, an essential factor in the planning of mountain development and the analysis of mountain transformations.

This leads us to the third set of specific parameters, the integrational parameters essential for evolving a scientific approach to the formulation of a holistic natural resource management strategy for mountain environments. Unfortunately, while the need for integration at the conceptual level has been repeatedly articulated, clearcut identification of the nature of this integration has been conspicuous by its absence. Looking into the most important needs for the integration of natural resource management in mountain environments, at least three levels of integrational need can be classified. They are as follows:

- Integration at the disciplinary level,
- Integration at the geophysical level,
- Integration at the institutional level.

Integration at the **disciplinary level** poses the major intellectual challenge of internalising and utilising the progress made in current scientific disciplines to make natural resource management decisions based on interdisciplinary ecosystemic understanding. This leaves tremendous scope for drawing upon developments in the most advanced areas of the disciplinary sciences, such as atmospheric physics, sedimentology, hydrogeology, plant ecology, soil chemistry, and for the evolution of decisions based on these disciplines. In terms of its

functional role, natural resource management has several broader spheres of intervention such as environmental policy analysis and innovation, management of research in ecological sciences, monitoring of resource processes and endowments, continuous clarification of the concept of sustainability etc. Sometimes independently, sometimes as a result of some discipline based reasons, minute but significant changes are continuously taking place in these interdisciplinary areas that make natural resource management a continuously evolving concept. (Bandyopadhyay and Shiva, 1985; WCED, 1987; Sachs, 1988). Integration at the disciplinal level plays the central role in this evolution.

Integration at the **geophysical level** is no less a fascinating problem. While every micro-watershed in a mountain environment is, to a large extent, a unique ecosystem on a small scale, it is also necessary to look at the whole river basin as a hydrological ecosystem on a large scale, spanning as it does from the upland watersheds to the plains, to the estuaries and the delta. The integration of the diverse ecological situations in various parts of the basin is important. This is because it not only contributes to the total understanding of geophysical processes, such as floods and sedimentation, but because it provides also an additional perspective to the human geography of urban growth, transportation, migration, and industrialisation. The issues of natural resource management in the mountain environments, therefore, can be analysed in the perspective of an evolving and integrated understanding of a river basin of which the uplands are integral parts.

Integration at the **institutional level** is the third level of integration, and it is vital for the execution of natural resource management strategies. While some serious attention has gone into the first two forms of integration (di Castri et al., 1980), the research on institutional innovations that is needed for more informed natural resource management, especially in the mountain environments, is still in an embryonic stage. The situation demands the conceptual linking of the people, the indigenous institutions at the micro level, the scientists, the scholars, the decision makers, and the formal institutions at the macro level.

Unlike the other two levels of integration, which are more or less intellectual challenges, institutional

integration is a programmatic challenge. The evolution of this process has been restrained by the existing institutions and power structures that oppose the change for obvious reasons. Most integrated development programmes in the Himalaya can be cited as examples. Integration at the institutional level is not a question of mechanically adding two existing departments and making one - or bundling two individual project objectives within one programme. Institutional integration is a practical process, the chemistry of which is governed by a clear understanding of the other two forms of integration mentioned earlier.

These specific parameters and the characteristics within them, together with the three levels of integration, will be used as an elementary framework to review and analyse the experiences of natural resource management in the Doon Valley. In this form it will be identified as integrated environmental management. While in no way is such a framework a comprehensive one, a beginning has to be made, because, in the absence of any framework at all, natural resource management in the mountain environments becomes an extremely uncertain field (Thompson and Warburton, 1985). Summing up the current state of the art, Ives and Messerli (1989) stress the need for further systematic analysis in order to arrive at better scientific understanding and better management of the mountain areas. The main objective of the present study is to review and analyse the experiences in the Doon Valley, in order to enable this evolving framework to guide natural resource management in the mountain environments in general, and urbanised valleys in particular.

Objectives of the Case Study on Doon Valley

With the above objective in mind, the present review and analysis of the experiences in the Doon Valley was undertaken. There are several very important reasons for selecting the Doon Valley for this. The Doon Valley represents an administrative unit called *tehsil* (county) that almost completely overlaps the watershed boundary of the area. This avoids a fundamental difficulty that is always faced in administering an area of environmental sensitivity. The Doon Valley also represents, in the most recent form, the demographic and socioeconomic trends of urban-industrial growth in the valley areas at the foot of the Himalaya. As a result, this valley has evolved as the

most important centre for economic activities in the whole of the mountainous administrative region of Garhwal Division, which is comprised of five hill districts of the Indian State of Uttar Pradesh, namely Dehradun, Uttarkashi, Tehri, Garhwal and Chamoli.

The next important speciality of the Doon Valley is that there is a long, and recorded, history of natural resource management by the formal departments. This new institutional framework started with the establishment of British rule over the valley. At the same time indigenous and informal institutions continued to function collaterally, although in a more subdued form compared to those in more remote hill areas. From the early parts of the 19th century, when the British arrived, to date, there has been a long and well-documented departmental history of natural resource management in the valley that provides us with a very important stock of knowledge for review and analysis.

What probably makes the case of Doon Valley the richest in experiences of natural resource management in the whole of India is the fact that the valley has been the object of an ecosystemic analysis (Bandyopadhyay et al., 1983), and this led to the mobilisation of public opinion. The latter proved to be important, because it culminated in India's first public interest litigation on environment in the Supreme Court of India (Ramamurthy, 1985). The emergence of a responsible environmental movement informed by ecosystems research, and supported by the voluntary participation of the concerned people in activities that shape the future of the valley, provides us with an opportunity for examining and testing administrative innovations that would encourage the participation of these environmental movements in the planning and monitoring of future economic activities.

The Doon Valley has the added advantage of being able to easily attract the attention of senior administrators in the national capital. This is probably because of their close emotional links with the valley where the National Academy of Administration is located. Due to these important and favourable factors, Doon Valley has moved ahead, compared to the rest of India, in facing the main issues of natural resource management, particularly with respect to forests, water resources, mineral resources, and land-use.

The record of the valley in matters related to institutional innovations is no less impressive. Closely following the innovations and trends set by the erstwhile British administrators are the present advisory and executive institutions in Doon Valley. Among the first significant steps taken by the Department of the Environment of the Government of India, following its establishment in 1981, was the formation of the high powered Doon Valley Board. Its purpose is to ensure that economic development activities do not lead to irreparable ecological damages in the valley's ecosystem. The State Government has also risen to the occasion by establishing the Doon Valley Special Area Development Authority, and a Master Plan has been made to internalize environmental expertise in the management of natural resources.

The present review and analysis of natural resource management is made against this background. It is an attempt to examine and understand the issues involved within the matrix of several thematic and sectoral dimensions. The three main thematic dimensions are:

- economic history of natural resource utilisation and management,
- evolution of ecosystemic knowledge and institutions for natural resource management,
- growth of an ecologically informed public, legal, and administrative action;

and the four main sectoral dimensions are:

- management of forests and wildlife,
- management of water resources,
- management of surface quarrying,
- management of urban-industrial growth.

In view of the history of more than a century of discovery and management of natural resources, the review and analysis will be initiated on a sectoral basis. For example, the question of forests and wildlife management will be analysed from ecological perspectives, the pressure from users, afforestation strategies, monitoring of the quality and extent of forest ecosystems, and the question of wildlife protection and conservation. In the same manner, in the case of water resource management, the study will analyse the increasing pressure on the water resources in the valley,

the institutional framework for their transportation, and distribution. It will also examine the challenge of the enhanced understanding of the hydrology of the valley, in terms of the possibility of sustaining higher levels of lean season supply, with a view to satisfying the increasing requirement of the urban, industrial and rural sectors.

Two specific elements in the case of Doon Valley, that add to its importance, are the issues of the management of the surface quarrying of limestone and the management of urban-industrial growth. Both these issues have generated highly informed public protests and legal actions. The public interest litigation has also created a new trend in environmental litigation and has strongly influenced research on law and natural resources in India (Bhagwati, 1988).

The last part of the review and analysis will try to understand the prospect of an ecologically sensitive and a socially equitable ecosystemic approach to natural resource management in the Doon Valley. The study will examine these important innovations and their effectiveness in terms of encouraging management with environmental responsibility.

Most of the factors for such a review and analysis are favourable in the case of Doon Valley. The store of departmental and disciplinary knowledge is extremely large. The possibilities, that now exist in the valley, of using the legal and administrative opportunities for natural resource management largely depend on the possibility of generating interdisciplinary, ecological knowledge from the above-mentioned store. This problem is not unique to the Doon Valley, but in the present context Doon Valley is one of the most convenient areas for the evolution and utilisation of such knowledge. This is more so because, in the valley, there are a large number of institutions dealing with natural resources. Informed and responsible people's environmental action groups, whose commitments have been tested through years of sustained action, have successfully collaborated with these organisations. This rich multi-dimensional experience of natural resource management in the Doon Valley, therefore, provides a very useful backdrop for the search for a future management oriented strategy for integrated development in the mountains in general, and the rapidly urbanising valley areas in particular.

FIG. I
CASE STUDY - DOON VALLEY
WATER DRAINAGE SYSTEM

