II. The Doon Valley

Geography of the Doon Valley

The word Doon represents the bouldery valley that runs parallel to and between the lesser Himalayan range and the Shivalik range. The area commonly known as Doon Valley is a small portion of this geological formation, located between the rivers Yamuna and Ganga, at the north-western limit of the state of Uttar Pradesh and adjoining the state of Himachal Pradesh in India (Fig.1, page 6). It should be mentioned that through common usage two separate spellings have emerged for the name of the valley, e.g. Doon and Dun. The official records in the settlement report written by Daniell (1867) use the spelling Doon, but the settlement report of Baker (1886) uses the spelling Dun, indicating a change somewhere in between. As of now, administrative names, like those of the district, tehsil, or the city, have the spelling Dun, while the valley is commonly identified with the spelling Doon. Accordingly, in this case study, "Dun" will be used to identify the administrative units and "Doon" to identify the geographical unit of the valley. In the same way, of the various spellings of the two rivers bordering the valley, the spellings Ganga and Yamuna will be followed.

The Lesser Himalayan Range, which forms the northeastern boundary of the valley, is part of the Great Himalayan ranges, while the Shivalik range, forming the southwestern boundary of the valley, is a younger formation of debris swept from these mountain ranges. The continuous accumulation of debris resulted in a gentle slope of the Shivaliks towards the Himalayan ranges and in turn formed a longitudinal shallow valley that is higher than the great plains immediately to the south of the Shivaliks. (Fig. 2 Page 8). These valleys are called "Doons" and are often cut by streams that drain the interior mountains. In some places the Doons disappear with the merging of the Shivaliks and the Lesser Himalaya. Because of the elevation of the Doons, and the short distance over which the drainage from the upper parts of the valley meets the water courses in the plains, the landscape is characterised by deep gorges and gullies that cut through the unconsolidated strata that form the floors of these valleys.

The Shivalik range belongs to a tertiary belt consisting of conglomerates interbedded with sandstones. This belt meets the older pre-Tertiary Himalayan belt at the main boundary fault, and this is a major tectonic feature of the area. The area has recorded tectonic movements of about 2 cm per year. The rocks in this dislocation zone are thus fractured, crushed, and weakened. Much of the ecological instabiligy of the Doon Valley may be attributed to this inherent geological weakness.

On the basis of rock and soil types the valley can be divided into three distinct belts, the Lesser Himalayan belt, the Doon proper, and the Shivalik belt. At the base, the Himalayan belt consists of high grade limestones and shales, and these change gradually into dolomite covered by a shallow layer of topsoil. The Doon Valley proper is covered by unstratified mixed pebbles and boulders with very little matrix. The Doon gravels of the Pleistocene age are covered by a thin mantle of soil, except in the river beds. These gravels are highly pervious and form a poor underground water reservoir. The boulder bed of the drainage channels provides the underground course for most streams originating in the Himalayas. Many of these disappear deep into the boulder bed for long stretches and reappear near the edges of the plateau where they find impermeable clay formations. The natural abundance of water in the valley, particularly in the eastern part, is described in the settlement report of Baker (1886) as follows:

> *At present the eastern Doon is a vast natural reservoir or feeder of the Ganga. The forests are intercepted with running streams rising from innumerable springs in every direction and the ground is literally oozing with water. The volume of water poured into the Ganga by the Suswa and Song is immense.*

An almost straightline from Mohand pass to Dehradun, onwards to Rajpur and Landour, divides the valley into the two sub-water sheds, one draining eastward into the Ganga and the other westward into the Yamuna (Fig.1 Page 6). Except for a small portion at the north-eastern extremity of the Doon Valley the whole area forms one administrative unit, the Dehradun *tehsil*. Accordingly, for all practical purposes, in this study, as well as for reasons of convenience in comparison, the ecological limits of the Doon Valley will be equated with the administrative boundary of Dehradun *tehsil*.

In terms of its economic importance, the Dehradun *tehsil* is the foremost area in the whole of Garhwal division. This is because cities and settlements such as Dehradun, Mussoorie, Vikasnagar, and Rishikesh are situated there. Dehradun is the largest urban area in the Himalayan foothills of India and has emerged as a major centre for trade and, of late, also for industry. Mussoorie is the largest hill station in the State of Uttar Pradesh and it attracts about a million tourists a year. Rishikesh, on the river Ganga, is an ancient centre of religious and philosophical learning. It is also the main entry point by road to the whole of the Garhwal division. Large numbers of pilgrims, from all over the world, use Rishikesh as the starting point for visiting the famous temples of Yamunotri, Gangotri, Kedarnath, and Badrinath.

The most important physiographical feature of the Doon Valley is the sharp rise in the Himalayan range, locally known as Mussoorie hill, which commences from about 1000m. at Rajpur and reaches about 2400m. at Landour (Fig 2 Page 8). This results in a significant hindrance to the movement of the monsoon wind resulting in heavy rainfall in the valley. About 85 percent of the total rainfall comes from the summer monsoon. The average annual rainfall in Dehradun is about 2200 mm and in Rajpur and Mussoorie it is even higher. The heavy rainfall is drained eastwards by the Song-Suswa river system and westwards by the Tons-Asan river system. The Song-Suswa is joined by large Himalayan streams such as Bindal, Rispana, Jakhan etc., and the Asan by the Tons, Suarna, Sitala etc. (Fig.1 Page 6). Small seasonal streams from the Shivaliks, which meet the two main drainage channels, are dry during most of the year.

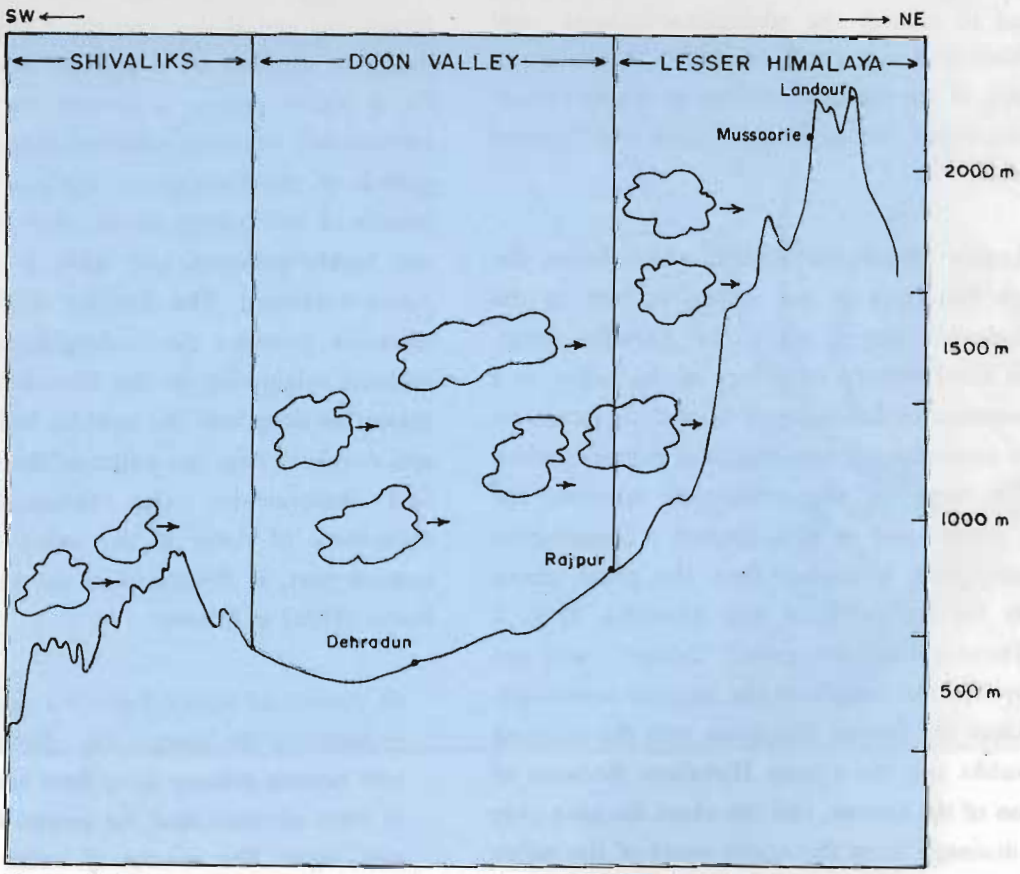


Fig. 2. Schematic Cross-section at right angles to the Doon Valley and the movement of monsoon clouds (based on Munn et al. 1986)

The absence of water on the surface is characteristic of most rivers in the Doon. This is because the water conveniently sinks into the depths of loose boulders and shingle, and then reappears at the bottom of the valley where an impermeable band of clay comes up near the surface. The abundant rainfall and the existence of numerous springs and streams provide the basis for rich biomass productivity as well as a foundation for the valley's scenic beauty. The rich vegetation cover, moreover, contributes to the effective management of the heavy rainfall and the enhancement of groundwater recharge. The quick variation in height (and hence climate) and the abundant rainfall in the northern part of the Doon Valley has created suitable conditions for a great genetic diversity in its flora.

The abundance of water and the rich vegetative cover have induced many visitors to praise the beauty of the valley. Commenting on it Baker (1886) wrote:

The praise indeed is well merited, but its liberal bestowal, to some extent, is perhaps due to the many splendid views which every visitor sees on his way from the vantage points afforded by the hills and mountains by which it is enclosed.... At almost every turn and winding of the steep hill-road leading from Rajpur to Mussoorie fresh beauties of scenery disclose themselves, as a wider and wider view of the valley is gradually obtained. When the summit is reached, many of the houses in Mussoorie and Landour, as well as some of the principal roads, including the Mall, command views of the Dun which can hardly be surpassed in any country of the world.

The rich vegetation cover is predominant in the foothills and the Shivalik hills. Parts of the southern slope of the Mussoorie hill are also covered with rich forests. The frequent changes, within small spatial limits, in the hydrogeological and meteorological conditions of the valley, have provided conditions for the growth of various types of forest cover such as:

- North Indian tropical moist deciduous,
- Tropical freshwater swamps,
- North Indian tropical dry deciduous,
- Sub-tropical pine forests,
- Himalayan moist temperate forests.

The lowest slopes of the Shivaliks, where there is a large proportion of clay and better drainage, provide the best soil for the growth of sal trees (*Shorea robusta*), the predominant forest species in the area. Sal and its associates, forming the northern tropical moist and dry deciduous communities, occur throughout the Shivaliks across large tracts of the valley and also along the lower foothills of the Himalayas. The main species is sal, with associates such as Bakli (*Anogeissus latifolia*), Sain (*Terminalia tomentosa*), Haldu(*Adina grandis*), Behera (*Terminalia belerica*), Jhingan (*Lannea coromodelica*), Kharpat (*Garuga pinnata*), Dhauri (*Lagerstromia parviflora*), Padal (*Stereospermum suveolens*), Safed siris (*Albizia procera*), Tun (*Cedreale Toona*), etc. The underwood is light, often absent. It consists of Rohini (*Mallotus philippinensis*), Amaltas (*Cassia Fistula*), Sandan (*Ougeinia dalbergioides*), Pipal (*Ficus religiosa*), Chamaror (*Ehretia laevis*), Aonla (*Emblica officinalis*), Kachnar (*Bauhinia variagata*), etc. The undergrowth consists of Karaunda (*Carisee opacca*), Gandhela (*Murraya Koenigii*), Bindu (*Colebrookia oppositifolia*), and the grasses consist of Gorla (*Chrysoogeon talvus*), Kumeria (*Heteropogeon contortus*), Baib (*Eulaliopsis binata*), etc.

The soil and climate of the Himalayan belt support subtropical and moist temperate forests of Chir pine (*Pinus roxburghii*), Burans (*Rhododendron arboreum*), Oak (*Quercus incana*), Kilmore (*Berberis spp*), Dhaula (*Woodfordia fruiticosa*), Hinselu (*Rubus ellipticus*) etc. The low lying and marshy areas support forests of Cane (*Calamum tenusis*), Gular (*Ficus glomerata*) Gutel (*Trewi anudiflora*), Tun (*Cedrela toona*), Kala Tendu (*Dyospyros pregrina*), etc. (Fernandez, 1887, Bhola, 1923, Champion, 1932, Sen, 1940, Kubernath, 1958, Mishra, 1968, Singh, 1980).

The valley, thus, has a great potential for forests, particularly in the lower parts. One can clearly visualise Doon Valley as it must have been in the past, covered by dense forests interspersed with swampy grasslands, a situation that must have prevailed several centuries ago. The transformation of the Doon Valley from sparsely populated dense forests and flowing streams to its current state, characterised by a resident population of about 600,000, fast expanding urban-industrial areas and quick disappearance of water, needs a detailed step by step historical description of the growth of human economic

activities in the valley and resultant interventions in its rich natural resource base. Current problems of natural resource management are often ecologically rooted in resource management practices in the distant past. For a complete perspective on the current problems, it is necessary to understand the evolution of both formal and informal management trends for natural resources in the past. In the following section an attempt will be made to present a short temporal account of the growth of human economic activities. It will then be related to the current issues for environmental management against the background of the dynamic socioeconomic changes in the valley, particularly over the last century, which constituted a period of appreciable human economic activities.

Economic History

Early records of human economic activities in the valley are scanty. The famous Chinese scholar-traveller, Hwen Thsang, visited areas near the Doon Valley during 635 A.D. but there is no mention of the valley in his writings. This would indicate that there were few human economic activities in this area at that time. The township of Rishikesh, at the Eastern extremity of the valley, was the gateway to the pilgrim centres in the interior of Garhwal for people coming from the great plains of the south. The famous stone at Kalsi, a town on the bank of the Yamuna at the western extremity of the valley, is inscribed with an edict of Emperor Ashoka indicating important human movement along the Yamuna. Doon Valley proper, in between these two important rivers, was relatively less known or frequented. Generally, the valley was not inhabited to any considerable extent. The earliest settlements were on the southern slopes of the Mussoorie hill. The area was governed by the king of Garhwal but, due to its distance from the capital of the kingdom, it probably didn't get much attention. It is mentioned that among the earliest settlers in the lower parts of the valley were a group of Banjara tribes, people who came from the drier west in the eleventh century and, struck by the lush green forests of the valley, settled on the spot.

The present name of the township of Dehradun owes its origin to the Sikh Guru, Ram Rae, a lineal descendant of Guru Nanak. In his younger days he was taken hostage to the Delhi court of the Mughal Emperor, Aurangazeb, where he became a favorite of the Emperor. In 1699, on being recommended by the Emporer to Fateh Sah, the King of Garhwal, he finally decided to settle in the tranquil Doon Valley. The king, in turn, gifted three villages to the saint who established a "dehra" or small religious settlement. The saint soon attracted a number of devotees who started settling around the "dehra" and the village sprang up. The rich natural resource endowment led to the flourishing of agriculture in the valley. Soon after the arrival of Guru Ram Rae, Fateh Sah expired and was succeeded by his infant grandson, Pratap Sah. After about 5 decades of continued prosperity under Pratap Sah, the valley attracted the attention of Najib-ud-doulah, the Governor of neighboring Saharanpur, who, encountering little resistance, occupied the valley in 1757 with the help of a Rohilla army. Under the enlightened and benevolent rule of Najib, the valley further attained an unexampled degree of wealth and prosperity, especially with the introduction of an irrigation system by the use of small canals. Mango gardens were established and large scale horticultural production introduced. The mango trees still stand today amid apparently primaeval forest. The death of Najib in 1770 put a sudden stop to this growth of a prosperous agricultural economy in the Doon Valley.

Thenceforth, the people of the Doon Valley faced continuous invasions from the Rajputs, Gujars, Sikhs, and Gorkhas that soon turned the fertile land into an almost depopulated barren waste. The area was ceded to the Marahattas in 1780 and passed from hand to hand until it was recovered by the Garhwal King in 1788. In February, 1803, Umr Singh Thapa and Hustee Dhul Chautra of Nepal attacked Srinagar, the capital of Garhwal, and in October 1803 the Doon Valley also was occupied by the Gorkhas.

Under the rule of the Gorkhas the Doon almost became a desert, because most of the inhabitants migrated out and this led to depopulation. Under the strict fiscal arrangement of the Gorkha rulers, slavery increased in this once prosperous valley, because every defaulter was condemned to lifelong bondage. Soon the Gorkha rulers occupied more territory further westwards and, crossing the Yamuna, their invasion continued up to the Sutlej. This expansion drew the serious attention of the other military power, the British, who occupied bordering Saharanpur about the same time. Constant Gorkha aggression against the British occupied areas led

to the war of 1814 in which the Gorkhas were defeated. With the defeat and retreat of the Gorkhas, Dehradun was annexed to the district of Saharanpur in British India and a completely new phase started in the history of the Doon Valley. Consequently the nature of human settlement and management of natural resources in the valley underwent rapid changes of unprecedented magnitude and significance.

Impact of the British Annexation

The annexation of the Doon Valley by the British changed the socioeconomic dynamics of the valley in many fundamental ways. Immediately after the British victory in the Gorkha war, a Government resolution of November 17, 1815, ordered the annexation of the newly occupied area of the Doon Valley to the district of Saharanpur, and the Gorkhas formally ceded the area by a treaty signed a few months later. In 1825 the area was transferred to the jurisdiction of the Commissioner of Kumaon. This, however, was a temporary arrangement and in 1829 it was placed under the Commissioner of the Meerut Division. In 1871, after a series of administrative changes, the Doon was given district status. Almost a century later the district of Dehradun was brought back full circle to the Garhwal Division. An important element of the British administration in the Doon Valley was marked by the painstaking documentation of settlement and assessment reports, the production of maps, and quantified planning for natural resource management. Baker (1886) gives an account of this socioeconomic change introduced by the British in the following words:

> *Under the energy and perseverance of its first English officials the Dun rapidly recovered its prosperity. Roads and canals were constructed, cultivation spread over the waste lands, and the people themselves, awaking from their previous apathy, began to acquire habits of industry and self-reliance.*

In 1816, almost within a year of gaining control, an assessment was undertaken, and this was followed by the settlements of 1820 and 1825, on the lines of *zamindari* (landlords') arrangements. The arrangement was changed to a *ryotwari* (cultivating proprietors) system in the settlements, of 1830 and 1840. There was a great deal of difficulty in following the new *ryotwari* system. Consequently, in the revised settlement of 1845, much of the *zamindari* system was reintroduced. A 20 year settlement was undertaken by Daniell in 1867, with the help of better maps drawn by the survey department.

The British administration improved and systematized the internal management process of the valley. More important, they established transportation links connecting the valley with the larger economy of the plains south of the Shivaliks.

Following the end of fighting and anarchy, the population of the valley showed a remarkable increase. This was because of older residents deciding to return to the valley and new people wanting to move in. This re-established the activity and prosperity that had existed in the first half of the 18th century. A rough census taken immediately after the British victory put the population of the valley at 17,000. In 1823 it rose to 20,179, in 1847 to 32,083, and in 1865 to 66,299 (excluding Mussoorie). In 1881 the population stood at 98,953, in 1891 it rose to 1,17,438, and in 1901 it was recorded at 1,27,094, an increase of about 650 p.c. in just 75 years.

This increase in population was the result of a sudden spurt in the valley's economic activities. The most important socioeconomic effects of the British entry were the establishment of road and railway connections with the plains, reservation of forests for management, quick changes in land use, improved water distribution by the canals, beginning of a tourist economy in Mussoorie and, at later stages, establishment of important offices, institutions, and schools in Mussoorie and Dehradun. All these set the trend for urbanisation and environmental changes of great importance. Accounts of these provide useful historical perspectives within which to examine the current environmental problems of the valley. These problems will be analysed in detail in the remainder of this case study.

Immediately following the British annexation, Mussoorie became an attractive spot as a sanatorium, and the calm of Dehradun attracted pensioners, mainly of European origin. The first house belonging to non-locals in Mussoorie is said to have been a hunting lodge built in 1823 by two English officers. Within no time Mussoorie became popular with the people in the plains, especially after the rail and road connections to the valley were

established in 1900. Table 1 presents the nature of growth in the two urban centres in the Doon Valley during 1885-1905; the period during which the railway was opened.

The British introduced other fundamental changes such as the draining of swamps and clearing of forest cover for settlements. These were mainly handed over to Europeans as land grants for farming. The first grants were made in 1838 when about 48,000 acres of land were given away. The quick opening up of agricultural land was supported by the expansion of the canals under the Irrigation Department. Referring to the benefits of the Doon canals, Baker (1886) was absolutely correct in saying that "the canals are, without doubt, the making of the Doon". His profound statement is still valid after more than a century. The canals not only increased revenue but encouraged the introduction of high value crops such as Basmati rice, sugarcane, and tea.

An important element of natural resource management techniques, introduced by the British, is the level of quantification in almost all spheres. Considering the inaccessibility of the main parts of the valley, the prevalence of forests with rich populations of wildlife, and the language barrier, the British officers left their juniors with a remarkably rich information base that was very useful for new officers. The summary account of irrigated agriculture in the Doon Valley during 1865-75 is presented in Table 2 as an example of this level of organisation and systematisation achieved by the British more than 125 years ago.

Table 1: Population and Municipal Income at Dehradun and Mussoorie (1885-1905)

Year	Dehradun		Mussoorie	
	Population	M. Income (Rs)	Population	M. Income (Rs)
1885	18,959	15,173	7,662	32,020
1905	34,039	64,447	14,689	126,207
Growth Rate% (20 yrs)	79.5	324.8	91.7	294.2

Source: Dampier (1907):

Table 2: Area Irrigated By Classes and Revenue Income From The Canals (1865-72)

Year	Irrigated Area by Class of Land (Acres)				Revenue
	1st	2nd	3rd	Total	Income (Rs)
1865-66	896	3,467	2,626	6,989	28,995
1866-67	1,815	1,862	5,175	8,852	34,818
1867-68	1,105	2,922	6,667	10,694	38,737
1868-69	677	2,832	10,508	14,017	38,281
1869-70	723	3,130	6,448	10,301	43,112
1871-72	856	3,814	7,522	12,192	43,854

This choice of agricultural expansion as the main thrust for economic growth during British rule is best articulated in a statement by Ross (1848) who wrote that:

nearly 20,000 ha of land, charmingly suited **[for]** *and all capable of yielding a good return, were lying waste for want of labour, capital and enterprise.*

Undoubtedly, the early British officers precipitated deforestation through their commitment to agricultural expansion. The resultant environmental loss, that was invisible to the early decision makers, soon became evident. In the 1880s British administrators started questioning the wisdom of agricultural expansion policies. Baker (1886) argued:

Perhaps no mistake was more common in the early days of British rule than to suppose that the extension of cultivation wherever culturable land could be found, and the clearing of forest and jungle to extend cultivation, must necessarily benefit the country and Government, and should be encouraged and 'pushed on as much as possible. It is now fully recognised that every country requires to have a certain proportion of its area under forests, and that in a tropical country like India, where the heat is so intense and the very existence and well-being of the people depend on a regular and sufficient rainfall, this proportion should be even larger than in European countries... The mere extension of cultivation in itself, at the expense of clearing away forest, is a source of weakness rather than gain to the State in a country where the forest area is admittedly too small already. Forests form a great reserve for the people and cattle to fall back on in years of drought. When they are cleared away, not only are the rainfall and the water-supply of the country prejudicially affected, and the chances of drought increased, but the resources of the country are diminished-evils which a few thousand acres more or less of cultivation poorly compensate for.

This statement is one of the first clear articulations of the need for environmental considerations in the management of natural resources in the Doon. Forest felling for the expansion of agriculture came to a halt with the reservation of forests and the nature of environmental changes in the valley took a new turn. Economic activity ceased to be dominated by the timber trade. Slowly the Valley started growing as an urban area of touristic importance and new institutions and schools flourished. In spite of this growth, the valley did not face any serious environmental problems until the final days of British rule and it maintained its reputation as a quiet area with a salubrious climate and fresh air.

Changes in the Post-colonial Period

The long history of the transformation of the Doon Valley during British rule left an institutional framework for natural resource management in the post-colonial period. Departments such as Forests, Irrigation, Revenue, Public Works, and local administrative units such as the various city boards remained almost unchanged. The economic aspirations of the people of a newly independent country merely enhanced the activities quantitatively. In the case of the Doon Valley, a sudden increase in both population and economic activities came during 1947 when a large number of people migrated into the valley from the newly formed Pakistan. Later, there was an influx of refugees from Tibet who came and settled in the valley in the early 1960s.

In tune with the inexorable logic of urbanisation, a prominent demographic pattern in independent India, Dehradun quickly grew into a densely populated city (Fig.3). This growth took place mainly around institutions and tourism. At a later stage, approximately from 1960 onwards, quarrying of limestone on the northern periphery of the valley, from Mussoorie to Sahasradhara, became important. The urbanisation trend was further encouraged by financial and institutional incentives that were given to new industrial units when the Garhwal area was given an "industrially backward" identity. Industrial growth, thus encouraged during the 1970s, affected the urban environment considerably through pollution, congestion, and the formation of slums. On the other hand, over the years, limestone quarrying resulted in serious environmental degradation. Increasing demands for fresh water from the domestic, industrial, and agricultural sectors conflicted with reduced sustainable water supplies in lean periods. The growth of urban settlements led to increased pressure on the forests for timber and firewood, while the rich wildlife was exposed to added threats from poachers because of easy access into and from the core areas of the sanctuaries and reserved

forests. Today, the problems of natural resource management in the Doon Valley have all the dimensions of the challenges both of a rural mountain area and of the quick and unplanned growth of an urban-industrial complex. This has transformed the one time tranquil pensioners' paradise into a busy and polluted urban centre and strained the natural resource base to its limit.

The total reporting area of the valley is 2130 Km2 and of this the urban area covers 156.5 Km2. There are one city, two sub-regional towns, 13 market villages, 38 central villages, and 337 basic villages in the valley (Fig. 4). The forest area managed by the forest department is as high as 68 percent and the net sown area is about 19 percent. Recently plans have been made for the conversion of 644 hectares of land into industrial zones. These are to be located in five areas that are a reasonable distance away from the city of Dehradun.

The environmental impacts of the rapid growth of quarrying and urbanisation resulted in public protests and interventions in several important areas of natural resource management. The Doon Valley can be credited with generating a high degree of dynamism in administrative, legal, and research processes. It is within the framework of this dynamic expression of public concern and judicial-administrative interventions that the review and analysis of natural resource management in the Doon Valley will be undertaken. It will be made against the background of the existing disciplinary perspective and then against a foreground of a prospective interdisciplinary one. Initially, attention will be focussed on the historical evolution of environmental problems, both those generated over a long period of time, such as deforestation, and those that occurred more rapidly such as industrial pollution. Based on disciplinary reviews and a review of institutional responses to the problems, an attempt will be made to outline a viable plan for integrated ecosystems management.

Fig. 3 : Population of Dehradun Municipality Tehsil and District in the Current Century

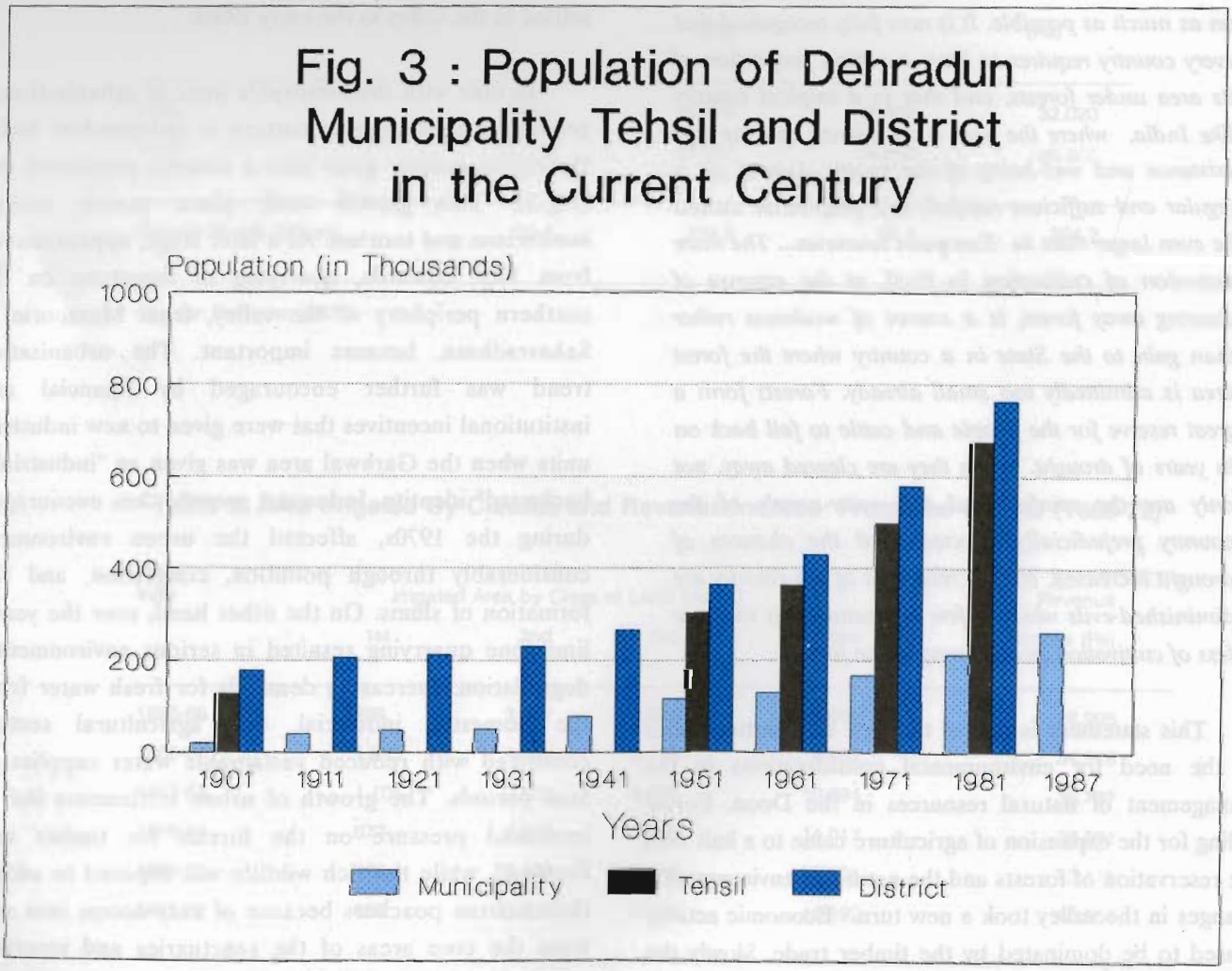


FIG. 4

CASE STUDY – DOON VALLEY

EXISTING HIERARCHY OF SETTLEMENTS

(based on Anon, 1988b)

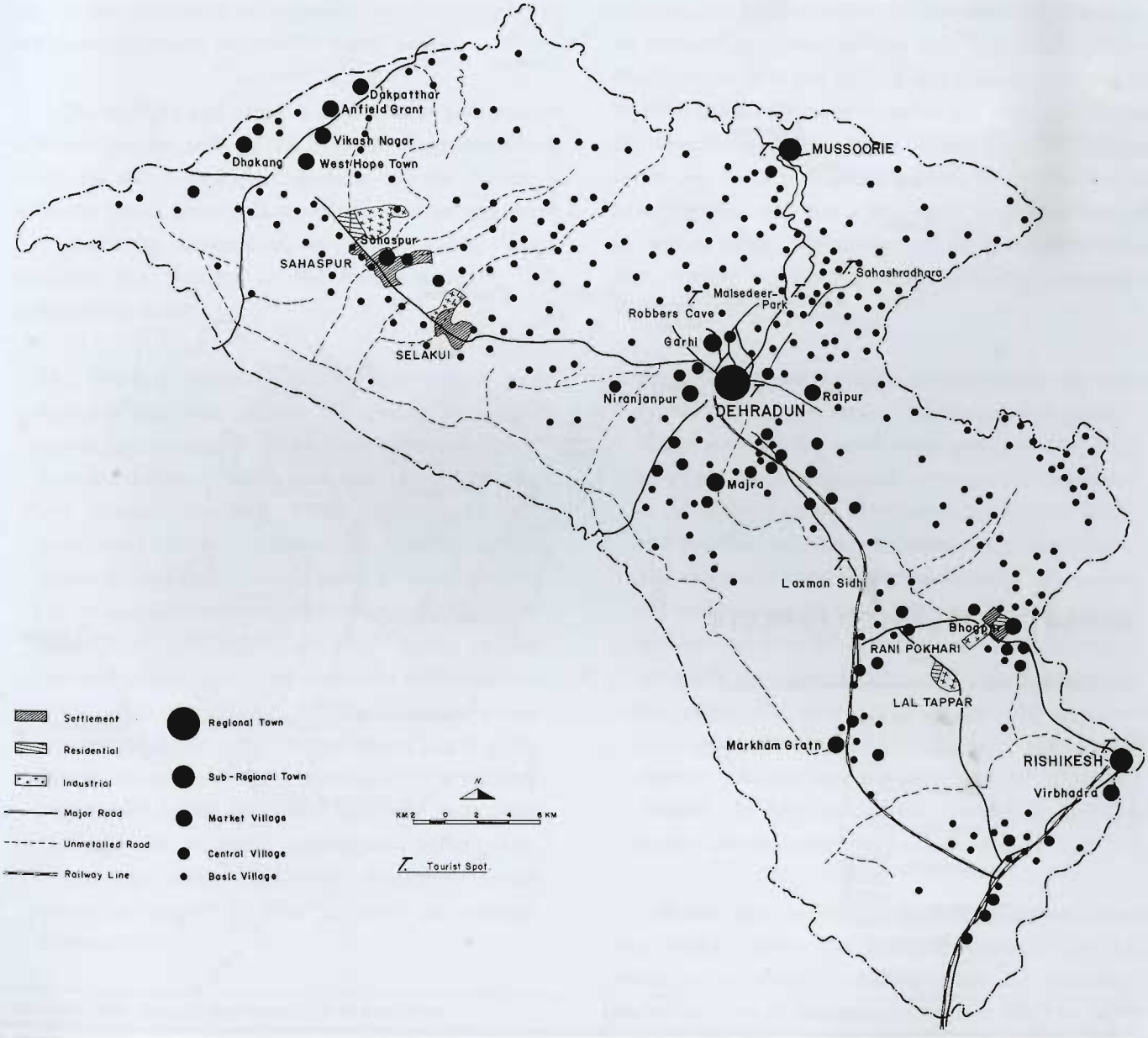
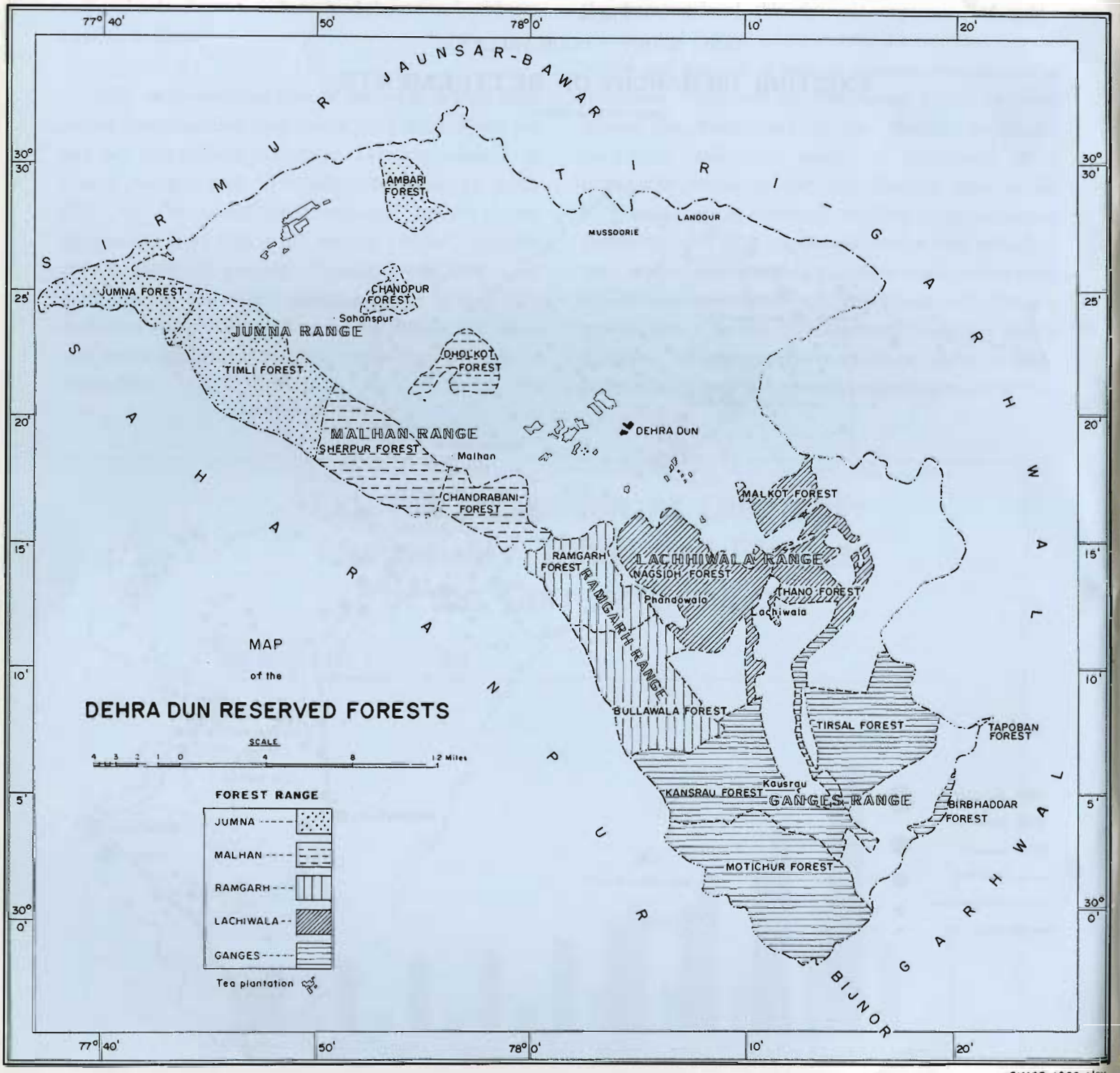


FIG. 5: FOREST MAP OF DEHRADUN AS DRAWN IN 1887



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Besed on Map Drawn by Munshi Tulsi Ram in the Office of Superintendent Forest Surveys, Oct. 1887.