NATURAL HISTORY AND ECONOMIC BOTANY OF NEPAL

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Preface to the Second Edition

The author is naturally happy to put the second edition of the book, *Natural History and Economic Botany of Nepal*, into the hands of the readers. This edition incorporates some of the latest information on wildlife, plant distribution, agriculture and economic botany of Nepal, and as such, it would be of greater use for the students of biology, forestry, agriculture and economics. At the same time, the author hopes that the book in its revised form would continue to be patronized by the laymen also.

The impetus to revise this book came not only because of its inclusion as a text for the Certificate Level biology students of the Tribhuvan University, but also due to the generous response from the general public. The author is indeed grateful to all those who encouraged him to undertake the revision of the book and particularly to Orient Longman for constantly helping him in the preparation of the manuscript. Thanks are also due to the National Parks and Wildlife Office of His Majesty's Government for making available the reports and photographs.

Finally, it is the earnest hope of the author that in the context of the new and emerging interest in the conservation and rational use of natural resources, this publication will help in the development of a new perspective in the students of the Tribhuvan University on whom so much of the future of the country rests.

July 15, 1977 DIBYA DEO BHATT

Preface to the First Edition

This book is an attempt to present the basic elements of the natural history and economic botany of Nepal. The author has tried to make the book useful to a wide range of readers — agriculturists, biologists, naturalists and the laymen, all may find something of interest in this small publication.

In writing this book the author has drawn information from many sources and it is hoped that this work will stimulate others to undertake more deeper studies on various aspects of the natural resources of this country. It is also hoped that this will generate a feeling of awareness on the part of our countrymen to conserve and make rational use of these resources.

The author would like to express grateful thanks to Dr. Richard Schultes, Director, Arnold Arboretum, and Editor of the *Economic Botany*, Harvard University for going through the manuscript and speaking kindly about the book. Thanks are also due to Dr. M. L. Bristol, Assistant Professor, Department of Botany, University of Hawaii for making helpful suggestions and giving encouragement in writing this book.

Finally, thanks are also due to Mr. S. R. Basnet, Lecturer, Patan College for making some of the line drawings and the Department of Information of H. M. Govt. of Nepal for undertaking publication of this book.

1970 AUTHOR

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Chapter I

The Land

Location

Nepal lies between the latitudes 26° 20′ N and 30° 10′ N and the longitudes 80° 15′ and 88° 10′ E — a roughly rectangular piece of land in the middle Himalayas. It covers an area of 141,577 sq. km. From east to west, at its maximum point, the country is 830 km long ; from north to south, its breadth varies between 145 km and 242 km, yielding a mean width of 200 km.

Nepal is a land-locked country, lying in between the two giants of Asia — India towards the south, east and west, and China towards the north. In the east the Singalila range, which is dominated by the Kangchanjunga, demarcates the boundary of Sikkim and Nepal.

The Himalayas form the northern boundary between Nepal and Tibet only in certain parts. In western Nepal, 'the relief is less rugged than those found on the main Himalayas', and the Tibetan marginal ranges, with an average altitude of 6,096 m, form the 'main watershed between the Rivers Ganges and Tsang-po'.

The Himalayan ranges which run all along the northern frontier of Nepal 'are arranged like narrow strips predominantly longitudinally and the highest Himalayan chains are not massive elevations but narrow ridges. The Himalayas pass into the highly elevated Tibetan plateau...the Tibetan plateau desert often called "The Roof of the World" which has an average elevation of 15,000 ft (4,572 m)'.[1]

1. Good, Ronald. 1953. *The Geography of Flowering Plants.* Longman Green. p. 35.

Physiography

Nepal can be conveniently divided into seven natural zones[1] which occur in the following order from south to north : 1. The Terai ; 2. the *Siwalik* hills ; 3. the Mahabharat *Lekh* (*Lekh*-mountain) ; 4. the Midlands ; 5. The Himalayas ; 6. the Inner Himalayas ; 7. the Tibetan marginal mountains.

It is significant that 'more than a quarter of the country's land surface exceeds 10,000 ft (3,048 m) in altitude, including a thousand square miles under the realm of snow and ice (2,590 sqm.)'.[2]

Of the total land surface, nearly half lies below 1,524 m and 20 per cent has an elevation of less than 305 m above sea-level. As one flies from south to north, the 'succession of the ranges arranged *en echelon*'[3] becomes at once manifest.

Terai

The Terai is part of the alluvial *cis*-gangetic plain of northern India. It covers an area of 20,720 sq. km with an average width of 32 km. It contains more than 70 per cent of the cultivated land and narrows from east to west.

Bhabar

This is a narrow strip of land between the Siwalik (Churiya) and the Terai, extending over 9,065 sq. km. Locally, it is called '*Char Kose Jhadi*' because of its average width of 13 km which was entirely under forest in the past. The soil contains mainly gravel, boulders, and sand brought down by the streams from the Siwalik hills and Mahabharat ranges. This tract of land is characterized by a humid tropical climate and is noteworthy for possessing such valuable timber trees as *Sal* (*Shorea robusta*), *Semal* (*Salmalia malabarica*), *Khair* (*Acacia catechu*), *Sisso* (*Dalbergia sisso*), etc. Here one finds a rich wild life including tiger, elephant, bear, deer, rhino, antelope, etc.

Churiya

The Churiya range is made up mainly of gravel, pebbles and a conglomerate of sand and limestone deposited by the south flowing rivers during the pliocene times. The soil contains little or

1. Hagen, Toni. 1960. *Nepal. The Himalayan Kingdom.* p. 36.
2. Gurung, Harka. The land. *Nepal in Perspective.* Ed. P. S. Rana and K. P. Malla. CEDA 1973.
3. *Ibid.* p. 25.

no humus and is porous. Geologically, the *Churiya* hills consist of 'a great thickness of detrital rocks, such as coarsely bedded sandstones, clays, conglomerates, and sandy limestones and are known to be derived from the weathering of the granite core of the Central Himalayas'. The depositions of the Siwalik were, at a later date, raised up due to tectonic movements. Ravines, steep hillocks and pillar-like mounds are the most characteristic features of this region, whose altitudes vary from 150 m to 1,368 m. A number of *duns* (valleys), viz. Rapti, Nawal Parasi and Dang-Deokhuri lie between the Siwalik and the Mahabharat ranges.

Mahabharat Lekh

This is the central region of the country, which comprises the high lying valleys and central range of mountains with elevations between 1,524 m and 2,743 m. The climate of this region is cool and humid. The Mahabharat is a fold mountain and is made up of 'little differentiated, metamorphosed, sedimentary and igneous rocks of various ages'.[1] The spurs of the Mahabharat are a conspicuous feature of the topography of this region. The 'heart of the country' as Toni Hagen calls the Nepal midlands, lies between the Mahabharat and the high Himalayas. Hagen divides these midlands into nine natural regions each enclosing a wide valley drained by one of the major branches of the great rivers which form the main drainage system of Nepal. The valleys of Kathmandu, Pokhara, Banepa, etc. in the midland are tectonic in origin.

Dun

There are some minor '*dun*' valleys — Jogbura, Surkhet, Narim Kamala, Trijuga, etc. which are formed as a result of formation of longitudinal basins by the east flowing rivers between the *Churiya* and the Mahabharat. A little over 71 per cent of the Nepalese people live in this central hilly region ; it has about 27 per cent of the land under crop and 58 per cent in forest.[2] Through their sheer industry the farmers living in this part of the country have made terraces on the steep hillsides, sometimes rising from the valley floors (altitude *circa* 609 m) to the top of the high mountains

1. Rimal, D. N. 1967. *A Guide to Mineral Resources in Nepal.* Bureau of Mines, Kathmandu.

2. *Forest Statistics* : *Hill Region.* Forest Resources Survey. 1973.

which average around 3,500 m. Due to the removal of the forest cover, however, serious soil erosion problems have arisen in this part.

Himalayas and 'Tibetan Marginal land'

In this region are included the outer, lesser and inner greater Himalayas, as well as the Tibetan marginal land, with altitudinal limits varying between 3,657 m to 8,848 m — Mount Everest, the highest mountain in the world. North of the main Himalayan range is an area of wet alpine (altitude 4,014 m to 4,572 m) and dry alpine zones (altitude 4,739 m upwards).[1] This region is characterized by a series of peaks which are part of the great solid wall of snow and ice, which present towards the north a flat tableland, the Tibetan plateau. Such well-known peaks of the Himalayas as Kangchanjunga (8,732 m), Makalu (8,476 m), Everest (8,848 m), Cho Oyu (8,153 m), Ganesh Himal (7,406 m), Machhapuchhre (7,059 m), Nampa (6,754 m) and Api (7,131 m), are found in this region.

The country lying beyond the inner Himalayas and described as the 'Tibetan marginal land' varies in altitude between 3,657 m to 4,572 m. It is an arid zone, as it lies in the rain shadow of the high mountain ranges. The country is windswept and presents a bleak appearance.

The districts of Manag, Mustang, Dolpo, Humla, Tibrikot are part of this distinct geographical unit. It has a vegetation similar to that of Tibet, the landscape is one of 'rolling hills, often smooth and round in outline but sometimes crowned with masses of red and yellow rock which resembles the castle-like peaks of the dolomites'.[2] The peaks, which arise from comparatively flat land, are formed of sandy shales of sedimentary origin but the rocky dolomite peaks are made of limestone.

Land Use

Topographically, the country is principally mountainous. Only 20 per cent of the land lies below 3,048 m.

Nearly a third of the land (32 per cent) is under forest,[3]

1. Swan, Lawrence. 1963. The Ecology of the Heights. *Natural History*.

2. Stainton, J. D. A. 1963. Notes on Journey in West Nepal. p. 2. (Mimeo.).

3. Area under forest has further decreased, according to recent studies.

and 14.9 per cent under permanent snow, as shown in the following Table.

TABLE 1

LAND USE TYPE (1970/71)

Land Use Type	*Area*	*Sq. km.*	*Per cent*	*of Total*
I. Agricultural		19,800		13.98
Hilly Region	5,795		4.9	
Terai Region	14,005		9.89	
II. Forest Land		44,750		31.61
Hilly Region	28,750		20.31	
Terai Region	16,000		11.30	
III. Other Land		77,027		54.41
Land Reclaimable	18,600		13.14	
Land Un-reclaimable	26,441		18.68	
Land Under Perpetual Snow	21,121		14.92	
Land Under Riverbeds, Canals and others	10,865		7.67	

Source : Ministry of Food and Agriculture, Economic Analysis and Planning Division, HMG/Nepal.

The difference in altitude combined with an increasing rainfall from west to east has resulted in difference in climate and vegetation — both vertically and horizontally. One should look at the diversity in agriculture, economy and cultures of Nepal against the topographical complexities.

Regional Variations

There are wide differences in land area — cultivated land and population density in the hills and the Terai, as the following table shows :

TABLE 2

REGIONAL VARIATION

Criteria	*Mountains and hills*	*Terai & Inner Terai*	*Kathmandu Valley*	*Nepal*
1. Land area (%)	72.9	26.7	0.5	100
2. Cultivated land 1970/71 (%)	26.9	70.7	2.4	100
3. Population density 1971 (sq. km)	58.0	128	1,039	80

Source : Ministry of Food and Agriculture, Central Bureau of Statistics.

The geographical distribution of the population is as follows :

Hills	66,81,287
Terai	39,94,502
Inner Terai	8,80,194

The country has a population of 11.5 million people, with an average density of 213 per sq. mile[1] (80/sq. km). By 1980, the population of Nepal will exceed 13 million. Of the country's total population, 94.4 per cent is engaged in agriculture ; it provides bulk of the GDP — Rs. 6539 000,000 in 1969-70 (at 1964/65 constant prices). Only a small section of the people is engaged in manufacturing (2.47 per cent) and service (2.74 per cent). Agriculture contributed 68.75 per cent of the total GDP at current market prices (1968/69).

According to the latest census, the percentage of rural and urban population is 96.16 and 3.84 respectively.

Nearly two million people fall within the age group of 15-24, of which nearly a third are economically inactive. The majority of the people are Hindus (89 per cent), followed by those who follow Buddhism. There are many ethnic groups : Gurungs, Magars, Rais, Limbus, Tharus, Sunwars, Rajbhanshis, Satars, Danuwars, etc.

From the linguistic standpoint, for more than 6 million people Nepali is the mother tongue; the rest speak Maithili (1.32 million), Bhojpuri (8,64,800), Tamang (5,55,560), Tharu (4,95,881), Newari (4,54,979), Awadhi (3,16,950).

Demographic Trends

The disparity between the Terai and the hills is also seen in the density of population. To cite an example: Siraha (Terai) has 265 people/sq. km and Terathum 145/sq. km. While the rate of population increase in the hills is 56 per cent, in the Terai it is 129 per cent. Besides the Kathmandu Valley, the hills and mountainous regions cover 72.9 per cent of the land area but they support 53.2 per cent of the total population. The Terai and Inner Terai, which have only 26.7 per cent of the land area, support 41 per cent of the population.

1. Nepal : National Report on Human Environment. National Planning Commission, Kathmandu.

Though the national average of density of population is rather low, in terms of arable land per head, in Nepal it is 0.17 ha. as against 0.07 in Japan, 0.33 in India, 1.05 in USSR and 20.5 in Canada.

In Nepal birth rate is 42.87 per 1,000 which is much higher thar that prevalent in the developed countries. A number of factors have contributed to this: early marriage, the desire to have more children, both as an insurance for old age and to fulfil the need for extra hands to work on the farm and manage the family, the uncertainty about survival of new-born children and lack of information on birth control. The 'crude' mortality rate, as estimated by the Bureau of Statistics, is 22.87 per 1,000 which is higher than that in other Asian countries. Infant mortality in Nepal is around 145 per 1,000 newborn babies and life expectancy about 43. According to the demographers, 'a gain of 6 months of life expectancy is expected to be realized every year'.[1] This is attributable to the greater medical facilities in the rural and urban areas. Population problems in Nepal are real because of limited amount of cultivable land in the country, a fall in foodgrain production (2.4 per cent) in the hills and a marginal increase of 1.3 per cent in the Terai. In fact, experts[2] have predicted that at the end of the Fifth Plan period (1980-81), 'there would be a gap in the demand and supply of paddy to the order of 240 thousand tonnes'. In the coming decade, i.e. 1980-90, 'the situation with respect to the gap between demand and supply for "total foodgrains", would, however, be most distressing. By 1985-86, under all situations, the country will have a deficit ranging from 103.04 thousand tonnes under best conditions to about 804.57 thousand tonnes under worst conditions'.

While the need for bringing about an increase in agricultural production cannot be overemphasized, a diversification in the pattern of cereal consumption would reduce too much dependency on rice, millet, wheat and barley. The *per capita* consumption of foodgrains in 1969-70 was: paddy 192.13 kg, maize 72.62 kg, millet 9.21 kg, wheat 19.43 kg (total 293.39 kg). Though there is still a more or less heavy consumption of paddy and maize, an

1. Manandhar, T. B. 1974. *The Growth and Distribution of Population in Nepal.* Bull. Nepal National Commission for Unesco 6 (4) : 39-42.

2. Pant, Y. P. and Jain, S. C. 1972. *Long Term Planning for Agriculture.* Vikas. pp. 166-67.

increase in the amount of millet and wheat is seen during 1961-70 period.

The Central Bureau of Statistics had estimated an annual increase of 1.81 per cent in population during the Third Five Year Plan (1965-70) and for the Fourth Plan (1970-75) around 1.95 per cent. The actual increase in the last decade has been 2.07 per cent. The projected rate of increase in the Fifth Plan is 2.24, which would mean a population of 12.59 million in 1976.

TABLE 3

ESTIMATES OF POPULATION PROJECTIONS OF NEPAL OVER THE PERIOD 1971 TO 1991

Year	*Population in Millions*	*Percentage Annual Increment*
1970	11.04	—
1971	11.25	1.81
1976	12.39	1.95
1981	13.78	2.14
1986	15.35	2.28
1991	17.21	2.42

Source : Central Bureau of Statistics.

Population Problems

The developing countries of the world contain two-thirds of the world population with a growth rate of 2.5 per cent. The world is witnessing an unprecedented increase of 70 million per year, and if the present rate continues, by the year 2000 the world population will be nearly 6.5 billion. At the existing rate of growth, India will have a billion people by 1990, Pakistan 250 million, and Indonesia 200 million. U. N. demographers predict a decline in birth rate for the world as a whole — 38 per thousand to 34 per thousand in 1985. This would still be much greater than the world can manage with the limited resources now available. Reduction in population growth rate would be accompanied by an increase in life expectancy in developed countries — from the present 55 years to 59 years by 1985.

In Nepal new patterns in demography are emerging. Some parts of the country, such as the Terai, are growing faster than the hills, a fact which is ascribed to large-scale migration, as Rana and Thapa (1974) point out :

'Population movement in Nepal, however, is not limited to Terai. Nepal has since long been a population exporting country and the past two censuses indicate that this trend is on the increase. Whereas 2.4 per cent of the total population had migrated outside the country in 1952/54, the corresponding figures for 1961 and 1971 were respectively 3.5 and 5.2 per cent.'[1] Another significant fact which has emerged from present studies is that in the last two decades there has been a steady increase in the redistribution of population within the country. While in 1952/54 the total population involved was 0.13 per cent, ten years later (1961 census) it had increased to 1.3 per cent, and by 1971 it had more than doubled, viz. 3.6 per cent. During this period, some areas had increased by as much as 75 per cent, while in the hills the density has remained more or less the same. The populatior in the hill and Terai regions is not increasing at the same rate. In the last decade though the population in the hill and the mountainous regions did not exceed 1.76 per cent, the population in the western Terai doubled during the same period. Furthermore, while the growth rate for the country as a whole was 2 per cent, that of the Terai was 3.4 per cent. Thus the increase in the population in the Terai 'is due to immigrants both from the hills as well as from people born outside the country (98.9 per cent from India)'.[2] The results of the last census also revealed that '9.5 per cent of the total population of the Terai had been born in the hills (including Kathmandu Valley); of the population as a whole, 8 per cent of the total were born in India'.[3] Obviously, one sees a shift in favour of migration of the hill population into the Terai.

The reasons for this shift are not far to be found. Two decades ago, people from the hilly region never ventured to go to the *awl* (malaria) infested inner valleys of Chitwan, Dang-Deokhuri, Udayapur Sinduli, and to parts of the Terai still under heavy forest. The eradication of malaria set in process migration of population on a scale unprecedented in the history of the country. Some people who were habituated to living in the hills at altitudes of 1,524 m to 2,438 m, were also emboldened to move into the

1. Rana, Ratna S. J. B. and Thapa, Yadav S. 1974. 'Population and Development'. T. U. CEDA. Seminar. August 1 and 2, 1974. (Mimeographed, draft paper).

2. *Ibid.* 3. *Ibid.*

Terai. The migration rate is highest in western Nepal, 'where as many as 86 persons are absent for six months or more for every 1,000 people, which is more than double the national rate, and almost eight times higher than the average for the Terai'. It seems that both the eastern Terai and western Terai have received the bulk of people from outside-hills as well as across the border : 'The Eastern Terai had absorbed 175,532 persons compared to 68,182 persons in 1961.' The 'net positive migration' of 235 per cent in 1971 over the previous census in the far western Terai is indicative of the extremely poor economic conditions which are prevalent there. A poor terrain, loss in productivity, deficit in foodgrains and drought have all contributed towards making the people of this part the poorest in the country.

Urbanization

The process of urbanization is taking place slowly but imperceptibly. This has been most manifest in the bordering towns where economic activities have been intensified in the past decade. According to the United Nations definition, 'urban' areas are those localities which have a population of more than 20,000 inhabitants. In Nepal, as a whole, there are only 7 such centres, Kathmandu leading with a population of more than 100,000. In the country as a whole there are 16 Town Panchayats, 12 of which have a population of 10,000 or above. Housing, sanitation, electricity, water supply and sewage system are either lacking or at sub-optimal level. As means of communication improve, the trend towards migration to urban centres is on the increase, bringing fresh problems of employment, education, health, etc. to the fore.

Chapter II

Climate

Meteorological data for Nepal have been compiled in a systematic manner only since the last decade. In the Kathmandu Valley itself, however, the British Embassy and later the Indian Embassy also have kept records of climate. These stretch for a period of well over 40 years. In more recent years, meteorological data of different parts of the country have been collected with a view to assessing the hydro-electric potential of the major rivers of Nepal. The Department of Hydro-Meteorology has a network of weather stations for keeping climatological data — temperature, rainfall and humidity.

In Nepal local climatic differences (micro-climate) are very sharp, which in turn are reflected in the vegetation too. In the river valleys within a vertical drop of almost 914 m, one comes across tropical, sub-tropical and temperate climates and vegetational zones.

Rainfall

West Nepal is drier than East Nepal. Rainfall increases as one proceeds from east to west; the southern slopes of the Mahabharat receive more rain than the Terai; similarly rainfall increases with altitude until a certain height is reached. The moisture-laden south-east monsoon brings rain during the months of June, July, August, and September, while the winter months are comparatively dry. Winter rains are more common in the western hills. It is not unusual to have a rainy spell in late March. Spring rains are accompanied by thunderstorms. These are quite heavy on the south faces of the Mahabharat.

In the inner Himalayas and beyond its main chain are found areas which are completely dry. While the Khumbu glacier gets rainfall of 39 cm, it is 166 cm in the Dudh Kosi river basin. The reason, according to Hagen, is this: 'The Himalayas are a one-sided meteorological unit, and being situated on the margin of a huge land mass, they receive moisture from one side only, namely, from the south. Seasonal rainfall is, therefore, encountered only on their southern flanks.'[1] In the foothills of Everest, Lhotse, Makalu, Cho Oyu and Gyachung Kang, which create a solid wall separating the northern arid Tibetan plateau and the moist south flanks 'the rainfall may be 5080 mm. per year'. Rainfall increases from south to north, from the Terai plains to the foothills and still higher on the southern slopes of the Himalayas. In the eastern Himalayas where the rainfall is high, long glaciers are found.

Stainton says :

'The total annual rainfall in many places in the hills would be higher, but the fact which has most effect on the vegetation is not that the total is higher but that thunderstorms and spring rains spread the rain over a much longer period. It is this which enables a winter crop to be harvested in the hills before the monsoon rains arrive.

'In many of the big river valleys of Nepal a wind blows daily up-stream, clearing away the clouds from the centre of the valley and sharply reducing rainfall there....The gap through which the Kali Gandaki passes between Dhaulagiri and Annapurna provides an extreme example of reduction of rainfall by valley winds. The wind is so strong that in the middle of the day, it is something of an effort to walk against it. Jomsom lies at 2,743 m. and here even during the monsoon the centre of the valley is normally kept free of clouds, though the sides of the valley at the time of the year are usually covered in mist. The up-valley winds greatly reduce the rainfall, but it is further reduced by the rain screen effect, for, by the time one has reached Jomsom one has passed to the northern side of the main ranges where the general rainfall is low. Both factors combine to give Jomsom, the lowest recorded rainfall figures for any station in Nepal.'[2]

1. Hagen, Toni. *Op. cit.* p. 12.
2. Stainton, J. D. A. 1972. *Forests of Nepal.* John Murray.

TABLE 4

RAINFALL AT SELECTED PLACES

Station	*Mean Annual Rainfall (in mm)*
Dhangarhi	1916
Kakarpakha (Baitadi)	1408
Jumla	490
Dailekh	1850
Chisapani	2363
Surkhet	1929
Jomsom	347
Rampur	1952
Hetaunda	2279
Kathmandu	2447
Dhankuta	984
Soktim	2368
Barahchetra	3101
Dharan	3044
Walungchangola	1954

Source : Climatological Records.

In the Nepal Himalayas are found 'deep, extensive, desert-like valley cuttings' and due to high solar radiation 'the surrounding mountains become greatly heated and suck in air. This leads to an extraordinary dry descending wind above the valleys. It is because of this that while the valley floor is dry, the hill sides bear moist temperate forest, the trees of which are covered with mosses and lichens, a distinctive feature of the temperate forests'.[1]

The Kathmandu Valley (altitude *circa* 1,231 m), which is located between latitudes 27.34° N and 27.50° N and longitudes 85.11°E and 85.32° E, gets a mean annual rainfall of 2,447 mm. The highest rainfall 2,012 mm was recorded in 1954 during the nine-month period, May to December. Rainfall in the valley is heaviest in the months of June, July, August and September. The monsoon breaks around the second week of June, and in early July, strikes with full force. Rains persist until the last week of September, with occasional showers occurring as late as October.

In the Kathmandu Valley, the total rainy days vary from year to year; in the seven-year period, from 1955 to 1962, the minimum number of rainy days were 99, while the maximum were 153.

1. Swan, L. *Op. cit.* p. 24.

TABLE 5

TOTAL NUMBER OF RAINY DAYS IN KATHMANDU IN 7-YEAR PERIOD

Year	1955	1956	1957	1958	1959	1960	1961	1962
Rainy days	121	152	99	112	128	112	111	127

Source : Climatological Records 1968.

Temperature

Records for temperature and humidity are now available for many parts of the country. In the Terai winter temperature varies between 25°C (Parwanipur) and 27°C (Napalganj). Summer temperature exceeds 42°C in both places. In the Kathmandu Valley, the average maximum temperature (in 1968) was 23.3°C while the highest temperature was 31.8°C (in 1958). The coldest month is January with average daytime temperature of 11.3°C. The night temperature, however, falls well below freezing point during the months of January and February (—1.5°C and —1.8°C respectively). April, May, June and July are the warmest months in the valley with a temperature range of 21.8°C to 29.9°C, the maximum recorded so far being 31.8°C. Extremes in temperature are lacking in the Kathmandu Valley.

TABLE 6

MAXIMUM AND MINIMUM TEMPERATURE RECORDED IN KATHMANDU[1]

Months	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Max	66	80	80	84	86	90	90	86	87	88	88	82
Min	37	37	44	46	52	60	68	69	70	58	47	41

Altitude and aspect (slope) play equally important roles in determining climate and vegetation. With the increase in altitude there is a loss of intensity of rainfall and it is more in the form of a drizzle. The mist covered *lekhs* are a characteristic feature of the mountain landscape of Nepal. Damp weather with perpetual cloud determines the upper limit of crop cultivation which is normally around 2,438 m, though in very wet areas such as

1. Hydrological Section, Ministry of Irrigation and Power. Figures denote only the maximum and minimum recorded in the year and not average.

Annapurna Himal and the upper Arun, cultivation ceases at around 1,828 m, and in contrast in the Junbesi district, there are fields at up to 3,048 m. In the Jumla and Dolpo districts and in the inner valleys conditions are altogether different and cultivation may continue upto 4,267 m. 'Extremes of temperature are found in the plains and the mountainous parts of the country.'

TABLE 7

MEAN TEMPERATURE IN IMPORTANT PLACES

(in centigrade)

Name of the Place	*1967*		*1968*		*1969*		*1970*	
	Max	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*
Taplejung	20	11	20	11	21	12	N.A.	N.A.
Barahksetra	29	19	29	19	N.A.	N.A.	N.A.	N.A.
Okhaldhunga	21	11	21	12	21	12	21	12
Namche Bazar	11	1	12	1	11	2	N.A.	N.A.
Bhojpur	20	13	20	13	N.A.	N.A.	N.A.	N.A.
Kathmandu	25	11	25	11	26	12	24	11
Gorkha	25	15	25	15	25	15	N.A.	N.A.
Pokhara	26	15	26	16	26	16	25	14
Butwal	31	20	30	20	31	20	29	21
Jomsom	19	6	19	5	19	5	N.A.	N.A.
Sallyan	23	14	23	14	N.A.	N.A.	23	15
Dailekh	N.A.	N.A.	23	14	N.A.	N.A.	N.A.	N.A.

N. A. : Not available.

In Butwal (263 m), which is at the base of foothills, average maximum temperature lies near 30°C (1968), while in Namche Bazar (3,050 m), which is near the Everest, it is 10.5°C. Chainpur (1,329 m) is a typical hilly location in the midlands ; here the maximum and minimum lies between 24°C and 15°C (1968).

In the far western Terai district of Kanchanpur, the average summer temperature goes up to 32.2°C, which is usually accompanied by a blast of hot air or *Loo* ; winter temperature remains between 10°C and 12.8°C.

TABLE 8

STATION: POKHARA (AIRPORT)—YEAR 1968

Month	AIR TEMPERATURE °C		Relative Humidity
	Mean		
	Max	Min	%
Jan.	14.1	9.9	89
Feb.	—	—	—
Mar.	—	—	—
Apr.	—	—	—
May	—	—	—
June	28.3	22.0	82
July	28.6	22.2	85
Aug.	29.3	22.3	87
Sep.	28.5	21.2	82
Oct.	25.1	13.9	75
Nov.	22.9	10.8	78
Dec.	20.7	6.4	80
Year	24.7	16.0	82

Source: Climatological Records. HMG.
— Not recorded.

TABLE 9

STATION: JIRI—YEAR 1968

Month	AIR TEMPERATURE °C		Relative Humidity
	Max	Min	%
Jan.	12.8	0.1	82
Feb.	15.5	0.1	76
Mar.	19.1	4.2	76
Apr.	22.4	7.0	50
May	21.7	17.8	64
June	22.0	19.5	82
July	23.9	19.1	86
Aug.	22.6	19.6	86
Sept.	23.0	18.7	89
Oct.	19.0	—	83
Nov.	17.8	3.7	74
Dec.	14.5	0.1	72
Year	19.5	—	77

Source : Climatological Records. HMG.

TABLE 10

MONTHLY AVERAGE RELATIVE HUMIDITY OF KATHMANDU

Months	*1959*	*1960*	*1961*	*1962*
January	60.5	59.6	60.1	66.7
February	54.07	53.4	60.0	75.6
March	44.9	—	46.6	56.4
April	43.2	—	51.56	51.9
May	61.6	—	45.3	57.9
June	?	66.9	56.0	75.4
July	76.1	83.0	77.1	75.0
August	75.6	75.7	79.8	84.8
September	75.65	76.0	74.1	75.7
October	71.01	69.42	69.66	60.1
November	63.36	55.90	65.3	62.3
December	62.31	60.1	64.2	64.4

Relative Humidity

Rainy months, especially in the Terai belt of Nepal, are marked by high humidity which gets close to the saturation point. In the Kathmandu Valley, during the months of July and August, the atmosphere has a relative humidity of more than 80 per cent.

Chapter III

Soils

Next to the climate, the soil is the most important factor affecting the growth of plants. The four distinct vegetational zones of the country generally typify the soil composition of at least four types : 'The soils of Nepal' according to Karan, 'reflect mesothermal, microthermal and tundra climatic zones and the tropical (including the sub-tropical), temperate and alpine zones of vegetation. Azonal (lithosols) exist on the steepest and highest Himalayan slopes, but on the gentler slopes of the Mahabharat range and the Churiya, shallow zonal soils prevail where vegetation cover remains more or less intact.'[1] Red laterite soils which are characterized by a high iron and aluminium oxide content, are common in the middle mountainous region. In the Terai, alluvial soil, which has been transported by the river systems from the hills, is characterized by having rounded and smoothed particles of soil and is generally well stratified. Depending upon the movement of water, alluvial deposits show strata of finely grounded silt, clay or sand. The soil is, on the whole, poor in organic matter and contains a low amount of nitrogen, but has adequate amounts of alkalies, potassium, and phosphoric acid.

The *Churiya* hills which are of tertiary origin are part of the range that extends from Afganisthan to Assam. The primary soils of these hills are made of coarse rocks, clay and conglomerates. 'The soils, in their northern parts, resemble mountain forest soils in showing podzolic and brown earth characteristics on their profiles.'[2]

1. Karan, P. 1960. *Nepal : A Physical and Cultural Geography.*
2. Legris, Pierre. 'Report to Govt. of Nepal on Forestry.' (mimeographed p. 27.

Bhabar Soils

'Fringing the alluvial soils of Terai is the tract known as Bhabar. This is the slope of gravel and shingle along the foot of the Himalayas, in which the water of mountain streams disappears to reissue again in the form of springs in the Terai. The porous soils of Bhabar support dense *sal* forests. Coarse gravels and torrent boulders, generally mixed with ferruginous sand and clay, cover great portions of the *duns*.'[1]

Soil of the Mountain Region

The mountain soils contain little organic matter and are formed quite often by the breakdown of limestone, gneiss, quartz, etc. The rock pieces are mica schist, and being new the soils (lithosols) are generally poor for agriculture. Karan says : 'Scanty soils prevail in the mountainous regions of Nepal, where sandstones, clay and limestones mainly of the tertiary age, form the fundamental plant material. These mountain soils are liable to constant erosion. Of restricted extent, in the inner-mountain basins, they include mountain meadows and forest soils, alluvial ricelands, and podzolic soils, as well as talus accumulations, screes, and residual materials left by the weathering away of limestones and dolomites.'[2]

In the temperate parts of the country red or yellow lateritic soil is 'succeeded by brown or gray podzolic forest soils and mountain meadow soils at higher altitudes'.[3] *Sal* (*Shorea robusta*) is invariably associated with red soils.

Soil of the Kathmandu Valley

The soil of the Kathmandu Valley is of recent (pleistocene) origin and is azonal, i.e. with no distinct soil profile. It is in most parts, clayey with lot of organic matter. Fossils of recent origin (eocene) have been found in Phulchoki — a place about eight miles south-east of the capital city. Besides shale, here one comes across fossiliferous iron ore, haematite, calcite, quartz, limestone and marble. The boulders and stones are mostly of mica schist, quartz and sand.

Large deposits of peat exist in the valley, which is dug out

1. Legris Pierre. *Op. cit.* p. 27.
2. *Ibid.*
3. *Ibid.*

and used as fuel. In the peat, impressions of leaves as well as other parts are found. Ecologists have attributed three reasons for peat accumulation : water logging, leaching, and low temperatures. These conditions decrease soil fertility due to their harmful effects on the aerobic micro-organism population of the soil. As a consequence of this, there is an increase in the anaerobic population of soil micro-organisms. When these act upon the organic matter, the breakdown products are not carbon dioxide and nitrate, but ammonia and methane (CH_4) gas. The discovery in recent times of methane gas in the Valley provides evidence of boggy conditions that once existed here.

Soil types in the Valley vary from silt loam to clayey loam. The water table is rather high in most parts and the soil reaction varies from pH 5 to 9 (Table 11).

TABLE 11

SOIL TYPE AND pH OF THE KATHMANDU VALLEY AT THREE SELECTED SITES

Site No.	*Horizon (in mm)*	*Colour*	*Texture*	*pH*	*Water Table (in mm)*
1.	127	Dark	Fine Sticky with small particles of minerals and mica.	6.5	914
	152	White Grey	Coarse sand plastic with iron.	9.0	914
	330	White Grey	Fine slightly plastic with iron.	9.0	914
	381	Grey	Plastic fine	8.0	,,
2.	279	Dark Grey	Mixed with Ferric Oxide	6.5	482
	457	Light Grey	Sand mixed with a thin layer of clay	6.5	533
3.	279	Dark Grey		5.0	533
	381	Light Grey		5.0	,,

All samples from paddy fields along the Bagmati river.

Source : Soil Section, Department of Agriculture.

Soils of the Terai Region

Soils of the Terai are essentially made of materials transported and deposited in relatively recent times by the Ganges and its tributaries. Being immature soils, they show weak profiles. In general, soils are poor in nitrogen because of continuous cropping under one crop. The alluvium is reported to be 2,434 m deep. The soils are pale yellow to dark greyish brown in colour and vary in texture from sandy loam to sandy clay loam. (Tables 12, 13, 14.)

The soil data establishes the fact that 'the pH values of the surface samples of Parwanipur, Biratnagar and Nepalganj are between 6.45-7.10, which are proper for the general crop growth, whereas the pH of the Rapti valley soils is 5.4, in which case liming may have to be practised'. The total soluble salts are low except in the samples of the Rapti valley (2.0 per cent organic carbon and 0.16 per cent of nitrogen). All the samples are adequately supplied with phosphorus and the values are fairly uniform. The potash content of the samples seems to be high.

Soil Types

In the Nawalpur Resettlement Project, which covers an area of nearly 11,170 acres, the soil types are mainly loamy, loam and sandy clay loam, mostly strewn with boulders and stones. Soil pH varies from 3.9 to 6.5, organic matter from 0.321 per cent, nitrogen from 0.021 to 0.154 per cent, and phosphorus from 0.002 to 0.6 per cent.

Nepalganj Agricultural Farm : Soils in this region vary from loamy sand to clay. The pH is within the range of 5.5 to 8.5, organic matter content 0.184 to 1.738 per cent, nitrogen from 0.035 to 0.112 per cent, and phosphorus from 0.0015 to 0.060 per cent. The fertility in general is quite low.

Biratnagar Agricultural Farm : Soil type varies from sandy loam to clay loam. The pH lies within the range 5.5 to 8.3, organic matter from 0.021 to 0.464 per cent, and phosphorus from 0.004 to 0.464 per cent.

Dhankuta Agricultural Farm : The soil is mostly sandy loam in nature. The average pH is 5. The percentage of organic matter varies from 0.4 to 3.8, nitrogen from 0.05 to 0.11 and phosphorus from 0.004 to 0.11.

Pokhara Agricultural Farm : Three soil types are found: sand,

TABLE 12

CHEMICAL COMPOSITION OF SOILS

(expressed as per cent on oven dry basis)

Depth cms	*Loss on Ignition*	*Hygroscopic Moisture*	Sio_2	R_2O_3	Al_2O_3	Fe_2O_2	T_1O_2	P_2O_5	*CaO*	*MgO*	K_2O	*MnO*
					Profile 1 (*Parwanipur*)							
0-23	4.55	0.18	80.39	8.465	5.308	2.80	0.187	0.170	0.710	0.651	2.328	0.169
23-45	3.86	0.19	79.22	14.227	10.065	3.60	0.438	0.124	0.701	0.601	2.473	0.258
45-165	1.24	0.39	88.45	7.780	4.968	2.40	0.226	0.186	0.396	1.376	1.791	0.228
					Profile 2 (*Rapti Valley*)							
0-15	6.80	0.82	67.90	18.094	13.547	3.83	0.441	0.276	0.705	0.504	2.844	0.051
15-45	6.43	0.58	72.72	18.708	0.02	0.377	0.124	0.704	0.124	0.452	0.754	2.111
45-75	4.26	0.38	73.52	16.372	11.753	4.01	0.376	0.233	0.562	0.302	2.980	0.161
75-150	4.82	0.27	70.12	17.387	13.006	4.01	0.226	0.155	0.772	0.501	3.328	0.183
					Profile 3 (*Birat Nagar*)							
0-30	3.94	0.20	73.24	18.887	13.556	4.40	0.730	0.201	0.701	0.951	3.364	0.081
30-53	3.09	0.29	77.20	15.946	12.564	2.80	0.396	0.186	0.562	0.927	2.830	0.567
53-75	2.45	0.13	79.44	14.518	10.929	3.20	0.250	0.139	0.139	0.735	0.742	0.288
75-150	2.20	0.14	82.52	12.522	8.708	3.20	0.459	0.155	0.631	0.450	2.827	0.213
					Profile 4 (*Nepalganj*)							
0-28	5.98	0.27	83.92	4.261	1.289	2.40	0.417	0.155	0.701	0.350	1.851	0.243
28-70	4.31	0.37	82.15	9.284	5.791	2.81	0.543	0.140	0.562	0.401	2.582	0.199
70-150	30.9	0.45	79.12	15.821	11.143	4.01	0.565	0.103	0.562	0.426	2.417	0.017

Source : Soil Section, Department of Agriculture, HMG/Nepal.

TABLE 12

ORGANIC CARBON, NITROGEN C/N RATIO, pH, TOTAL SOLUBLE SALTS. CEC. OF SOILS & CLAYS

(expressed on oven dry basis)

Depth in cms	*Organic Carbon %*	*Total Nitrogen %*	*C/N Ratio*	*Total Soluble Salts %*	*pH*	*C. E. C. me/100 gm*	*Total Exch. Cations*	*Exchangeable Cations*			*C. E .C. of Clays me/100 gm*
								Ca	*Mg*	*K*	
					Profile 1 (*Parwanipur*)						
0-23	0.238	0.0364	6.53	0.035	6.45	8.00	7.57	5.73	1.27	0.57	42.47
23-45	0.404	0.0560	7.21	0.242	6.15	8.30	7.81	4.25	2.25	1.31	24.47
45-165	0.048	0.0210	2.28	0.210	6.85	4.00	3.84	1.26	0.43	2.15	—
					Profile 2 (*Rapti Valley*)						
0-15	2.091	0.1596	13.10	0.035	5.45	17.40	5.64	3.17	1.27	1.20	38.36
15-45	1.152	0.0952	12.10	0.021	8.40	3.53	1.27	1.27	0.99	1.27	30.14
45-75	0.238	0.0350	6.80	0.201	6.05	4.60	4.36	1.58	1.26	1.52	24.66
75-150	0.143	0.0210	6.80	0.014	6.40	3.60	3.41	1.26	0.32	1.83	20.55
					Profile 3 (*Birat Nagar*)						
0-30	0.428	0.0490	8.37	0.042	6.45	7.80	7.36	3.85	2.15	1.35	42.21
30-53	0.238	0.0266	8.94	0.035	6.85	5.30	5.15	2.55	0.85	1.75	41.10
75-150	0.066	0.0210	3.14	0.021	7.05	3.00	2.94	1.90	4.3	0.61	—
					Profile 4 (*Nepalganj*)						
0-28	0.428	0.0392	10.91	0.021	7.12	7.58	7.30	4.73	1.84	0.73	32.88
28-70	0.143	0.0252	5.67	0.028	7.36	10.48	10.15	5.06	4.42	0.67	31.51
70-150	0.095	0.0238	3.99	0.021	7.75	12.39	12.06	6.95	4.44	0.67	32.88

Source : Soil Section, Department of Agriculture, HMG/Nepal.

TABLE 13

pH AND NUTRITIONAL STATUS OF SOME TERAI AND BHABHAR FOREST SOILS

	Forest Type	*Soil Texture*	*pH*	*Nitrogen in %*	*Phosphorus lbs/acre*	*Potassium in lbs/acre*
1.	Sal forests — (*Shorea robusta*)	Sandy Loam,	4.25-4.90	0.05 -0.152	6.0-96	225-575
		Sandy Clay Loam	5.40-5.70	0.027-0.160	7.2-30	205-280
		Loam	5.85-6.00	0.02 -0.12	2.8-34.8	770-96.0
2.	Mixed Sal forests — (*Shorea robusta* mixed with *Terminalia tomentosa*, *Dillenia pentagyna*) Shrubs : (*Murraya, Koerigi Adhatoda vasica, Clerodendron infortunatum, etc.*)	Sandy Loam	5.60-5.95	0.12-0.15	7.60-16.32	620-795
		Loamy Sand	5.80-5.95	0.12-0.16	256-385	187-567
3.	Miscellaneous Forests — (*Salmalia malabarica, Albizzia lebbek, Cedrela toona, etc.*)	Loamy Fine Sand	6.90-7.45	0.02- .045	4.48-23.6	0-62.5
4.	Khair & Sisso Type — (*Acacia catechu, Dalbergia sisso*)	Loamy Sand	6.70-7.20	0.04-0.12	2.80-7.68	50-190
			6.70-7.50	0.02-0.13	7.20-19.60	115-140
		Remarks :				
		Rating for		***N (in %)***	***P_2O_5 in lb/ac***	***K_2O in lbs/acre***
		Low		**1%**	**20 lbs/ac**	**125 lbs/ac**
		Medium		**0.1-0.2%**	**20-50**	**125-300**
		High		**0.2 &above**	**50 & above**	**300 & above**

Source : Soil Section, Forest Resources Survey, HMG/Nepal.

sandy loam, loam, and silty-loam. The pH ranges from 5.0 to 8.2, the organic matter percentage varies between 0.2 to 3.0, and that of phosphorus from 0.007 to 0.199. The soils are in general, coarse, calcareous and in some cases have stones and pebbles.[1]

Soils of Kanchanpur

In the far western Terai district of Kanchanpur, five different types of soils have been recognized: loamy sand, sandy loam, silty loam and clay loam. In forests (canopy 50 per cent and surface litters 100 per cent), the soil is 'moderately alkaline, excessively drained sandy loam underlain by loamy sand and high in organic content'.[2]

The Terai alluvium, especially the cultivated soils of Kanchanpur district are deficient in nitrogen, phosphorus and organic matter. Fertility of soils in general can be increased by applying NPK in combination with farmyard manure or green manure. In one experiment, 'an application of 34 kg N, 34 kg P_2O_5 and 34 kg K_2O together with 6720 kg of F. R. M. per hectare resulted in 26.47% and 60.99% increase in yields of two improved varieties of paddy — BR 34 and Taichung Native 1 respectively'.[3]

Green manuring by *dhanaicha* (*Crotalaria*), *Sunhemp* (*Sesbania*) Clover (*Trifolium*) and soyabean greatly improves the texture and fertility of soil. The yield may be increased by more than 16 per cent.

The Soil section has recommended the following rates of application of fertilizers for the major crops (in Kanchanpur) in shown in Table 14.

1. Pradhan, M. L., Basnyat, R. H. and Maharjan, P. L. 1964. *Soil Survey of some Areas of Pokhara* (West no. 3) and Syanjya (West no. 4) Gandaki Zone. Soils Section/HMG.

2. Pradhan, Manik L., Tej Bahadur, K. C. and Purna L. Maharjan. 1969. *Soil Survey of Kanchanpur District*. Soils Section, Dept. of Agriculture.

3. *Ibid.* p. 54.

TABLE 14

RECOMMENDED DOSES OF MANURES AND FERTILIZERS FOR THE IMPROVED VARIETIES OF CROPS IN THE DISTRICT

(*requirements of fertilizer elements* kg/ha)

Crops	*Nitrogen* (*N*)	*Phosphorus* (P_2O_5)	*Potash* (K_2O)
1. Paddy Taichung Native 1, Taichung and Taiwan varieties	70-90	45	35
2. Wheat, maize	90	45	35

Soil pH and Fertility

Fertile soils have a pH range of 2.8 to 9.7. Micro-organisms —bacteria, fungi, actinomyces, protozoa, etc. play a big role in breaking down complex organic matter into simple substances which are then utilized by the plants or released into the atmosphere.

Root nodule bacteria perfer an acidic soil, but in the case, of soyabean, the micro-organisms thrive best between pH 5.5 and pH 7.8. For the optimum activity of the micro-organisms, 'the pH should lie between 5.5 and 7.8'.[1]

Soil Erosion

Soil erosion is caused principally by rain and wind and, of course, helped by man. The problem of soil erosion in the hills has become so serious that unless some effective steps are taken, soon it will be beyond repair. The reckless destruction of the forest-trees, shrubs and all kinds of vegetation leads to the loss of large tracts of fertile land every year during the monsoon. It has been estimated that soil erosion brings about 13.56 per cent and 2.12 per cent loss in revenue in the plains and hills respectively. Conservation of the soil and water can only be accomplished through large-scale afforestation in the areas which have been denuded of the forest cover. In the hills bordering the Kathmandu Valley an effective programme for afforestation is being carried out. In the Kathmandu Valley besides eucalyptus and wattle, many indigenous trees, such as chirpine, wild cherry (*Prunus*), etc. and exotic plants are being planted. Recently, this

1. Wrigley, Gordon. 1961. *Tropical Agriculture*. p. 37.

programme has been extended to the Trisuli watershed region, to Bardiya, Panchkhal and many other parts of the country. It has become necessary to carry out the afforestation programme in all the hilly regions of Nepal where there is acute shortage of both fodder and firewood. The river valley projects, which have become an intrinsic part of the development programmes in the developing countries, play an effective role in this matter. They are essentially meant to prevent floods, to generate hydroelectric power and for irrigation. Their utility in the matter of conservation of natural resources, especially those of soil and water, is well recognized. The protection to catchment areas of the major river systems needs special attention, as already silting has become troublesome to power generation. Erosion can be prevented through building of spurs and revetments.

The reasons behind soil erosion are manifold. All the green cover is subject to constant encroachment from the farmers who are always looking for firewood, fodder or fibre. Use of cover crops such as alfalfa, clover, etc. is unknown in these parts and overgrazing is a common practice throughout the hills. Grasslands are burned, a practice which results not only in substantial decrease in the fertility but also causes widespread floods down below in the plains. One comes across reports of whole villages being washed away by flood waters during the monsoon season.

Landslides in the hill regions of Nepal are as much due to the misuse of the land by man, as to the general instability of the 'fractured and displaced rock formation'. Earthquakes, which are frequent in certain parts of the country, make them more prone to landslides. Furthermore, in the outer valleys of the Himalayas, because of steepness of the hillsides, the erosive forces are much more at work than elsewhere.

The frequent occurrence of famine in certain parts of the coun try is often due to the scarcity of rainfall, a phenomenon which is related to the vegetational cover. Very high rainfall on the southern flank of the Mahabharat range causes soil erosion because the soil is quite unstable. In these regions the process of weathering and tearing is going on which is of course being helped by man. In parts of the country, however, where grazing is done during part of the year only, the soil remains in good condition. The Sherpas of Solo Khumbu have developed an efficient

system of soil conservation through seasonal grazing, crop rotation and shifting cultivation.

The situation can best be summed up as follows: 'Nepalese farmers have exhausted the soils by continuous grazing and cultivation and as a consequence have subjected it to accelerated erosion. It seems that farmers have done everything possible to speed up the impoverishment of their productive lands by clearing the natural vegetation, by ploughing hill sides usually straight up and down, by overburdening the range lands, and by planting the fields with the same crop year after year.'[1]

Afforestation of Watersheds

Afforestation can only partially bring about erosion control. For erosion control, torrent or river control becomes essential. The trees which are most suitable for afforestation are those of pine and alder (*Alnus*). In the Trisuli Watershed, a number of plants were tried for preventing erosion and torrent control: two species of *Salix* (*S. tetrasperma, S. wallichiana*), *Alnus nepalensis* and *Viburnum* spp ; the last two plants being not liked by goat and sheep. Of these, *Alnus nepalensis* was found to be the most suitable for controlling soil erosion along the channels and in places where heavy landslides occur.

In the hills 'much of the erosion is caused as much by poor irrigation practices as by irrigation of geologically unsuitable areas and by terraces sloping not to the next river bed but to some other place without an established run off channel'.[2]

The geology of a country has an important role to play in the process of erosion. In Nepal this has much relevance, as pointed out by Tautscher:

> 'Many of the flat areas used for agriculture on otherwise very steep slopes are caused by geological faults in which the formations are strongly shattered along the fault plane and so are highly permeable for water. Irrigation of the steep slopes greases not only the fault plane itself, but also penetrates between rock layers and reduces the friction between them very much,

1. Thapa, B. 1964. 'Report of the Soil Section'. Nepal Agricultural Conference II, p. 2.

2. Tautscher, O. G. 1968. *Surveys and Demonstration for the Management and Development of the Trisuli Watershed.* Project Report no. 13. UNDP/HMG.

so causing erosion of sometimes geological dimensions. But even without geological faults, dipping and striking of geological formation often favour erosion enough to make leakage of an irrigation canal put big landslides into motion.'[1]

In the Trisuli watershed region, where the Survey-Demonstration project was carried out, it was found that 'large erosions and deeply cut in torrents have washed down big areas of newly cultivated land and so increased the gravel and silt load of the rivers several times'.[2] This increased load exceeds the transport capacity of the river and its tributaries, causing floods, which then bury fertile tracts under silt.

1. Tautscher, O. G. *Op. cit.* p. 30.
2. *Ibid.*

Chapter IV

Geology

Historical

Pradhan[1] has dealt at some length with the history of geological studies in the country. In the past these were carried out with a view to discover mineral deposits and naturally the emphasis was on the study of rocks. Detailed field mapping has just begun.

The first scientific observations about the geology of Nepal were first carried out by Hooker when he visited eastern Nepal in 1848. 'From 1875 onwards, a number of geologists visited the kingdom on different assignments in association with the Geological Survey of India. Bowman, Auden, Ghosh, Heim and Gansser in the 1930's made considerable contribution in the field of geology in Nepal.' The Nepal Bureau of Mines was established in 1941 and in 1967 the Geological Survey came into existence. In the past two decades, several studies, both by foreigners as well as by Nepalese geologists, have been carried out. These have resulted in innumerable reports, a large number of these being of a preliminary nature.

There is a difference of opinion among geologists about occurrence of minerals in sizable amounts in Nepal. The classical 'Nappe theory' as propounded by the Swiss school sees remote possibilities of finding vast deposits of minerals. The 'Block theory' which has been proposed by the Japanese geologists is more optimistic in this respect, as the latter say *inter alia*: '....It must be said that in the Himalayan region, the essen-

1. Pradhan, Biswa M. 1974. *The Status of Geology in Nepal and its Appraisal.* Proc. Natural Science Seminar, T. U. Kirtipur.

tial problem is whether or not these high mountains were derived directly from the Tethys sedimentary basin and never influenced by other factors such as younger block movements or plutonism. Classical nappe theory postulates *a priori* for the idea of folding movements generated by a contraction of the crust, but our data suggest that this basic idea is very questionable in the Himalayas.'[1]

It is thus obvious that the concept of nappes in Nepal, proposed by Toni Hagen, is now disputed, principally on account of lack of stratigraphical work.

Hagen carried out his field work for a period of eight years (1950-58) covering the country with numerous traverses.

His views have been summarized thus: 'The main range of Himalayas is formed by the roots of the big nappes. The backbone of the nappes corresponds with the midlands, while the front parts of the nappes correspond with the Mahabharat Range from the western end to the eastern end of the country. The Siwaliks in the southern part of the country are the detritus formed from the rising Himalayas brought down by the rivers.' About the economic possibilities of the mineral deposits in Nepal, Hagen does not seem to be very optimistic, as is evident from these remark:

'Given the extremely complicated nappe structure, the lack of massive magnetic intrusions into undisturbed rock formations, especially into sediments, and, last but not least, the total lack of a transport system, Nepal in general cannot be considered to be rich in mineral resources as had been the general view so far ...there is, however,one resource that shows favourable prospects —petroleum.'

The painstaking work of Talalov has, however, brightened the picture. He has studied the magnetism, metamorphism and the tectonics of Nepal Himalayas. His reports have indicated 'hitherto unknown minerals like tantaloniobate, rare metal mineralization, tin, tungsten, molybdenum, bismuth, tellurium and lithium based on his spectrum analysis of his systematically collected specimens.'

Talalov says: 'It is beyond doubt that under proper execution of prospecting and evaluation works, large deposits will be discovered in the country and Nepal will become in future a major supplier of tentalum-niobium and rare metal ores.'

1. Pradhan, B. M. *Op. cit.*

Fossils

In the Nepal Himalayas very large number of rock groups have been identified; the rocks found in the Tibetan Plains are much older — Paleozoic and Mesozoic; fossiliferous marine beds belonging to Cambrian have also been found.

Itihara *et.al*[1] have divided Nepal Himalayas geologically into three zones: upper, middle and lower. This they call as 'tripartite sequence'. Significantly, Itihara and his group did not find any fossils in the Siwaliks.

The Siwaliks are one of the World's important sources of the later Tertiary fossil mammals and provide basis for much of our present knowledge of the evolution of Asian fauna and, especially, for the fossil primates.[2]

The Siwalik fauna has been a very rich one in the past, a fact which is confirmed by the discovery of fossils of elephants and elephant-like creatures. In the fossil remains, 'bones of many species of giraffes, hippopotami, rhinoceros, horses, camels, antelopes, hyaenas, buffaloes, ostrich like birds, crocodiles, tortoises and apes have been discovered'.[3]

In the Terai, near Janakpur, a molar jaw of a hippopotamus has been found and in the Kathmandu Valley that of *Stegodon gonesa* from Hikum dol.[4]

In the rocks south of Kathmandu are found number of fossils — grey slates with Brachiopods, haematite with *Trilobite* and grey shale quartzite with amphibian. In the far west at Tinker-Liphu lekh area no limestone ammonites are found. 'Fresh water gastropods of cretaceous age are also found in the Mahabharat range — from Karnali to Narayani.'

In South-eastern Nepal — at Ranikhola carbonized tree trunks and thick carbonaceous shales have been found.

Geological Origin of the Himalayas

The Himalayas are comparatively young mountains. It is said that they arose from the bed of the sea some 60 million years ago

1. Itihara, Minoru, Tatsuo Sibasaki and Noboru Miyamoto. 1972. *Photogeological Survey of the Siwalik Ranges and the Terai Plain, South-Eastern Nepal.* Jour. Geosciences, Osaka University. 15 (4) : 77-98.
2. *Ibid.* p. 67.
3. Randhawa, M. S. *Agriculture and Animal Husbandry in India.* p. 19.
4. Sharma, C. K. 1973. *Geology of Nepal.* Kathmandu.

during eocene-oligocene times and it took six or seven million years for them to attain the present height. In the course of the earth's history, the region now occupied by the Himalayas was a vast expanse of water — the sea of Tethys, which was an extension of the present Mediterranean sea. Towards the northern side of this sea was the Siberian shield, towards the east the Chinese tableland, and towards south, the Indian tableland of today. Gradually the bed of the sea began to be filled in with stones, soil, sand, etc. which in due course turned into a sedimentary rock. During the passage of time, the Siberian shield and the Chinese tableland approached each other with the result that the sedimentary rocks of the Sea of Tethys with the help of the Indian tableland began to fold and rise up. As the Himalayas rose from the bed of Tethys, an event which took place in the middle eocene, the sea itself began to disappear. The Himalayas which are the highest, yet the youngest mountains in the world, are still rising because the forces which led to their uplift from the sea are still at work. The discovery of mesozoic ammonite fossils in Manang and micro-fossils of small marine animals in the tertiary deposits near Dang substantiate the previous statements. *Shaligrams* so much revered by the Hindus are Jurassic and Triassic fossils from the Muktinath area. According to the 'Continental drift theory' which was first proposed by Alfred Wagner 'the continents are, as it were, immense land masses floating on the viscous hot interior of the earth', and 'when continents collide a chain of mountains arise at the line of juncture'. The origin of the Nepal Himalayas may also be looked at against this background.

As a result of the collision of the two continents in the mesozoic era the Tibetan marginal mountains were the first to appear, the juncture of the north Asian and southern continents seems to lie at 4,876 m on Nepal-Tibet border. The rivers that originated in these mountains flowed both towards the north and towards the south. But a second 'thrust' led to the formation of 'old original Himalayas' and 'because of the steeper gradients towards the south, and the precipitation, the rivers cut a more southern direction and led to the development of transverse river systems'.[1]

The upliftment of the Himalayas was accompanied with the downward cutting by the rivers which possessed an increased erosive power because of the steep gradient. In central Nepal

1. Hagen, Toni. 1960. *Op. cit.* p. 50.

one finds steep gorges, such as that of Kali Gandaki river, which now flows at 1,828 m, while the peaks of Dhaulagiri and Annapurna on either side rise over 6,096 m. The view that the rivers existed before the Himalayas is often disputed, and geologists hold the view that the steep gorges are the result of 'cutting back' or 'a headward erosion process', which allows these rivers to push their way towards the north.

Another theory is that the rivers were there before the Himalayas appeared on the scene and as the latter rose higher, the rivers went on cutting down their beds which allowed them to maintain their passages through the mountains.

Mineral Resources

Three main geologic zones are generally recognised in Nepal. These are alluvial plains, middle region and snow-capped Himalayas. In the tropical plains and foothills sediments were deposited during mountain building of conglomerates, sandstone, shales, and minor marine limestones. Minerals in these parts include placer gold, and probably petroleum and natural gas.

'The middle region,' which is the region of the Mahabharat was 'carved out of palaeozoic sediments of phyllite and micaceous quartzite.'[1] Subsidiary rock types include dolomite, a kind of limestone with high content of magnesium, carbonaceous shale and slate, granite and iron formations. The majority of the mineral deposits found in this zone are: copper, lead, zinc, iron, cobalt, nickel, talc, ocher, slates, etc. 'The high snowcapped Himalayas which rise abruptly above the middle ground to attain heights of more than 8,000 metres (Sagarmatha or Everest) is built of a thick sequence of mesozoic sediments in the eastern sector of the country. Only a few small deposits of mica, lead, zinc and iron have been found in this zone so far.'[2]

'Two types of granitic intrusions are occupying large areas of western and north-eastern Nepal. They yield deposits of mica, and clay but seem to contain few hydrothermal deposits, although they may possibly be related to such deposits in the rocks which they intrude.'[3]

Until the turn of this century, the country seemed to be self-

1. Malla, P. B. 1964. *Mineral and Underground Resources in Nepal.*
2. *Ibid.* pp. 8-10.
3. *Ibid.*

sufficient with regard to the requirement of metals useful in agriculture and in the household. Nepalese artisans achieved distinction in metalcraft, especially in bronze and copper. There existed a number of mines in the country, some of which are still in production. A difficult terrain and the absence of a good transportation network has, however, hampered large-scale exploitation of the mineral resources of the country. It is reported that 'several minerals could be exploited to cover the internal demand and export as well'.[1] A short description of some of the more important minerals found in the country is given below.

Nickel : Nickel (*Nias*) has been found in Khokling (Dhankuta-Taplejung), Khore Pani (East No. 2), Nampha (East No. 1), etc. Cobalt as well as nickel occur in association with copper.

Cobalt : The ore occurs mostly as cobaltite ($CoAs_3$ Sx). A good amount of this useful metal is known to occur in Palpa district (Samar-Bhamar).

Gold : 'Placer gold has been reported from several places in the Terai rivers and tributaries of the Gandaki and Karnali rivers.'[2] A little panning is done in these rivers but the amount is too small to warrant any commercial undertaking. Alluvial gold has also been reported from such places as Kholpu Khola (West No. 1), Mustang, Barbung Khola, Sun Kosi and Chaurnikhola.

Mica : The most important ore of mica is Muscovite. Large deposits of mica occur in Chainpur, Bhojpur, Langtang, Bajhang and Sindhuli gadi. The pegmatite veins contain mica as well as aquamarine and coloured tourmaline. A part of the Nepalese mica finds its way into foreign markets.

Slate : Good deposits of slate have been discovered in Bandipur. Galkote in Baglung district is well known for its slate mines. In the hilly parts of the country, especially in the west, slate is much used for roofing. There are good possibilities for large-scale mining of slate in the country.

Limestone : Limestone is present as calcium carbonate ($CaCo_3$). Large deposits of limestone are known to occur in the Mahabharat and Churiya ranges. It is a useful material for agriculture and with the establishment of sugar and leather factories

1. *Khanij Parichaya* (*Introduction to Minerals*). 1962.
2. Bureau of Mines.

and in the future of pulp, paper and cement manufacture, production of limestone will be greatly augmented. 'Limestone of different ages like Ordovician, Silurian-Devonian to Jurassic and Triassic have been found.' Good quality marble is found in Phulchoki. All the marble that one sees in the palaces of Kathmandu has come from the Phulchoki mine. A cement factory near Kathmandu (Chobar) with an annual production capacity of approximately 60 tonnes a day has now gone into production. It will use the limestone deposits of Chobar hill, a thing which, besides destroying the natural beauty of the area, will create pollution problems.

Talc : Talc is found as talc or soapstone (H_2Mg_3, $4SiO_2$, H_2O). Talc deposits have been found in Khari Dhunga (East No. 2), Baglung, and in small amounts in many other parts of the country.

Coal : Lignite Coal, Peat and lignite have been found in the districts of Kailali, Sindhuligadi, Palhi (Tamaspur), Dang, Sallyan, Chitwan (Narayangadh), Morang (Barahchhetra), Muktinath, and Kanchanpur. Peat is found in the Kathmandu Valley but it is of poor quality, so it is used in brick kilns. Peat deposits have also been reported from other parts of the country — Baglung, Musikot and Karnali. The quality of coal so far found in the country is said to be poor; coal mining is practically non-existent. The coal deposits in Dang, laid in eocene under marine conditions, contain micro-fossils. The quality of coal, again, is rather poor.[1]

Phosphorus : Phosphate ore deposits are reported in Dharan and Barahchhetra : 'Traces of Phosphate are noticed in Eocene shales.'[2]

Iron : Iron ore occurs in Nepal in the form of Haematite (Fe_2O_4) and limonite ($2Fe_2O_3$, $3H_2O$). It has been found in the districts of Bajhang, East No. 2 (Those), (the mine is still in operation), Phulchoki (Kathmandu), Piuthan (Bajin village) and West No. 3 (Bandipur). In the Kathmandu Valley, 'it is found in the Cambrian of the Nuwakot nappe'. In Phulchoki — a place nearly eight miles east-west of Kathmandu — fossiliferrous iron ore is found. In Chitwan along Lothar Khola, rich iron deposits have been found.

1. Sharma, C. K. 1973. *Op. cit.*
2. Rimal, D. N. 1967. *Op. cit.* p. 5.

The Phulchoki iron ore deposits have been estimated to be around 10 million tonnes, while those in Those and Bandipur are known to exceed 8.4 million and 10 million tonnes respectively.

Copper : Copper ore occurs as bornite ($Cu\ 5FeSO_4$), Chalco pyrite ($Cu\ FeSO_4$), and as pure *Cu*. Copper veins have been found in Chisapani gadi, Baglung, Galkot, Garsing, Chobar, East No. 1 (Jugedi), and East No. 4 (Ditang Kahri), as well as in the districts of Dhankuta, Illam and Baitadi (Marma). In Bandipur 0.4 per cent of copper in the copper-cobalt ore has been found. Some copper deposits have been noted in granite gneiss as well, some of which contain a little gold, silver, nickel and cobalt also.

Lead : This is mostly present as sulphate of lead (PbS). It has been found in Galkote (Baglung), Phulchoki (Kathmandu Valley) and Major Khola (West No. 1). Lead as well as zinc ores are the 'results of quartz veins and pegmatite intrusions'.

Zinc : Zinc is present mostly as zinc sulphide (ZnS). Preliminary investigations have confirmed the occurrence of this metal in Phulchoki and Tipling (West No. 1). From Ganesh Himal upto Rapti valley lead and zinc mineralizations occur in carbonate formations, apparently, near granite intrusions.

Magnesium : Magnesite deposits (native magnesium carbonate) at Kharidunga are known to be rich. Present estimates are 400 million tonnes of high grade ore. This compound has found use in iron and cement industries as well as in the manufacture of chemical fertilizers.

Gypsum : Gypsum is found in nature as hydrous calcium sulphate ($CaSO_4\ 2H_2O$). It is used in the manufacture of cement, plaster of paris, ceramics, paper, disinfectants, etc. In Nepal it is found in the districts of Dang and Sallyan.

Sulphur : In the volcanic regions sulphur is found in pure elemental form. In Nepal it is found as galena or sulphide of lead (PbS) and Pyrite. It has been found in Gosainkund (West No. 1), Chisapani gadi, and Jumla.

China Clay : The clay is known as kaolin ($2Al_2O_3$, $4Si_2O$, $4H_2O$). It is used in the manufacture of porcelain. It has been found in Jitpur Phedi.

Beryl : Beryl is silicate of berylium and aluminium (Be_3 Al_2 (SiO_3) 6). It has been found in Tame (West No. 1), Bhojpur and Hedang (Chainpur).

Graphite : This mineral is soft and has a black metallic lustre. It is all carbon and is used in the manufacture of pencils, crucibles, lubricants and electric furnaces. In Nepal it has been found in Illam district.

Salt : Common salt (NaCl) is found in Kunchha District (West No. 3) in a belt of 10-15 mile radius.

Petroleum and Natural gas : In the Kathmandu Valley, natural gas (Methane) has been struck at few places. It is reported to contain 91 per cent methane and 5 per cent CO_2. In Muktinath (West No. 1), a place of pilgrimage in the Central Himalayas, travellers have reported a 1.5 m to 1.8 m high 'eternal flame', which obviously is due to presence of natural gas in the soil. Gas seepage has been reported at Sagure (Dang) and Padukasthan (Dailekh). 'Parts of the zone of the southern flank of the Himalayas,' according to Malla, 'belong to the same system of upheavals as the great Iranian oil belt. The cretaceous formations occur in the Nepalese part of the Tibetan plateau and are limited to the upper parts of the Kali Gandaki valley, the Langu valley and the area north-west of Saipal. Eocene formations have been found in the above three areas, and in Muktinath which is proved by a sufficient number of fossils. Here the Eocene formations transgress over strata of various ages from Devonian to upper Cretaceous. In the Langu valley too, Eocene formations are probable.'[1]

Exploration for oil has been carried out in the vicinity of Muktinath (altitude *ca* 3,657 m), Dailekh and in some parts of the Terai. In case of the first two, preliminary investigations have shown the 'presence of gas and crude oil (diesel oil)'.[2] The gas is mostly methane. 'As there are igneous rocks over the sedimentary rocks with enough evidence of marine life of comparatively recent-cenozoic era in them, and these ranges extend from Dailekh to Muktinath, indications are that oil in sufficient quantity may be found in this area.'

1. Malla, P. B. 1964, *Op. cit.* p. 9.

2. Sharma, Chandra Kant. 1964. 'Possibilities for Petrol in Nepal and its Investigation.' *Gorkha Patra.* October 10, 1964.

There is a possibility of striking oil between Koilabas and Dhangadi. The nummulitic limestones of Dang and adjoining regions — Deokhuri, Pyuthan and Sallyan have indicated the possible occurrence of petroleum in this part of the country. But oil exploration is an expensive, and often futile undertaking which cannot be carried out without outside help.

Water Resources

Next to forest, water or 'White gold' is the second most important resource of Nepal. The country is traversed by a dozen or more big rivers which run in a north-south direction providing during their course many natural falls that are ideally suited for the construction of dams and reservoirs. There has been a shifting of the river courses recently towards the west. While the extensive river system of Nepal is a boon, they also cause widespread floods every year during the monsoons. The rivers carry a large volume of water. Kosi near Barahchhetra has a flow of 500 million cu. metres, Trisuli near Trisuli Bazar, 47 million cu. metres, and Mahakali, near Banbasa, 210 million cu. metres. The Karnali river basin which drains an area of 42,890 sq. km at Chisapani showed a minimum discharge of 263 cu. metres per second and maximum of 11,400 cu. metres per second during the 1965 period.[1] Karnali river takes origin in Mansarovar lake and cuts a gorge at 4,267 m. The Arun river cuts its way past Mount Everest. In the Himalayas 'cutting back' phenomenon is also seen. This occurs most on the southern side where there is ample rainfall. Most of the river valleys are 'V' shaped. All the rivers in Nepal are tributaries to the Ganges in India.

During the course of history, when these rivers cut through the great Himalayas, they faced another obstacle — the Mahabharat *Lekh*, which was rising in the meantime; this forced the rivers to change their course eastward or westward rather than straight south. The rivers which could not be kept within the confines of the transverse lakes, escaped through the three gaps in the Mahabharat *Lekh* — Karnali at Chisapani, Gandaki at Deoghat and Kosi at Barahchhetra.

1. 'Compilation of Surface Water Records of Nepal through December 31, 1965.' Department of Hydrology, HMG. p. 17.

River System

The Himalayas, which run for 2,011 km from Burma to Afghanisthan, very effectively divide the temperate Central Asiatic plateau from the tropical and sub-tropical south-east Asiatic regions. The head waters of many Nepal rivers lie behind the mountain chain of the greater Himalayas.

In Nepal we find the following three distinct watersheds each of which encloses one-third of the area of Nepal in its basin:

1. Karnali watershed—Humla Karnali, Mugu Karnali, Seti and Sinja, *Thulo* and *Sano* Bheri.
2. Narayani watershed—Seti, Budhi Gandaki, Trisuli, Kali Gandaki, and Marsyangdi.
3. Sapta Kosi watershed.

The Kosi is made up of seven smaller rivers and hence called Sapta Kosi; of these the more important ones are: Indravati and Sun Kosi, Likhu Khola, Dudh Kosi, Tamba Kosi, Arun and Tamur (Tamor). The watershed between the Tsangpo (Brahmaputra) river system and the Ganges system is not the main Himalayan range but Tibetan marginal land which lies north of these mountains.

Water Drainage

Since the beginning of the last decade, regular hydrological data is being kept. River and stream gauging stations are located throughout the country. These have provided valuable data for irrigation, flood control and electricity generation. A short account of the drainage area and discharge of the main river systems of Nepal is given here:[1]

Karnali River Basin (at Chisapani)

Drainage area	42,890 sq. km
Average discharge (4 years)	1,360 cu. metres/sec

Narayani River

Location: Near Narayangarh

1. 'Compilation of Surface Water Records of Nepal through December 31, 1965'.

Drainage area	31,100 sq. km
Average discharge	1,561 cu. metres/sec

Bagmati River

Location: 60 m above Sundarijal

Drainage area	16.0 sq. km
Average discharge	0.951 cu. metres/sec.

Sapta Kosi Basin

Location: North of Chautra at Pachuwa Ghat.

Drainage area	4,920 sq. km
Average discharge	201.4 cu. metres/sec

Chamaliya

Location : Nangaon (Baitadi)

Drainage area	1,150 sq. km
Average discharge	21 cu. metres/sec

Floods

These occur due to combination of factors: Heavy rainfall in the Himalayan region — is the main, but in the flat Terai — silting of the rivers is also another factor. The obstruction and inadequacy of waterways also contribute towards floods.

Kosi has steep bed slopes below the Himalayan foothills; this coupled with high flood discharges and heavy silt load causes instability of river bed. During the last 30 years, the river has moved 112 km east to west.

Control

Erecting embankment along the side of the rivers and improving channels, construction of storage reservoirs and multi-purpose dams are the principal methods. The large quantity of sediments swept down by the river reduce the storage capacity of reservoirs, so dredging of the channels becomes necessary.

Power

The total hydroelectric potential of Nepal is estimated at 83 million Kw but the present installed capacity does not exceed 40,000 Kw. Power production at Chisapani alone is estimated at 1.8 million Kw, which would be cheapest in the world. The

Karnali, which forms a huge 'S' shaped loop, would be traversed by two tunnels — each 2.6 km and 5.5. km long and providing heads of 180 and 110 metres respectively on a main dry season flow of about 3,000 cu. metres per second. New hydroelectric power stations are being planned at Devghat, Kulekhani and at Chisapani.

Lakes

There are many glacial, river valley and oxbow lakes in Nepal. Lakes in the north are mostly of glacial origin. 'Tectonic lakes are confined to the midland parts and oxbow lakes occur in the south in the Terai plain.'[1]

Rara, in Jumla, is the biggest of the lakes and, of course, the most famous one. Situated at an altitude of 3,048 m in a crater-like depression, it is 6.5 km long and 1.5 km wide.

Another lake situated higher up (3,657 m) is Phoksumdo, whose blue green waters reflect the 7,010 m high peak of Kanjiroba Himal. The lake lies in Dolpo district. It is an alpine 'Y' shaped lake surrounded by pine and fir trees. The shore line is 25 km. It is a deep lake with little aquatic life in it.

Phewa lake is situated in Pokhara valley, the largest of many lakes there. It is '1.5 km long and 400 m wide'.[2] It is quite productive and is well stocked with fish, mostly carps.

1. Sharma, C. K. 1973. *Op. cit.* p. 19.
2. *Ibid.*

Chapter V

Vegetation

Vegetation Zones

Climate and soil are the two most important factors which affect vegetation in any part of the world. Nepal is divided into five climatic regions, each characterized by its own topography, climate and vegetation. These are: tropical, sub-tropical, temperate, sub-alpine and alpine. In the Terai and in Bhabar, the climate is tropical and sub-tropical, while in the midland, which is mainly the region of Mahabharat, it is temperate. The inner and outer Himalayas as well as the Tibetan marginal land has typical sub-alpine and alpine types of vegetation.

The vegetation of Nepal has been classified by Swan[1] into the following seven zones:

TABLE 15

VEGETATION ZONES OF NEPAL

Type	*Approx. Altitudinal Range in m*
1. Lower monsoon forest	152-1,066
2. Middle monsoon forest	1,066-1,981
3. Upper monsoon forest	1,981-2,590
4. Deciduous and rhododendron forest	2,590-3,200
5. Conifer and rhododendron forest	3,200-4,114
6. Wet alpine zone	4,114-5,029
7. Dry alpine zone	4,876-above

1. Swan, L. and Leviton, A. E. 1962. *Herpetology of Nepal.* Proc. Cal. Acad : 103-142.

The altitudinal limits, however, are subject to variation as there are sharp climatic differences in the eastern and western parts of Nepal. There are always zones of merging vegetation, whether one considers it in the vertical or in the horizontal scale. The lower, middle and upper monsoon forests of Swan have been designated as tropical deciduous, tropical evergreen, and tropical mixed broad-leaved forests by Hagen.[1] The vegetation of west Nepal is quite different from that of the east, a combined effect of such factors as rainfall, temperature, elevation, soil, etc. To cite one specific example: in western Nepal *sal* grows up to a height of mostly 914 m, rhododendron and oak occur mostly between 1,524 m-1,981 m. In eastern Nepal, on the other hand, in the districts of Morang and Jhapa where the rainfall exceeds 3,000 mm in a year, the altitudinal limit of *sal* is pushed up by 304 m or so. The forests in the western parts are of an open type, but both in the western and eastern and lowland forests *sal* is the dominant species and invariably associated with lateritic soils. It also grows well in sandy and gravelly soils of sub-Himalayan tract — the Bhabar. Other tree species found in the eastern Terai forest are: *Adina cordifolia, Terminalia belerica, T. paniculata, Careya pentagyna, Dillenia pentagyna, Holarrhena antidyssentrica, Eugenia operculata, Bombax malabaricum, Acacia catechu, Michelia champaca, Anogeissus latifolia,* and *Dalbergia latifolia.* In the Central Terai (Gandaki circle), *sal* is again the dominant species where it reaches a height of 21 m to 27 m. Some other important timber species besides *sal* of this part are: *Anogeissus latifolia, Dalbergia latifolia, Terminalia tomentosa,* and *Terminalia belerica. Shisham* (*Dalbergia sisso*) and *Khair* (*Acacia catechu*) are the common riverine species. The valley floor supports such timber trees as: *Lagerstroemia parviflora, Terminalia tomentosa, Terminalia belerica, Michelia champaca, Shorea robusta, Careya arborea, Dalbergia latifolia, Bombax malabaricum, Adina cardifolia, Hymenodictyon excelsum* and *Schlichera trijuga.* Bamboo and canes are also common.

In the temperate region, an area which consists principally of the Mahabharat range and inland valleys, the vegetation is clearly temperate and quite rich. Between 1,828 m to 3,048 m, it consists of mixed broad-leaved evergreen forests with oak, rhododendron, maple, myrsine, magnolia and laurel as the main tree components, often mixed with pine, fir, hemlock, cypresses and

1. Hagen, Toni. 1960. *Op. cit.* p. 48.

junipers. In the temperate parts, the commonest tree associates of *Kharsu* oak (*Quercus semecarpifolia*) are in east and central Nepal, *Rhododendron arboreum* and *Pieris ovalifolia*, while the ground vegetation is made of such plants as *Anemone, Androsace, Lilium, Gnaphalium, Erigeron, Primula, Iris*, etc. A small pink flowered *Daphne* (*D. papyracea*) along with *Mahonia* are two small but conspicuous plants in the *Rhododendron-Castanopsis* forest. At altitudes of more than 3,048 m, rhododendron, fir (*Abies*), birch (*Betula*), hemlock (*Tsuga*) are the commonest trees in east and central Nepal. At higher altitudes are found grassy meadows which are full of dwarf rhododendrons (*R. nivale*) and juniper (*J. communis*). Cushions of *Primula, Caragana, Artemisia, Potentilla, Gentiana, Arenaria, Pedicularis, Kabaschia*, etc. are common between 4,572 m and 5,029 m. Isolated plants occur between 5,029 m and 5,334 m, but beyond this the vegetation is sparse.

Tropical and sub-tropical parts of the country have a long hot and moist season. Precipitation, which is almost exclusively due to the south-west monsoon, falls during the months of June, July, August and September. In parts of Terai, especially in the districts of Jhapa and Morang, the monsoon forests have an understorey of tree and common ferns (*Cyathea, Marattia, Polystichium, Dryopteris, Athyrium, Pteris* (*P. cristata* and *P. longifolia*), *Lygodium* (*L. japonicum*), etc. On the tree trunks are found different forms of club mosses (*Lycopodium*) and orchids (*Coelogyne, Cymbidium, Bulbophyllum, Dendrobium, Rhynchostylis*, etc.).

Vegetation of the Mahabharat Range

The vegetation of the Mahabharat *Lekh* is mostly of temperate type. At altitudes between 1,219 m to 1,828 m, chirpine (*Pinus roxburghii*) is found along the inner rim of Mahabharat, but it is in isolated patches — stunted and not well formed. However, on the slopes, *P. wallichiana* is found as a climax forest. It grows upto a height of 2,590 m in west Nepal as against a maximum of 1,981 m in Central Nepal and 1,676 m in East Nepal.[1]

On the steep slopes. *Maesa macrophylla* (mostly scrub), *Quercus lamellosa, Q. dilatata, Q. incana, Acer campbellii, A. oblongum, Aesculus indicus, Myrsine semiserrata, Myrica nagi* and *Schima wallichii* — the latter is mainly an eastern species and confines itself below 1,524 m

1. Stainton, J. D. A. 1964. 'Notes on Journeys in East and Central Nepal'. (litho).

elevation — are common trees. At middle altitudes, i.e. between 1,828m and 3,657 m which is the main zone of broadleaved temperate forests in Nepal, *Quercus semecarpifolia*, *Quercus lamellosa*, *Quercus incana*, *Quercus glauca*, *Castanopsis* sp., *Symplocos sumuntia*, *Pyrus pashia*, *Salix tetrasperma*, *Magnolia campbellii*, *Cedrus deodara* (eastern limit Tibrikot, known range not beyond 83° E), *Magnolia campbellii* (westernmost known station at 83° 5′ latitude), *Picea morinda*, *Picea smithiana*, *Abies webbiana*, *Pinus excelsa* (*P. wallichiana*, *Pinus chylla*), *Cupressus torulosa*, *Tsuga dumosa*, *Rhododendron arboreum*, *Pieris ovalifolia* and *Lyonia ovalifolia* are some of the more common species. *Rhododendron* is mostly a northern temperate genus, the great majority of species are in that part where India, Burma, Tibet and China meet the country of the great river Ganges.[1] From Nepal Himalaya more than 30 species have been reported. A tree fern, *Alsophila*, is quite common between 1,828 m and 2,133 m in *Castanopsis-Schima* forest.

The shrubby vegetation is made up of such plants as *Berberis aristata*, *Berberis nepalensis*, *Daphne bholua*, *Mahonia nepalensis*, *Gaultheria fragrantissima*, *Spiraea vaccinifolia*, *Rubus paniculatus*, *Hypericum patulum*, *Craetegus crenulata*, *Maesa macrphylla*, *Lobelia seguinii* (*L. pyramidalis*), *Cammelia drupifera*, *Viburnum erubescens*, and *Rhus wallichii* and on the dry walls, *Lycopodium clavatum* and *Onychium seliculosum* are quite common. The family Melastomataceae is represented by *Melastoma normale*, *Osbeckia nepalensis*, *O. stellata* and *Oxyspora paniculata*. Epiphytes are the most conspicuous feature of temperate forests; a few examples are: *Peperomia reflexa*, *Hoya longifolia* and species of *Polypodium*, *Pteris*, *Stenoloma*, *Onychium*, *Oleandra*, *Hymenophyllum*, *Usnea*, etc.

In western Nepal in Chakhura lekh (altitude 4,572 m) 'the vegetation is made up of *Tsuga dumosa* forest and several shrubs, e.g. *Rhododendron barbatum*, *Viburnum erubescens* and *Daphne bholua* var. *gracillis*'.[2] Mixed vegetation is characteristic of this part of the country, the region of 'Blue Mountain' or Mahabharat. Spruce (*Picea smithiana*), pine (*Pinus chylla*), fir (*Abies spectabilis*), Cedar (*Cedrus deodara*), birch (*Betula utilis*), maple (*Acer campbellii*), cherry (*Prunus padus*), *Prunus rufa*, beam (*Sorbus cuspidata*), elm (*Ulmus wallichiana*) and alder (*Alnus nepalensis*) are some of the common trees. The shrubby vegetation is composed of

1. Good, Ronald. 1953. *Op. cit.* p. 152.
2. Stainton, J. D. A. 1963. *Op. cit.* p. 61.

Rhododendron arboreum, (an undershrub between 2,438 m to 3,657 m), *R. campanulatum*, *R. microphylla*, *R. Brunonii*, *Cornus capitata*, *Colquhounia coccinea*, and species of *Cotoneaster*, *Phidelphus*, *Rubus*, *Lonicera*, *Zanthoxylum*, *Euonymous*, *Elaeagnus*, etc. The herbaceous vegetation in this part is equally rich; a few examples are: *Rumex*, *Polygonum*, *Galium*, *Viola*, *Iris*, *Plantago*, *Cymbidium*, *Curcuma*, *Primula*, *Commelina*, *Potentilla*, *Ranunculus*, *Anemone*, *Oxalis*, *Gleichenia*, *Athyrium*, *Nephrolepis*, *Botrychium*, *Pteris* and *Adiantum*.

Orchids of the Kathmandu Valley[1]

In the woods around the Kathmandu Valley are found a number of orchids — both epiphytic and on the ground. In the Kharsu-rhododendron forest are found species of *Pleione* (*P. hookeriana*, which is white flowered, and *P. humilis*, which bears funnel shaped long pinkish flowers), *Vanda cristata*, a common species, which bears not so attractive flowers and two species of *Gastrochilus* — *Gastrochilus calceolaris*, (whose small flowers are borne at the base of the leaves) and *G. distichus*, (having a double row of smaller leaves on a slender stalk with only few flowers at the top) are also found here.

Of course, the most magnificent of the orchids of the Valley is *Dendrobium densiflorum*, the '*sun gava*' whose golden yellow flowers on crowded long stalks are seen hanging from *Chilawne* trees. It is a late spring flowering orchid. There are other species of the same: *Dendrobium moschatum*, *D. longicornu*, a common epiphytic species with long spurred flowers having an extended flowering period — from October to November, and *D. nobile*, a prized species but found mostly in East Nepal. Two species of *Coelogyne* are found in Godavari forest: *C. cristata* and *C. ochracea*, both epiphytic, bearing clusters of white flowers on bulbs. They flower in late summer and in the early rainy season. *Coelogyne ovalis* is an interesting species, for it bears flowers on the same stalk year after year. *Cymbidium* is a common epiphytic species. *Cymbidium elegans*, which flowers in late October bears pale white flowers in lax racemes. *Rhynchostylis retusa* is also epiphytic ; its pinkish white flowers are arranged in a raceme. It is seen flowering in late spring on *Celtis* trees in Kathmandu. There are a number of ground orchids: *Arundina graminifolia*, the bamboo orchid,

1. *Flora of Phulchoki and Godawari*, 1969. Department of Medicinal Plants, Ministry of Forests. HMG.

Gymnadenia orchidis, *Satyrium nepalense*, *Spiranthus sinensis*, *Calanthe tricarinata*, *C. plantaginea* and *C. masuca*, all of which are found growing in the shade of trees or underneath rock.

Of late, Banerji and Thapa[1] have published serially accounts of the orchids of Nepal. Their list 'primarily includes species collected by the authors' and 'supplemented by records made by other published works and unpublished data of information of Dr. G. A. C. Herklot', a person who is credited with making preliminary plans for the Royal Botanical Garden at Godavari.

Vegetation of Outer & Inner Himalayas, and of Tibetan Marginal Land

It is the region of sub-alpine and alpine zones. At higher altitudes water is by far the most limiting factor for the growth of plants. The annuals which flower during the short spell of warm weather in the spring are most important elements of the vegetation along with shrubs.

The steppes which provide rich pasture land between 3,657 m and 4,267 m, turn into veritable flower gardens in the spring. The villages lie at an altitude of around 3,657 m. Many of them are occupied only during summer as there is heavy snowfall during the winter months. These high altitude villages are known as '*kharkas*'. The highest settlement is at Dingboche, a village situated at an altitude of 4,267 m.

In northern Dolpo, which lies in the rainshadow of Dhaulagiri, *Carogana brevifolia*, and *Lonicera spinosa* are dominant shrubs at altitudes between 3,962 m and 4,876 m. The flora is made up of *Potentilla fructicosa*, *Lonicera myrtillus*, *Juniperus squamata*, *Bergenia purpurascenes*, *Pedicularis elwesii*, *Primula muscoides*, *Hippophae rhamnoides* and species of *Berberis*, *Spiraea* and *Salix*. The herbaceous vegetation of the steppes includes *Androsace sessiliflora*, *Incarvillea younghusbandii*, *Erysimum melicentae*, *Darba areades*, *Aphragmus oxycarous*, *Physochlaina praeglta*, *Nepeta leucophylla*, *N. calursclens*, *Scutellaria prostrata*, *Calopha nugena*, and species of *Anaphalis*, *Artemesia juncus*, *Potentilla*, *Viola*, etc. Above 4,876 m cushion plants are common. These include *Potentilla biflora var. lahulensis*, *Androsace sessiliflora*, *A. muscoidea*, *Arenaria polytrichoides*, *Tylacospermum rupifragum*, and several species of *Kabachia* and *Saxifraga*.

In the eastern Himalayas, distinct shrub zone — truly alpine in

1. Banerji, M. L. and Thapa, B. L. *Jour. Bomb. Nat. Hist. Soc.* 66, 67, etc.

nature — develops above the tree line. Shrubs such as *Rhododendron campanulatum*, *R. anthopogon*, *R. setosum*, and junipers occur up to 5,181 m. Beyond this is found a zone of cushion and prostrate plants which extends up to 5,791 m. Himalayan birch (*Betula utilis*) is always associated with *R. campanulatum* in this region.

The vegetation of the dry alpine zone is quite different from that of 'wet alpine zone' which gets a fair amount of rain as compared to the former. The average height of this dry alpine (arid) region is around 4,267 m. The vegetation is made up of shrubby and cushion plants, while trees are conspicuously lacking. In Central Nepal, however, occasionally poplar (*Populus ciliata*) along with birch (*Betula utilis*) are found in the dry alpine zone. Travellers in the Himalayas have found vegetation well beyond the snowline. Stainton[1] found 'rocks covered with big cushions some two feet in diameter with golden flowered *Potentilla biflora var. lahulensis*' at an altitude well beyond the snowline. Between 3,810 m and 4,876 m, such herbaceous plants as *Pedicularis*, *Aconitum*, *Thalictrum*, *Potentilla*, *Gentiana*, *Meconopsis*, *Primula*, *Saussurea*, *Lonicera*, *Arenaria*, and *Saxifraga* are very common. Some of the species occurring between 4,572 m and 6,096 m are : *Rhododendron setosum*, *Juniperus squamata*, *Ephedra gerardiana*, *Gentiana venusta*, *Primula sikkimensis*, *Meconopsis horridula*, and several kinds of lichens. In western Nepal (Jumla-Humla districts) near Mohala Bhanjyang (5,943 m), Polunin[2] reports the occurrence of *Lagotis glauca*, *Potentilla saundersiana var. Caespitosa*, *Pedicularis*, a root parasite and *Arenaria*. Both *Leontopodium* and *Arenaria* have been found at 6,096 m in the Everest region. Swan,[3] however, claims to have found an angiospermic plant *Stellaria decumbens*, growing at an altitude of 6,492 m, 'a new record for flowering plant anywhere in the world'. These altitudinal records, however, being based upon the Survey of India maps cannot be considered too reliable. To cite one example: while Polunin gives altitude of Mohala Bhanjyang as 5,943 m, Tucci[4] reads it only 5,029 m.

In Langtang two species of *Pedicularis* (*P. sculleyana* and *P. megalantha*) are found on turf — the former being borne in heads

1. Stainton, J. D. A. 1963. *Notes on a Journey in West Nepal*. p. 20.
2. Polunin, Nicholas. 1960. *Introduction to Plant Geography*.
3. Swan, L. 1961. *Ecology of the High Himalayas*. Scientific American.
4. Tucci, G. 1962. *The Discovery of Malla*, quoted by Stainton (1963).

30 cm high and 15 cm across. These semi-parasitic plants cannot be cultivated without their hosts.

Timber Line in the Himalayas

In the Himalayas timber line varies from east to west; it rises considerably higher in the east than in the west. The snowline moves between 3,657m and 5,486 m, a condition much influenced by local climatic conditions. According to Swan and Leviton[1] 'the tree line in eastern Nepal reaches a maximum altitude of 4,114 m'. In central Himalayas, however, it varies between 3,048 m and 3,962 m. In the western Himalayas upper limit of timber line is generally around 3,048 m, but in the Jumla-Humla district, trees have been found growing at an altitude of 4,267 m.[2] *Rhododendron anthopogon*, a dwarf species, and *R. barbatum*, are common between 2,743 m to 3,657 m and Kharsu oak grows upto about 3,657 m. In the rainshadow of Dhaulagiri — the hillsides are covered with *Juniperus squamata*, *Caragana brevifolia* and *Lonicera rupicola*.

The snowline and its approximate equivalent, the plant line, rises in altitude from polar regions towards the equator. Latitude is not the only factor that limits the growth of plants. At high altitudes water limits the growth of plants more than anything else.

Plant Succession

Succession of vegetation at 4,572 m in the east Himalayas has thus been described by Swan[3]: Flowers may be found in bloom between the first week of April and the end of October, a period of about 200 days. Small gentians start the parade of flowers followed by primulas; then fields of polygonum precede the flowers of dwarf rhododendrons. New groups of flowers succeed each other throughout the monsoon months. Summer primulas and flowers of other moisture loving plants bloom and disappear before September, only to be followed by a new burst of flowers in the October sun. Gentians of different species again lead this shorter annual, and on the edge of the winter, in late October, flowers such as those of *Allardia glabra* are still fresh and attractive to insects. Above 6,096 m flowers of *Parrya lanuginosa*, *Pegaeophyton scapiflorum*, and *Gentiana urnula* bloom by May 27;

1. Swan, L. and Leviton, A. 1962. *Op. cit.* p. 131.
2. Stainton, J. D. A. 1963. *Op. cit.* p. 20.
3. Swan, L. 1963. *Op. cit.* p. 23.

on October 17, the umbeles of *Selinum cortioides*, and the blue spurred flowers of *Delphinium brunonianum* are still intact at 5,486 m.

Forest Types

The forests of Nepal have been dealt with extensively by Stainton from the standpoint of type, species composition and distribution.

Stainton's Climatic and Vegetational Divisions of Nepal[1]

I. Terai, bhabar, dun valleys and outer foothills,
II. The Midlands and the southern slopes of the main Himalayan ranges which lie north of them,
III. The West Midlands,
IV. The East Midlands,
V. The Central Midlands,
VI. Country to the South of Annapurna and Himal Chuli,
VII. Dry River Valleys,
VIII. The Arid Zone.

Stainton's Forest Types in some respects follow Champion's Classification, but are otherwise based on his own knowledge of the forest vegetation of Nepal. His Forest Types are:

Tropical and Sub-tropical
sal forest
Tropical Deciduous riverain forest
Tropical evergreen forest
Sub-tropical evergreen forest
Terminalia forest
Dalbergia sisso-Acacia catechu forest
Sub-tropical deciduous hill forest
Schima-Castanopsis forest
Sub-tropical semi-evergreen hill forest
Pinus roxburghii forest
Temperate and Alpine Broadleaved forest
Quercus incana-Quercus lanuginosa forest
Quercus dilatata forest
Quercus semecarpifolia forest
Castanopsis tribuloides-Castanopsis hystrix forest

1. Stainton, J. D. A. 1972. *Op. cit.* p. 57.

Quercus lemellosa forest
Lithocarpus pachyphylla forest
Aesculus-Juglans-Acer forest

Lower temperate mixed broadleaved forest
Upper temperate mixed broadleaved forest
Rhododendron forest
Betula utilis forest

Temperate and Alpine conifer
Abies spectabilis
Tsuga dumosa
Pinus excelsa
Pinus smithiana
Abies pindrow
Cedrus deodara
Cupressus torulosa
Larix forest

Minor Temperate Alpine Associations
Alnus woods
Populus ciliata
Hippophae scrub

Moist Alpine scrub

Dry Alpine scrub
Juniperus wallichiana

Distribution of Forest

The Central Midland forests show little or no resemblance with the west Midland forests, which show similarity with those of Kumaon. The east Midland forest, on the other hand, resembles that of Sikkim.[1] The Sikkimese elements, however, fall rapidly between Arun and Dudhkosi. 'The meeting of these different types of forest on the Central Midlands is complicated by the fact that the Pokhara area is exceptionally wet, but ignoring this point for the moment one can say that in most parts of the Central Midlands, the Western forest types are usually present on the south faces and the eastern forest types on the north faces.'

1. Stainton, J. D. A. 1972. *Op. cit.* p. 29

Nagarjun Forest

This forest forming the north-west boundary of the Kathmandu Valley has four forest types[1]:

Schima wallichii forest
Dry oak forest
Mixed Broadleaved forest
Chirpine forest

Schima wallichii covers most part of the hill, while mixed broad-leaved forest is found in the north facing slopes.

Dry oak forest is found on the southern or western slopes near the ridge in higher places. Pine forests occupy the drier southern slopes of the hill.

In the *Schima wallichii* forest, the shrub layer is made up of *Machilus dutheii, Phoebe lanceolata, Quercus spicata,* etc. In humid places *Juglans regia* is found. *Myrsine semiserrata* is frequently seen in shrub layers. Both *Rhododendron arboreum* and *Castanopsis indica* are found in this type of forest. Other shrubby vegetation is made up of: *Carex longipes, Capillipedium assimile, Elatostema sessilifolia, Litsea pulcherrima, Daphne bholua, Ligustrum nepalense* and *Mahonia napanlensis.*

In the Dry oak forest, the herbaceous flora is composed of *Strobilanthes atropurpureans, Youngia japonica, Carex longipes, Smilax aspera, Athyrium macrocarpum, Dryopteris sparsa, Onychium lucidum, Polystichum aculeatum, P. quadriaurita, Seleginella biformis, Gentiana capitata, Galium asperifolium,* etc.

Rhododendrons

In Nepal, a total of 34 species of rhododendrons are found. The centre of dispersion lies in the mountains of South-China and the number decreases as one goes west. In Sikkim, there are 84 species. Of the 34 species in Nepal, 5 are in the west Himalayas, i.e. *R. arboreum, R. barbatum, R. campanulatum, R. lepidotum,* and *R. anthopogon.* Numerous arborescent rhododendrons replace fir in the lower sub-alpine level of Eastern Nepal, one of the most common being *R. hodgsonii,* which is found growing in podzolic soil.

1. Kanai, Hiroo and Sakya, Puspa Ratna. 1973. *Vegetationa' Survey of Nagarjun Forest. In Flora of Nagarjun.* Depart. Medicinal Plants, Ministry of Forests, HMG.

R. dalhousiae is an epiphytic species. In the Trans-Himalayan Valleys, such as Langtang, the most common species are *Rhododendron setosum*, *R. anthopogon*, both dwarf. *R. nivale* at about 4,572 m is the species which grows in morainic valleys. It is the upper limit for any rhododendron. Occasionally, a few firs become mixed with maples and rhododendrons.

Forest Distribution

The Terai forests are economically more important than the hill forests as the former are more easily accessible. The commercial forests of Terai have been differentiated into: (*a*) *sal* forest ; (*b*) Terai Hardwood and *Khair—Sisso*.[1]

The annual floods which bring boulders, sand and silt in the Terai, while destroying some forests, also create conditions for the establishment of others. *Khair* and *Sisso* establish themselves principally in such a habitat of fresh silt.

Forests of Terai, as elsewhere, are conditioned by such ecological factors as rainfall, temperature, slope, exposure, soil and drainage. In the *Churiya* hills mainly dry type of forests — *chir* pine and *sal* are found, while in the recently formed alluvium, deciduous riverain forests are found. In Nepal, according to Stainton, 'true Tropical evergreen forests are rather rare and these are confined to moist situations'.[2]

The Terai forests and adjoining areas were surveyed in 1964, on the basis of which 3.1 million hectares of land was estimated to be under forests. The land use categorization was estimated as follows:

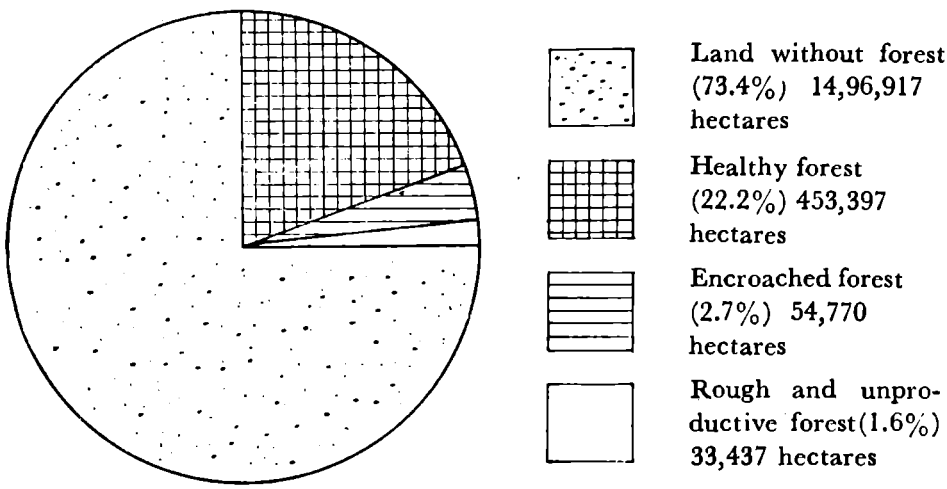
TABLE 16

Land Use Class	*Per cent*
Commercial forest	39.5
Non-commercial forest	13.1
Cropland	38.9
Water	4.7
Grassland	2.7
Other	1.1
Total	100.00

1. Forest Statistics for the Terai and Adjoining Regions 1967. Forest Resources Survey, Ministry of Forests.

2. Stainton, J. D. A. 1972. *Op. cit.*

This picture has undergone much change in the last decade as a result of wide-scale forest encroachment. A recent study (June-July 1974) carried out by the Forest Resources Survey on the basis of satellite pictures available showed that the area under forest has now shrunk to 26.6 per cent as against almost 40 per cent ten years ago.[1]



Land Use in Terai and Bhabar.

Source : Forest Resources Survey.

TABLE 17

TERAI AND BHABAR LAND USE

(*in hectares*)

	Forest	*Rugged Forest*	*Encroached Forest*	*Non-forest*	*Total*
Total	453,397	33,437	54,770	1,496,917	2,038,521
Per cent	22.2	1.6	2.7	73.4	99.9

Shrinkage of Forest Cover

According to the statistics which are now 10 years old, forest coverage is lowest in the eastern part of the Terai (32.5 per cent) (Biratnagar Division) and increasing towards west (75.4 per cent) in Dang.

In Terai proper, less than 3 per cent of the land is now under forest and this is also shrinking. More than two centuries ago,

1. Bhatt, Dibya Deo. 1975. 'Nepal Ka Jangal,' (Forests of Nepal). *Swatantra Biswa.*

Father Marc had to walk for three days through extensive grasslands before he entered forest at Parsa. In 1907, when J. H. Burkill visited Kathmandu he found no change in the situation, but now it has altered beyond recognition.

Due to enormous population pressure, loss in productivity of land, soil erosion and poor management, the hill sides between 1,300 and 2,600 m have practically been denuded of forests. What remains is only a scrub forest, which never gets a chance to regenerate as the trees are heavily lopped for fodder. In the hills, in place of forest one finds only thorny bushes of *Berberis*, *Cotoneaster*, *Ribes*, etc. Man, in his search for a *niche*, has come to occupy habitats which he never dared to tread before.

The eradication of malaria — largely due to extensive use of DDT, a product which has been banned in several countries — encouraged migration of the hill people to the forested parts of the Terai and inner Terai. The unprecedented floods of 1954 were the starting point for wide-scale resettlement of the hill people in the Rapti Valley. This set in motion process of destruction of forests and its wildlife. Natural ecosystems have given way to man-made ecosystems and in this struggle between man and nature, though man triumphs, his victory is short lived; for, in several parts malaria has already staged a come-back and productivity is on the decline.

One has to visit these encroached forests to appreciate the magnitude of the problem. There is something primeval about the process, a few lianas are removed with a *khukri*, the ground is scraped and seeds broadcast. For shelter the immigrants have an easy access to timber, bush and straw. Deer that come to nibble the emerging seedlings are done to death — usually in a trap. The area under occupation by each household looks bigger at each visit.

Hill Forests

The hill region, for the sake of the forest statistics, comprises 'the Mahabharat Range, the Midland Zone which includes areas between the Mahabharat and the Himalayas proper, the Himalayas and the Inner Himalayan Valleys'.[1]

According to the information based upon the data collected in 1963-64, 'the total area under hill forest is 8.8 million acres',

1. Forest Statistics of Hill Region. Forest Resources Survey. 1973.

and from the standpoint of land use, '27 per cent of the land is crop-land and 58 per cent is forest', and 'only 34 per cent is commercial forest'. Adverse topography, poor soil, severe climate or steep slopes over 100 per cent have precluded utilization of all the available forest resources in the hilly region of the country. The main forests found in the hills are: *sal*, Terai Hardwood, Lower Mixed-Hardwood, *Chir* pine, Upper Mixed Hardwood, Blue pine, oak, fir, hemlock, etc. Other important trees of the hill forest are: *champ* (*Michelia champaca*), walnut, chestnut, maple, magnolia, etc.

The forests coverage varies from 54.7 per cent in the Eastern Zone to 60.2 per cent in the Central Zone. Crop land is 14.1 per cent in the west and 36.2 per cent in the east. In the Western Zone 17.8 per cent of its land is under grass which is more than under agriculture (14.2 per cent); in the Central and Eastern Zones, grass occupies 5.1 per cent and 5.5 per cent respectively. The Eastern Zone has the highest percentage under crop (36.2 per cent), as compared to the Central Zone (30.3 per cent).

The percentage of commercially exploitable forests in the three zones is more or less the same, varying from 33.8 per cent in the Central to 35.3 per cent in the Western Zone.

Nearly a third of the coniferous forests in the west are those of *chir* pine — 'covering 149000 hectares of commercial forest land constituting 32.6 per cent, and this is the largest area covered by an individual forest type in all the three zones'.

Next is oak, which covers 14.1 per cent of the total forest. Hemlock, which occupies 1.8 per cent of the total forest area, is mostly found in the Eastern zone.

Species Association

In the lower slopes mixed hardwoods comprise 21.50 per cent of the total. *Chir* pine and *sal* are common associates, especially on the southern slopes of the Churiya range, while at higher altitudes fir is associated with oak and birch. Hemlock is associated with both oak and conifer. The hardwood species found in the hill region are: *Karma* (*Adina cordifolia*), *Tooni* (*Cedrela toona*), *Champ* (*Michelia champaca*), *utis* (*Alnus nepalensis*), *Okhar* (*Juglans regia*), *Sisoo* (*Dalbergia sisoo*), *Gamhari* (*Gmelina arborea*), *Kimu* (*Murus alba*), *Tikul* or *Phaldu* (*Mitragyna parviflora*), *Bahera* (*Terminalia belerica*),

Siris (*Albizzia sp.*), *Banjhi* (*Anogeissus latifolia*), *Katus* (*Castanopsis sp.*), *Jamun* (*Syzygium cumini*), *Bot dhairo* (*Lagerstroemia parviflora*), *Chilawne* (*Schima wallichii*), *Kusum* (*Schlishera trijuga*), *Maple* (*Acer sp.*), *Kharsu* (*Quercus semecarpifolia*), *Banjh* (*Quercus sp.*), etc.

Phyto-geographic Regions of Nepal

'Nepal is a meeting place of the eastern and the western Himalayan flora.'[1] It lies at the cross-road of South-East Asian, Mediterranean, Chinese and Japanese faunal and floristic elements. Hooker[2] divided the Himalayas into eastern and western phyto-geographic regions. His western region covered the regions from Chitral to Kumaon and eastern region from Sikkim in the east to Mishmi hill in Upper Assam. Hooker's contention of regarding the whole of Nepal as one phyto-geographical unit is no longer tenable. Chatterjee[3] has divided the entire Himalayan region from Burma to Afghanistan into three distinct floristic zones. He divides Nepal into two distinct zones, i.e. the central and eastern Himalayan zones and the third zone is what roughly comprises the western Himalayas. On the basis of the information now available, it is more accurate to divide Nepal into three phyto-geographical zones rather than into only one or two Himalayan botanical provinces as Hooker or Chatterjee has suggested. Each of these three zones are more or less delimited by distinct watersheds:

1. Eastern Zone — Mechi river in the east to Arun river in the west. Annual rainfall 1,270 mm to 2,032 mm or more.
2. Central Zone — Arun river in the east to Gandaki river in the west. Annual rainfall 1,270 mm to 2,032 mm.
3. Western Zone — Mahakali river in the west to Gandaki. Annual rainfall 762 mm to 1,270 mm.

The above boundaries are somewhat arbitrary, as both horizontally and longitudinally transition zones occur. In the

1. Stearn, W. T. 1960. *Allium and Milula in Central and Eastern Himalaya.* Bull. Brit. Mus. Bot. 2 : 161-191. p. 11.

2. Hooker, J. D. 1894. *A Sketch of the Flora of British India.*

3. Chatterjee, D. 1962. *Floristic Pattern of Indian Vegetation.* In Proc. of the Summer School of Botany. Darjeeling. ICAR, Govt. of India. Maheswari, Johri and Vasil. Ed. pp. 32-42.

Kathmandu Valley which lies in the Central zone, of about hundred families that have been recorded by the author, all are represented in the eastern and western zones also. Some species that are common to Baitadi (western zone) and Kathmandu (central zone) are: *Buddleia asiatica, Clematis buchananiana, Clerodendron infortunatum, Daphne cannabina, Drynaria cordata, Euphorbia geniculata, Gnaphalium leutoalbum, Hypericum patulum, Micromeria biflora, Justicia simplex, Rhododendron arboreum, Quercus glauca, Myrica esculenta* and species of *Viscum, Osbeckia, Smilax* and *Rhus*. Burkill[1] reported the presence of 28 east Himalayan and 4 west Himalayan species in the Kathmandu Valley. The differences in the flora on the two sides of the Kali Gandaki are striking, the river acting as a barrier to a certain extent between the eastern and western elements of the Himalayan flora.[2]

In east Nepal, i.e. east of Kathmandu, according to Banerji,[3] ninety per cent of the species are clearly east Himalayan elements. There are, however, central Himalayan elements also in this region, a few examples of which are: *Braya alpina, Stellaria webbiana, Rhus wallichii, Cynanthus microphylla, Campanula sylvatica, Anagallis arvensis, Pilea umbrosa*, etc. Similarly east Himalayan plants are also represented in west Nepal. Some common plants of these two zones, i.e. eastern and central zones are: *Meconopsis nepalensis, Viola distan, Kydia glabrescens, Eriobotrya elliptica, Prunus rufa, Homalium nepalensis, Symplocos thaeflolia, Clerodendron colebrokiana, Veronica klozii, Daphne cannabina, Micromeria biflora* and *Dioscorea sikkimensis*. Again, taking a specific example of *Pedicularis*, of which 19 species are present throughout the Himalayas, '6 are confined to Nepal and 7 enter Nepal from west and go all the way to Bhutan'.[4] In the central zone, the following species constitute the eastern elements: *Schima wallichii, Euonymus vagans, Begonia laciniata, Luculia gratissima, Senecio densiflorum, Senecio vagans, Pratia begonifolia, Gaultheria fragrantissima, Myrsine semiserrata, Symplocos thaefolia, Leucas ciliata, Loranthus ligustrina, Loranthus odoratus*, etc. From his study of the genus *Allium*, Stearn arrives at the conclusion that 'the flora of Bhutan is closely linked to and partly conspecific with the flora of western China

1. Burkill, I. H. 1904. *Notes from a Journey to Nepal.* Rec. Bot. Soc. India 4 : 59-140.

2. Sykes, W. 1954. 'Expedition to Nepal.' *Journ. Royal* Hort. Soc. p. 6.

3. Banerji, M. L. 1963. *Outline of Nepal Phytogeographic Vegetation.* p. 2.

4. *Ibid.* p. 3.

and that Nepal is a meeting place of the eastern and western Himalayan floras as regards the high mountain humid areas and an extension of Tibet as regards high mountain arid zone, rather than a floristic province in its own right'.[1]

Some species are, however, restricted in their distribution; while the westernmost limit of distribution of *Allium sikkimense* and *Magnolia campbelli* is the Karnali river, *Cedrus deodara* is not found beyond 50° longitude and therefore, is mainly a western species. Similarly *Magnolia campbelli* and *Primula sikkimensis* both are east Himalayan elements but their westward distribution extends to Kali Gandaki and Karnali rivers.

In the Himalayas, according to Puri,[2] 'only 28.8 per cent of the flora is endemic, as against 50 per cent for the whole country (India) which is not surprising, considering the position of this region as the meeting ground for the Indo-Malaysian, Chinese and Mediterranean floristic elements'.

The flora of the inner valleys of the high Himalayas, viz. Langtang, Rolwaling, Khumbu, Barun, etc. shows similarity with the dry flora of Tibet.[3] In the Rolwaling valley, while the southern side of the main range is covered with broad-leaved temperate forest, the northern side has only scrubby and cushion vegetation. The timber line is around 4,267 m. The moraines support such vegetation as *Rhododendron setosum, Lonicera myrtillus, L. obovata, Potentilla fructicoso, Juniperus indica, Ephedra gerardiana* and species of *Salix, Cotoneaster, Primula,* and *Androsace.* Stainton, on the basis of his numerous field trips in the east as well as in central Nepal, has expressed this opinion: 'the country west of Dudh Kosi differed very little from that part of central Nepal which I visited in 1964' and 'as one goes east of Dudh Kosi one meets with increasing number of ericaceous species particularly rhododendron often to the exclusion of *Abies* and *Betula*'.[4] According to him, 'Sikkimese element in the flora falls very rapidly between the Arun and Dudh Kosi. If there be any good grounds for dividing the eastern half of Nepal into botanical regions a line drawn here would probably fit the facts of plant distribution better than any other'.[5]

1. Stearn, W. 1960. *Op. cit.* p. 12.
2. Puri, V. 1959. *Forest Ecology.* Vol. I, p. 38.
3. Stainton, J. D. A. 1964. *Op. cit.* p. 27.
4. Stainton, J. D. A. 1964, *Op. cit.* p. 26.
5. *Ibid.* p. 26.

Stainton (1972) has summarized the phyto-geographical complexities in Nepal thus:

1. The East Himalayan element is dominant in the flora as a whole, which becomes reduced as one travels westward through Nepal.
2. Locally, endemic species of trees and shrubs are not an important element in the flora.
3. The Tibetan element is dominant in the flora of some dry areas along the Tibetan border.
4. Some of the temperate species which occur in Nepal also occur in areas of high rainfall in the hills of South India, although they are absent from the intervening parts of North and Central India.
5. The West Himalayan element is strongly represented in the flora of Western half of Nepal particularly in the Jumla area and some of the inner valleys.

One significant fact which Stainton points out is that 'certain species which disappear in East Nepal and Sikkim reappear again further east'. He seeks to provide 'plausible' explanation: 'Pairs of species in the west and east, such as *Deutzia hookeriana* and *Deutzia corymbosa*, *Abies pindrow*, *Abies spectabilis*, *Picea smithiana*, *Picea spinulosa*, each of which is closely allied to the other, must have evolved from a common stock, and that even though some of these paired species now overlap in range each separate half must have evolved on separate lines at a time when they were geographically separate.'

Dobremez[1] who has studied the ecology and phyto-geography of Nepal — particularly of the Central Midlands in the region of Annapurna and Dhaulagiri, divides the tropical zones into hilly and mountainous region, but tropical elements regularly penetrate into the hilly region. 'Hygrophilous species are present on the slopes well protected from the sun and at the bottom of the valleys where monsoon rains are concentrated. *Quercus semecarpifolia* is a species which is not favoured by situation.'

1. Dobremez, Jean Francois. 1972. *Mise au point d'une méthode Cartographique d'étude des montagnes tropicales Le Nepal, ecologie et phytogeographie. These.* p. 373.

Chapter VI

Forest Products

The Nepalese economy being based primarily upon agriculture, the bulk of export commodities are agricultural and forest products. Forests are one of the biggest resources of the country; in 1969-70, the country earned a revenue of Rs. 16.4 million from forest products. Though nearly a quarter of the country is estimated to be under forest cover, in the absence of an accurate inventory, transport system, technical know-how and capital, Nepal has been unable to derive much benefit from her large forest resources (*see* Table 18, p. 64).

In contrast to this, only half of Sweden is covered by forest, which is less than 9 per cent of the world forest resource, but a good transportation system and better management has helped this country to capture 9 per cent of the world timber and 20 per cent of the total wood pulp exports.

Revenue through annual auction of timber still continues to be an important source of the country's income.[1] The system of selling timber to foreign contractors was first initiated during the reign of Rana Prime Minister Chandra Shamsher. Mr. Collier who came in 1923 to Nepal as an adviser recommended the bulk removal of *sal* (*Shorea robusta*) from the virgin forests of Morang in the east and Kailali-Kanchanpur in the west. This brought tremendous wealth to the Rana rulers but it also paved the way for reckless destruction of forests in Nepal. The country has now been left with a situation where the forests of the

1. More recently, the state owned Timber Corporation has gone into operation in selected parts.

more accessible parts have been over-exploited, especially those in the Terai belt where easy transportation helps removal of timber across the border to India. The practice of timber sale through public auctions is being gradually discontinued and now there is some degree of control over the activities of the contractors. At the same time, an improved method of selection of lots for auction is now employed. With the completion of forest resources survey of the Terai and the hills, a true picture of the forests of the country is available. About two dozen or so species are of importance as timber trees. These are mostly found in the Terai and Bhabar forests. The hill forests are in most part left unexploited because of their inaccessibility. Some of the more important timber species of Nepal are: *Shorea robusta, Michelia champaca, Adina cordifolia, Dalbergia sisoo, D. latifolia, Pinus roxburghii, Cedrus deodara, Terminalia tomentosa, Anogeissus latifolia, Dillenia pentagyna, Cedrela toona, Ternstroemia japonica, Dipterocarpus alatus, Alnus nepalensis, Careya arborea, Lagerstroemia parviflora, Juglans regia, Albizzia lebbek, Bombax malabaricum* and *Hymenodyctyon excelsum.*

Except for the match industry, which utilizes *semal* (*Bombax malabaricum*) for making match sticks and bamboo, which is used to weave mats, basket blinds and furniture, until few years ago there was no forest industry worth the name in the country. One forest industry, however, resin and turpentine, was established in West Nepal (Baitadi). Terai and Bhabar abound in raw materials for the paper and pulp industry. Every year vast quantities of bamboo (*Dedrocalamus strictus*), *sabai* grass (*Eulaliopsis binata*) and *semul* (*Bombax malabaricum*) are exported to India from the districts of Banke, Bardia, Kapilvastu and Lumbini as there is no paper industry within the country to utilize these raw materials. Palm and *tendu* leaves are exported from Terai to India. On the slopes of Churiya and spurs of the Mahabharat there are still vast tracts covered with *chir* pine (*Pinus roxburghii*), which can be utilized for resin tapping. Pine and fir which are much used in other parts of the world to make pulp and paper remain unutilized in Nepal for this purpose. There is very little use of pine for making furniture though this is the most suitable wood for making cabinets and planking.

A plywood factory has been established at Butwal recently, and strawboard from rice straw is manufactured at Biratnagar. Cane and bamboo furniture is made at Balaju, Biratnagar, Nepalganj, etc.

TABLE 18

REVENUE FROM FOREST PRODUCTS

(*in rupees thousand*)

Item	*1966-67*	*1968-69*	*1969-70*
Timber	14,460	16,494	7,778
Log Sales	5,733	4,872	2,599
Royalty Sales	6,042	10,692	3,823
Privilege Sales	2,685	930	1,823
Other	954	3,759	8,610
Fuel wood	249	571	316
Minor Forest	249	225	272
Grazing	19	239	61
Hunting	6	146	15
Miscellaneous	431	2,578	7,846
Grand Total	15,414	20,253	16,388

Source : Department of Forest, H. M. G.

Paper and Pulp

Nepali paper is made out of the bark of the paper tree *Daphne bholua* (*D. cannabina*). Often it is mixed with the bark of *Edgeworthia* and *Wickstroemia*. The bark is boiled with ash (now replaced by caustic soda), pulped and spread over cloth frames. The bark is removed every two or three years and there seems to be fair amount of regeneration. The main centres for production of local paper are: Baglung, Helumbu and Phalindi (*Doti*). It is essentially a cottage industry, though two factories have been established in Kathmandu and Baglung for large-scale production of paper. There is good demand for this paper, which is still used for keeping official records and printing greeting cards or for horoscopes. It is quite durable and resists attack by insects, but once wet, there is no way to retrieve it — it becomes a pulpy mass.

Saw Mills

All but five of the saw mills in the country are located in the Terai. In the hilly region saw mills have been started at Dhankuta, Bhojpur, Trisuli, and Pokhara. In the Terai they are located at Biratnagar, Birgunj, Bhairawa, Bhadrapur, Butwal, Dharan, Chitwan, Bankey, Kailali, Kanchanpur, Janakpur, Nepalgunj,

Rajbiraj and Jhapa. Many of these mills are rice, oil, flour-cum-saw mills, and quite a few remain idle for long or short periods. The total production capacity of all the saw mills in the country is 1,390,000 cu ft. The Timber Corporation of Nepal has installed a new plant at Hetauda at a cost of Rs. 48 lakhs with a production capacity of 750,000 cu ft of sawn timber. It is thus the biggest saw mill in the country. None of the mills possess seasoning plants, though a parqueting company at Hetauda has a small plant.

Besides, there are two *Katha* (Cutch) mills, at Nepalgunj and Birgunj, and two camphor mills, at Biratnagar and Kathmandu. Match factories are located at Biratnagar, Birgunj, Pokhara, Nepalgunj and Janakpur. Bees wax, honey and *tendu* leaves, which are used for wrapping *biri*, are all forest products. *Sabai* grass, *pipla* and *Chandmaruwa* are forest products, which are exported to India.

Herbs — Drugs

Nepal is well known for medicinal herbs. These are found in the tropical, sub-tropical as well as in the temperate and alpine regions of the country. Some plants which are of medicinal importance and grow between 1,219 m and 3,048 m are: *Delphinium denudatum* (*D. glaciale*, grows at a height of 17,000 ft, and has a smell resembling that of musk deer), *Curculigo orchioides*, *Iris nepalensis*, *Bryonia laciniosa*, *Artemisia vulgaris*, *Asparagus racemosus*, *Aconitum ferox*, *Aconitum palmatum*, *Achyranthes aspera*, *Hydrocotyl rotundifolia*, *Valeriana wallichii*, *Orchis incarnata*, *Podophyllum emodi*, *Picrorrhiza kurrua*, *Potentilla fulgens*, *Potentilla kleiniana*, *Thalictrum foliolosum*, *Bergenia ligulata* (*Saxifraga ligulata*), *Swertia chirata*, *Rubia cordifolia*, etc. In the warmer parts of the country are found such medicinally important plants as *Rauwolfia serpentina*, *Terminalia belerica*, *Terminalia chebura*, *Acacia catechu*, *Acacia arabica*, *Holarrhina antidysenterica*, etc. Efforts to cultivate and market crude drugs were first made in the year 1935. Herbal farms were set up in Manichur and Shivapuri, both in the periphery of the Kathmandu Valley.

The Depatment of Medicinal Plants of His Majesty's Government was first headed by Mr. K. N. Sharma. He made a survey for plants of medicinal value, and collected specimens from such places as Rasuwa and Jumla. In the Terai and foot hill region *Rauwolfia serpentina* (*Chandmarawa*), a drug now widely used

to treat patients with high blood pressure and hypertension, grows wild. Private traders have been exporting this plant for a long time — mostly to India. The Department of Medicinal Plants of the H. M. G. has established new farms in Dharan, Hetauda, Tarahari and Nafajgarh for large-scale cultivation of *Rauwolfia* and *Mentha*. Plants yielding alkaloids, such as *Aconitum*, *Digitalis* and *Datura* are now being cultivated in farms at Daman, Manichur and Shivapuri. There is much demand for *Lycopodium* powder, *Valeriana*, *Orchis*, and *Pycrorrhiza* all over the world. In the Nepal Himalayas, plants of medicinal value show a high degree of polyploidy. Cold climate favours the formation of polyploids. Plants such as *Acorus*, *Ephedra* and *Dryopteris* are adapted to grow in the warmer as well as in the colder regions, but it is often seen that only those that grow in the colder region contain a larger amount of the active ingredient. It has also been established that the total alkaloid content of medicinal plants is higher in the Nepalese plants than elsewhere. The full potential of the medicinal plants and of herbs and crude drugs has not yet been realized. Pyrethrum can be locally used for the manufacture of mosquito coils; it would have a good market both inside and outside the country. A systematic survey of the plants is under way which will bring into light new plants of medicinal or economic value and it will also contribute, in general, to the understanding of the flora of Nepal. The Royal Drug Company, a public undertaking, has started marketing pharmaceutical products, utilizing to a limited extent indigenous products.

For many people living in the hills, collection and marketing of herbs provides an important means of livelihood. Except for such plants as pyrethrum, digitalis, belladonna, and aconite which are being grown on a commercial scale in the Herbal farms, collection, processing, and marketing of herbs is in the hands of individuals. In the dry trans-Himalayan region many plants of medicinal value grow. These are brought into Nepal by the Tibetan as well as Nepalese traders and exported mainly to India. Nepalese herbs also find their way to such international markets as Singapore, Hongkong, Japan, USA, and several countries in Europe.

Nepalganj is one of the biggest centres of trade in medicinal plants. On the basis of one survey, the source, type and volume of medicinal plants were compiled which have been shown in

Table 19 (*see* p. 68). From the far western part of the country, a good amount of medicinal plants is exported from Marma and Duhunu. Most important of these are: *Orchis, Pycrorrhiza, Aconitum, Swertia, Cinnamonum, Rubia cordifolia,* etc. According to one source, in Baitadi as also in Darchula, there are enough possibilities for making paper from *Daphne cannabina,* and in the past one such factory was established at Jhulaghat.

TABLE 19

SOURCE AND APPROXIMATE VOLUME OF EXPORT OF MEDICINAL DRUGS THROUGH NEPALGANJ[1]

Vernacular Name	*Scientific Name*	*Source*	*Average Annual Export*	*Tonnes*
Jatamansi	*Nardostachys jatamansi*	Jumla Tibrikot	250-500 mds	9.25-18.50
Pipla	*Piper longum*	Banke-Bardiya	100-125 mds	3.70-4.65
Rohini	*Mallotus philippinensis*	,,	20-30 mds	0.74-1.10
Daruhaldi	*Berberis nepalensis*	Sallyan	?	
Sugandhwal	*Veleriana wallichii*	Jumla, Sallyan, Dailekh	200-300 mds	7.40-11.10
Kaphal (bark)	*Myrica nagi*	,,	,,	,,
Bojho	*Acorus calamus*	Dailekh, Surkhet	100-200 mds	3.70-7.40
Satawari	*Asparagus racemosus*	Sallyan, Dailekh	100-500 mds	3.70-18.50
Dalchini	*Cinnamomum tamala* (Bark)	Sallyan, Dailekh, Surkhet	200-400 mds	7.40-14.80
Tejpat	,, (Leaves)	,,	,,	,,
Timmur	*Zanthoxylum alatum*	Banke, Dang	800-1000 mds	29.60-37.00
Sarpagandha	*Rawwolfia serpentina*	,,	2-4 mds	.07-.15
Pakhanved	*Saxifraga ligulata*	Banke, Sallyan Dailekh	400-500 mds	14.80-18.50

Padamchal	*Rheum emodi* (Root, petiole)	Dailekh, Piuthan, Jajarkot, Jumla,	100-200 mds	3.70-7.40
		Musikot	100-125 mds	3.70-4.65
Atis	*Aconitum heterophyllum*	Humla	50-100 mds	1.85-3.70
,,	,,	Timurkot	,,	,,
Rajbriksha	*Cassia fistula*	Banke, Bardiya	?	
Panch anwle	*Orchis incarnata*	Jumla	5-10 mds	.18-.37
Manjetha	*Rubia cordifolia*	Sallyan, Dailekh	10-20 mds	.37-.74
Kutki	*Pierorhiza kurroo*	Jumla	300-500 mds	11.10-18.50

1. The above data were supplied by the firm of Sita.Ram, Radha Krishna, the biggest dealers in the medicinal herbs and drugs in Nepalganj.

Chapter VII

Wildlife

Wildlife in Nepal is both very varied and fascinating. The first person to bring this very rich wildlife of this country to the notice of the scientific community was Sir Brian Hodgson, the British Resident in Kathmandu during the years 1820 to 1822, and again, from 1824 to 1843. He published more than 100 papers which deal with birds, reptiles and mammals of Nepal. Although the erstwhile Rana regime put restrictions on his movements outside the capital, he employed *Shikaris* (professional hunters) to collect animals for him. Hodgson's collection, most of which went to the British Museum, included '9,512 specimens of birds, 903 mammals, and 84 reptiles...he contributed articles which contained descriptions of thirty-nine new genera and species'[1]. His primary interest was, however, in the field of ornithology and he has to his credit '563 species of birds, of which no less than 150 were new to the avi-fauna of the Indian Empire'.[2]

Zoo-geography

Prater[3] divides Nepal into three faunal zones: cis-Gangetic or Indian, the central or trans-Gangetic (Himalayan), and the northern, which is nearly Palearctic. The Palearctic region is sub-divided by Wallace into the Mediterranean, West Chinese and Indo-Chinese sub-regions. According to Caughley[4] (1969),

1. Swan, L. and Leviton, A. E. 1962. *Op. cit.* pp. 127-29.
2. Ripley, Dillon S. 1950. 'Peerless Nepal. A Naturalist's Paradise.' *National Geographic,* Vol. xc. No. 1. p. 1.
3. Prater, S. H. 1928. *In Percival Landon's Nepal.* p. 279.
4. Caughley, Graeme. 1969. *Wildlife and Recreation in the Trisuli Watershed and other Areas in Nepal.* HMG/FAO/UNDP/(mimeo.)

the mammalian fauna of the Himalayan zone in Nepal has three peculiarities:

(*a*) The Himalayan zone separates the regions occupied by the oriental fauna (India and North East Asia) and the Holarctic fauna (North America and Eurasia, excluding south East Asia) but neither contributes many species to the fauna of the Himalayan zone.

(*b*) An endemic Himalayan fauna has not been developed.

(*c*) The number of mammalian species in the Himalayas of Central Nepal is lower than that to its east and west.

Lack of endemism in the Himalayan fauna is due to its recent origin. Furthermore, there are distributional gaps. Red deer which is present in Kashmir and Bhutan is absent in Nepal. Similarly, the Himalayan Marmot (*Marmota bobak*), which lives at altitudes 3,962 m to 5,486 m, occurs in west Nepal and Sikkim, but it is absent in the intervening region. Several hoofed mammals — Ibex(*Capra ibex*, Markhor Wild Goat)and Urial, which occur in west Himalayas in parts of Kashmir, Ladakh and Kumaon are absent in Nepal. Interestingly, such gaps exist in plants also, a thing which is ascribed to 'natural Zoogeographic features probably dating back to the Pleistocene'.

In the sub-alpine regions, reduction in the mammalian fauna is quite significant. The most common mammals which are seen in this part are: the *jharal* or the Himalayan Tahr and the mouse hare. In the scrub forest musk deer is common. Above the timber line, Lynx (*Felis lyns*), wolf (*Canis lupus*), Brown bear (*Melursus ursinus*), Snow leopard (*Panthera uncia*), Blue sheep (*Pseudois nayaur*), and Tibetan sheep (*Ovis ammon*) are the big animals.

Nepal lies at the cross-roads of the diverse faunal elements. The fauna of the wet zone of the Himalayas are 'fundamentally related to species in Western China'.[1] The high altitude palobatid frog (*Scutiger sikkimensis*) and the lizard (*Japalura* sp.) found in wetter Himalayas have their counterparts in West China also. The Mediterranean elements (*Agama*, *Phrynocephalus*, *Alsophylax*, etc.) do not extend into West China but often extend into Tibet. It is, however, emphasized that 'this Himalayan-Mediterranean fauna is a minority conflux of species among the

1. Swan, L. and Leviton, A. E. 1962. *Op. cit.* pp. 127-29.

far more numerous Panoriential-Indian, Indo-Chinese and Himalayan amphibians and reptiles'.

Nepal is a paradise for ornithologists. Ripley, who collected data from both in the western and eastern parts of the country, from the flat Terai to the Mahabharat range, found the Spiny babbler (*Acanthoptila nepalensis*), 'a bird which had not been reported for 106 years'. Though he collected many different kinds of birds — sparrows, finches, magpies, partridges, black-throated thrushes, bush larks, Darjeeling woodpeckers, and many kinds of warblers, he failed to find the mountain quail (*Ophrysia superciliosa*), once reported from Nepal but now a lost species. He observed that as 'the hill forests are steadily and inexorably retreating, game animals and birds are disappearing'.[1]

Avian Zoo-geography

In Nepal, some uniqueness is seen in the distribution of the birds also, and there are specialized areas in which birds live. These have been designated as follows[2]:

1. Lowland Zone (sub-region of Oriental):
   Unique areas: Far Western Terai, Far Eastern Lowland.
2. Midland Zone (Unique areas): Baitadi-Darchula
   Rara-Ringmo, Mai Valley.
3. Himalayan Zone.
4. Trans-Himalayan Zone.

'The birds inhabiting the lowlands (Terai, Bhabar, Churiya and Mahabharat to about 900 m) are similar to those in the Indian plains.' Some of these birds are: Crested Larks (*Gabrida cristata*), Finch Larks (*Eremopterix grisea*), Parakeets (*Psittacidae*), Rollers (*Coraciidae*), Bee eaters (*Meropidae*) and Muniya (*Plocidae*) are found throughout the lowlands and they are also common in Jhapa and Kailali. Some of the lowland species travel up the valley and thus extend their range inward. 'The swamp partridge (*Francolinus gularis*) is only found in the grassland of Sukłaphanta. The Giant Flying Squirrels (*Ratufa bicolor*)[3] is found only in S. E.

1. Ripley, Dillon S. 1950. *Op. cit.* p. 4.

2. Fleming, R. L. Jr. 1971. 'Avain Zoogeography of Nepal.' *Jour. Nepal. Geographical Society.* 4 : 28-31.

3. Not a bird, it belongs to the *Rodentia.*

Nepal and is an extension of the one found commonly in south East Asia.'

In the Mahabharat Lekh, wherever forests have been spared, Babblers, Laughing Thrushes, Sibias and Yuhinas are found. 'Many forest birds of this zone are related to Indo-Chinese forms. Indian types predominate in cultivated sections.'

In the Trans-Himalayan area, 'in Rara and Ringmo are found high altitude west Himalayan birds'. Two birds — Missel Thrushes (*Turdus viscivorus*), White-necked Nuthatches (*Sitta leucopsis*) are confined to a narrow area of Rara-Ringmo.

Birds of the sub-alpine and alpine regions show uniformity in distribution. Both Yellow and Red Billed choughs, snow pigeons, blue Grandal (*Grandala coelicolor*), are common above the tree line. In the Trans-Himalayan zone, which is arid, one sees 'Turkestan Hill Pigeons (*Columba rupestris*), Tibetan Snow Finches (*Montitrnigilla adansis*) and Brown Accentors (*Prumela fulvescens*). As in the case of plants, eastern Nepal is a zone of transition between Indo-Chinese and other faunal zones. Arun River, Singalila range and Arun-Dudh Kosi all have been regarded as providing the principal barriers for the westward migration of birds. The distributional limit of some of the eastern species has now been extended to farther west. Fleming Jr. (1971) disagrees with Swan in regarding Singalila as a faunal barrier and that many eastern species extend into Central Nepal and so do the western ones. Citing the specific case of pheasants, he says: 'The west Himalayan *Chir* pheasant (*Catreus wallichii*) and the Koklas Pheasant (*Pucrasia macrolopha*) both occur as far east as the Kali Gandaki and Pokhara. An easterly pheasant, the Blood Pheasant (*Ithaginis cruentus*) has been seen as far west as Mansalu (K. B. Sakya and J. Blower *pers. comm.*), but are uncommon in Thak. Thus in considering a bird species, a dividing "break" would appear to occur more frequently in Central Nepal than elsewhere in the country.'

Another interesting feature of the avifauna is that of subspeciation. In general, birds are darker in the east than in the west. There are some birds 'which fit the three zone category'. Taking again the specific example of the pheasants, the common Kalij pheasant (*Lophura leucomelana*) has white crest and rump in Doti, a black crest and white rump in Kathmandu and a black crest and rump in Illam. This pattern is repeated in other birds as well: Red-Headed Laughing Thrush (*Garrulux erythroce-*

phalum), the Nepal Parrotbill (*Paradoxornis nepalensis*) and Leaf warbler (*Phylloscopus pulcher*).

Bird Migration

There is seasonal migration of the birds due to adverse climatic conditions during certain parts of the year. Some species, such as the Wall Creepers, mainly follow the snow line which in the Himalayas fluctuates between 4,572 m and 5,486 m in summer, to 2,438 m to 2,743 m during winter. There are others, such as, Lammergeiers and Bar-Headed Geese which have been seen flying high over the Everest region at incredible heights of 7,315 m to 7,620 m. There are claims of having observed birds (geese) at 8,839 m. Wagtails herald the migrating season in the Kathmandu Valley; White and Yellow headed ones are seen quite commonly. Hodgson's Pied wagtail (*Motacilla alboides*), though not so frequent, can be observed in March. In the paddy fields, the Pond Heron is an ubiquitous bird. Occasionally, Chestnut Bittern may also be seen and the White Breasted Kingfisher is also a very common bird. In Kathmandu Valley, one of the commonest sunbirds is the Yellow-backed sunbird. The male shows bright plumage only in the breeding season. The birds hang upside-down and avidly suck at the nectar of *Hoya lanceolata*.

Ducks, teals, geese, and other water birds, which visit India during winter months return north after collecting a lot of fat. They go as far north as Siberia — a journey covering several thousand miles. They follow fixed migration routes — usually following a river system — Kosi in the east, Bagmati and Narayani in the central and Karnali in the western part of the country.

A number of birds breed in the Himalayas, Golden Thrush, for example, but most spend their time in the warmer southern plains of India.

The woods around Kathmandu have a large bird population — thrushes, barbets, orioles, finches, warblers, babblers, magpies, doves and pheasants. The Spiny babbler (*Acanthoptila nepalensis*) is quite common in secondary scrub forest of *Gaultheria*, *Symplocos*, *Myrsine* and *Camellia*. The bird is reported to be abundant[1] on Sankhu ridge (1,981 m) and Tokha (1,524-1,828 m). Pairs are found from March to May.

1. Proud, Desireé (Mrs.). 1959. 'Notes on the Spiny Babbler. *Acanthoptila* in the Nepal Valley.' *Bomb. Nat. Hist. Soc.* August, 1959.

The Great Himalayan Barbet (*Megalaima virens*), is a bird of middle altitude — between 914 m to 2,743 m. This strikingly coloured bird, mainly blue and green but with splashes of red, has been collected from wide geographical areas, such as Nuwakot and Baitadi. It is locally known as *Himali Neuli.*

Thick-billed flower Peckers appear in the Kathmandu Valley in September. This is one of the smallest birds of Nepal. Some birds are now not seen as commonly as they used to be in the past. The Black-throated Thrush (*Turdus ruficollis*), eaten as a delicacy, is not seen that commonly. Similarly, the Demoiselle Crane (*Anthropoides virgo*) which arrive in October on their way to the Terai are also not seen in large flocks now.[1]

The Tibetan skylarks are seen late in January over wheat fields. The rock pigeons are also seen at this time of the year hovering over the fields. The magpie robin, with its beautiful plumage and sweet voice, can be seen in the ravines.

In the forests around Kathmandu, bulbuls, barbets, babblers, warblers, fly-catchers, tits and the finches are commonly found. Occasionally, one comes across the hawk eagle flying gracefully over *Schima-Pinus* forest.

Besides Fleming, Scully (1879), Smythies (1950), Proud (1955), Rand with Fleming (1957, 1961, 1964), Ripley (1950, 1953, 1961) and Biswas (1962, 1963) have contributed greatly to the ornithology of Nepal.

Bird Ecology

The ecology of Red-billed Blue Magpies, locally known as 'Lampuchre' has been discussed by Fleming, Jr.[2] These are common birds in the midland, in western and central parts of the country, but scarce towards east. With its long white tail and bright plumage, it is quite a distinctive bird; it is omnivorous and often robs other birds' nests. The Red-billed species lives at lower altitudes, while the Yellow-billed one, which is really another variety, can only be found higher up in the oak forests. Both species do not occupy the same niche.

Similarly the flycatchers feed exclusively upon insects which are caught on the wing. Fleming Jr. reports no less than 21

1. *Newsletter.* Nepal Nature Conservation Society. No. 8. Feb. 1972.

2. Fleming, R. L. Jr. 1973. *The General Ecology, Flora and Fauna of Midland Nepal.* US/AID. Kathmandu. p. 105.

species of this bird in the Kathmandu Valley but they are 'separated altitudinally'. No two flycatcher species are found eating the same types of insects within the same altitude.

Another example is afforded by the spotted forktails, which inhabit the streams. They emit the same call as the Whistling Thrush, a thing which is advantageous to them because a screech can be heard over the roar of the stream.

Interestingly, many of the birds found in the oak-rhododendron forests in Nepal are also found in other parts of South East Asia, 'eastwards through Sikkim, Bhutan, NEFA, and the mountains of Western China and northern Indo-China'. The most conspicuous birds in the oak-rhododendron forest are those belonging to the family Timaliidae, to which the laughing thrushes and babblers belong. The Slender-billed Scimitar Babbler can be seen among bamboo clumps digging out insects with its long scimitar-like beak. Its westerly distribution extends to Pokhara but this is a species known to occur mostly 'in Western China, west through Bhutan, and Sikkim to the Mai Valley of Nepal'. The Black-capped Sibia is another 'secretive bird of oak-rhododendron forests, whose loud ringing call can be heard almost constantly from early morning till dusk'.

Fleming Jr. has reported the 'Rediscovery' of the Yellow-Vented Flowerpecker in Nepal, the first to be made after Hodgson noted it in the early 1880's. He saw 'several individuals in *Acacia* trees with mistletoe along the Tamur River south-west of Dhankuta'.[1] According to him, this bird is rather 'unusual' for Nepal, but common in Thailand.

Fleming Sr.[2] besides reporting 'Two New Records' — the white-rumped Spinetail Swift (*Chaetura sylvatica*) and Kashmir Red-breasted Flycatcher (*Muscicapa subruba*), has made this observation about bird migration in eastern Nepal:

> 'The Kosi barrage has become a veritable bird paradise. The silt from up river above the dam, to the distress of irrigation authorities, has created shallows and mud flats which attract many migrating birds. Three years ago in March we estimated that in the week we were there some 35,000 ducks migrated north-

1. *Newsletter*. Nepal Nature Conservation Society. No. 22.

2. Fleming, R. L. Sr. 1974. *Newsletter*. Nepal Nature Conservation Society. No. 23.

ward. The canal banks and pools of water from the Kosi to Chatra also are well populated with bird life. A group of British ornithologists saw in this barrage, in the first week of February five thousand ducks, Gaylag Geese, Falcated Teal, numbers of Caspian Terns, Spoonbills and many waders.'

Khatri[1] has listed a number of birds from Baitadi. The list includes: Common Myna, Jungle Myna, House and Jungle Crow, Red Vented Bulbul, Red Whiskered Bulbul, Paradise Flycatcher, Robin Dayal, Yellow Cheeked Tit, Chestnut-bellied Nuthatch, Velvet-fronted Nuthatch, Fire-breasted Flowerpecker, Purple Sunbird, White-eye, Black Drongo, Gray Shrike, Common Swallow, Red-rumped Swallow, Green Bee-eater, Hoopoe, Spotted Owlet, Great Horned Owl, Koel (Cuckoo), Red-ringed Parakeet, Bengal Green pigeon, Blue Rock Pigeon, Red Jungle Fowl, Kalij Pheasant, Gray Partridge and Chukor, which is very popular as a fighting bird in Kathmandu. In the oak forest at Garhi was seen the Himalayan Pied Woodpecker.[2]

Cuckoo or the *Koeli* is a bird very familiar to everyone in Nepal. The bird arrives in late spring when *kaphal* (*Myrica esculenta*) berries begin to ripe. The call which sounds like the note '*Kaphal pako*', is emitted by the male only. It escapes the duties of parenthood by transplanting its eggs in the nests of several other birds.

The eggs, small in size, are left unnoticed by the rightful owners, who feed the young birds as if they were their own. Very soon the young Cuckoo bird becomes strong enough to fly away and able to fend for itself. This is a case of 'social parasitism, to which often babblers and thrushes also become victims'.

Locally there is another bird which is also known as *Koeli*. This is a small black shiny bird found throughout the central hilly regions and the low-lands. It is also called 'Brain Fever' bird because of the incessant call which it gives throughout day and night, somewhat monotonous and irritating. One is too familiar with the notes '*ko-ho, ko-ho, ko-ho*'. The *Koeli* also puts its eggs in the nest of a crow, who sometimes becomes suspicious and 'builds a new nest on the top of the old one thus sealing off the eggs below'.[3]

Another example of social parasitism is the Honeyguide, a bird

1. Khatri, H. S. *Ibid.*
2. Personal observation.
3. Fleming Jr. 1973. *Op. cit.* p. 47.

more common in the east than west. More recently, these have been studied by Ted Cronin of the Arun Valley Wildlife Expedition. These birds derive their names from their peculiar habit of guiding their 'helpers' — man or Honey Badger — to a beehive, which it cannot feed upon by itself. But once the honeycomb is exposed, it feeds upon nectar, larvae and wax. The bird is known to possess wax-digesting bacteria in its intestines, a case of remarkable adaptation.[1]

The pheasants are well represented in Nepal. From the lowland of the Terai to the alpine regions one or the other species can be encountered. In the Terai jungles, the Red Jungle fowl is a common bird, living very close to the roadside. It has a plumage of striking red and yellow, while the female is drab coloured. They feed in the wheat fields during winter.

The most common pheasant of the midland is the White-crested *Kalij* pheasant, *Lophura hamiltonii*. The bird is marked by conical silvery grey feathers on the chest and abdomen. *Chir* pheasant (*Catreus wallichii*) is found in the western parts in difficult precipitous terrain among tall grass, scrub and in oak forest.

At higher altitudes, the Monal or Crimson Horned pheasant (*Tragopan satyra*) and *Danphe* (*Lophophorus impejanus*), which is the National Bird of Nepal, are found. The *Danphe*, a 'many splendoured bird' and 'ornithologist's delight' is given complete protection by the Bhotiyas and the Sherpas, but is much sought after by the hunters. Both the pheasants have now been put under the Protected List.

The *Danphe* has a brilliant metallic green bronze and blue colour with a prominent green crest. The tail is short and square cut and hence it cannot fly too far. It is seen gliding over trees. It principally inhabits land over 2,743 m up to tree line, i.e. 3,657 m to 3,962 m.

The *Monal* inhabits *Rhododendron-Arundinaria* forest. The male is crimson bronze with white spots. They move so fast that they have been called 'animal projectiles'.

Bird life in the Everest region is richer than animal life. A number of birds migrate regularly across the high Himalayas. Among the migrants recorded by Wollaston in course of the Mount Everest Reconnaissance Expedition (1921) were: Temminck's

1. *Ibid.* p. 43.

Stint (*Calidris temminckii*), Pintail Snipe (*Gallinago stenura*), House Martin (*Delichon urbica*), Blyth's pipit (*Anthus godlewski*) and Hodgson's pipit (*A. roseatus*) all at a height of 5,181 m beside the glaciers on the Tibetan side of the Himalayan range.

Swan[1] has reported 'the most incredible feat of bird flight at 4,876 m of Bar-Headed Goose (*Anser idicus*)'. The birds in thousands regularly fly across the mountains to the shores of the Tsangpo River and the salt lakes in Tibet. A number of wildfowl species winter in India and go north during summer months: ruddy sheldrake (*Tadorna ferruginea*), common teals (*Annas crecca*), pin tails (*A. acuta*), gradwalls (*A. streppa*), pigeon (*A. penlope*), etc. To Everest climbers, red billed choughs are familiar sight; these have been recorded as high as 8,229 m. The Tibetan Raven (*Corvus Corax tibetanus*) constantly accompany man and his beasts. Snow cocks are seen at 5,791 m. Crested Grebes, Pochards, White Cormorants are also common at these heights.

National Parks and Wildlife Reserves

Nepal has proposed four National Parks and five Wildlife Reserves covering an area of more than 3,884 sq. m. A National Park is defined as 'an area of land of unusual ecological and or scenic interest set aside by Government, wherein fauna and flora are protected as far as possible in their wild state for their scientific, educational and recreational value, and for the benefit of the Nation, and Mankind as a whole'.

The oldest National Park in the world is that of Yellowstone, which was established a little over 100 years ago. There are now well over 2,000 National Parks in the world spreading from New Zealand to North America. These cover every type of habitat from desert to lush tropical forests and mountains to the sea coast. From the standpoint of fauna and flora, these are areas of great interest to the naturalists. These are also important from the standpoint of protecting natural environment and giving protection to endangered species. They help maintain the scenic beauty which at least in some parts of Nepal is unparalleled in the world. National Parks and Wildlife Reserves attract large number of tourists, thus becoming an important source of foreign exchange. They also offer opportunity for research in scientific

1. Swan, Lawrence W. 1970. *Goose of the Himalayas*. Natural History. pp. 68-75.

studies on living forms and their habitat and thus help acquire knowledge in the scientific management of the natural resources.

Many of the wild animals of Nepal are endangered;[1] three wild animals have already become extinct: Blackbuck, Wild Yak and Pygmy Hog. Those that have already become rare or endangered are: Rhinoceros, Tiger, Elephant, Buffalo, Clouded Leopard, Snow Leopard, Great Tibetan Sheep, Musk Deer, Swamp Deer, Gaur (Indian Bison), Red Panda, Wild Dog and Four Horned Antelope.[2] Animals fairly common are: Sambar, Chital, Hog-Deer, Blue Bull, Sloth Bear, Blue Sheep, Himalayan Tahr, Serow, Goral, Mouse Hare, Himalayan Marmot, Himalayan Bear, Leopard, Wild Boar, Barking Deer, Rhesus and Langur Monkey.

In the last decade, the country has witnessed some encouraging trends in the field of conservation of natural resources — forests, water, wild animals and birds. During the Rana regime, large-scale hunting was restricted to once a year, when the Prime Minister went on his winter safari to the warm valleys of the Terai. Though the toll was heavy, poaching was limited. Foreign dignitaries — dukes, viceroys, princes visited the famed forests of the Nepal Terai for big game hunting. On these occasions, the big game animals — particularly tiger and rhino were killed in large numbers. Though rhinoceros had been given protection since the time of Jung Bahadur (1845), the members of the ruling class not only hunted it but at times made profit by selling these to animal collectors. It is reported that between 1900 and 1950, in the five big *shikars*, 200 rhinos were killed and taking into account those killed illegally or about whom there are no records, the number would exceed 1,000.

The fall of the Rana regime, however, at the end of 1950 let the door open to destruction of forests, both in the hills and the Terai, a process which has its effect on wildlife also. The break-down of law and order in certain parts of the country and a succession of governments, more than contributed towards the depletion of wildlife in Nepal. In the Chitwan valley — the home of the one-horned rhinoceros — the results were devastating; from 1950 to 1968, the rhino population decreased by 88 per cent and over the

1. *Nepal's National Parks and Wildlife Reserves*. 1974. National Parks Wildlife Conservation Project. FAO/UNDP/HMG.

2. See List of protected animals.

same period — rhino habitat contracted by 70 per cent — chiefly as a result of grazing and burning of elephant grass. Willan[1] estimated that in 1950, rhino population stood at 800, which was reduced to 300 by 1959, a figure arrived at by E. P. Gee, when he undertook a mission for the IUCN and in the next decade, the population was reduced to less than hundred.[2]

Royal Chitwan National Park

The Royal Chitwan National Park, gazetted on September 20, 1973, covers an area of 540 sq. km. The habitat consists of open grassy lands as well as forest, an area varying in altitude from 76 m to 452 m. The Park touches India towards south-west and Mohan Khola and Narayani river in the west. The Park area extends towards the east upto the Rapti river. The open grassy lands and water-logged areas (*ghols*) constitute the main habitat of the rhino population in Chitwan.

Wildlife

The most important wildlife in the Park is of course the rhinoceros (*Rhinoceros unicornis*). The animals are mostly concentrated in the north-east corner and western end of the Park. They are seen during certain periods of the day — mostly in the morning and evening. Upreti and Pelnick[3] carried out aerial census of rhinos and estimated their population at 120, a figure which was later raised by Laurie (1973) to more than 200.[4]

Nepalese rhinos eat exclusively grass, in contrast to the African species, which eat scrub. The ideal habitat for the rhino is swamp land covered by tall elephant grass. Grazing is extensive. According to informed sources, large herds of domestic cattles graze in the rhino sanctuary each day which besides destroying the rhino habitat, also become a source of danger for introducing 'foot and mouth' disease.

Between 1950 and 1960, there was a sharp decline in the rhino population and between 1960 and 1970, it has remained more or

1. Willan, R. G. M. 1967. 'Forestry in Nepal.' *The Report of the Chief Conservator* (mimeo.).

2. Gee, E. P. 1964. *The Wildlife of India.* Collins.

3. Upreti, B. N. and Pelnick. 1973. *Report on the Chitwan National Park.* (mimeo.).

4. Laurie, Andrew. 1975. *Ecology and Behaviour of Rhinoceros. Newsletter.* Nepal Nature Conservation Society. No. 28.

less steady, but now they are increasing in number. In the last decade, the annual natality was 18. Upreti and Pelnick have come to the conclusion that if the incidence of poaching is curbed, there is good chance of increasing the rhino population in Chitwan, assuming that the habitat does not deteriorate further. Poaching has been reduced since the Park office was established and as a result of the prize money being offered to the informants. Still, there remains the problem of animals straying into cultivated fields, where they are shot by the poachers. Upreti and Pelnick's studies revealed that in the National Park rhinos are mostly seen in the early morning and in the late evening and in the hot season — a number of them (40 per cent) take shelter in the deep forest, rather than stay in the wallows.

Some other behavioural patterns of rhinos include: bobbing its head up and down or grazing and sweeping the head rapidly from side to side. 'Adult cows and bulls show aggressive behaviour.' When they do contact other rhinos, they adopt a head-up posture and may snort repeatedly. Flight is a common reaction of the other individual. Alternatively, as the first gets nearer, a head-low open mouth posture is taken up. The corners of mouth are pulled back and teeth displayed. A high pitched bleating vocalisation is repeated alternately with the honk, and the head-on position is maintained at the risk of turning the rump which is vulnerable then to slashes from the tusks.

'Thus attack or flight are the main methods of defence.'

Rhinos have the peculiar habit of defecating on old dung piles. Fresh dung is a stimulus to defecate. Calves invariably defecate after their mothers. When defecating, rhinos approach a dungpile, sniff at it, swivel around their hindquarters, lift their tails and defecate.

Urination, which occurs in squirts takes place

(*a*) during or after encounters with another rhino, elephant or man, especially while walking away;
(*b*) on leaving a wallow or going across any kind of boundary such as the forest or grassland;
(*c*) on seeing other male urinate;
(*d*) while walking/feeding.

Scent marking is less effective than in the dry plains of Africa.

Thus the behaviour pattern which scent marks the tracks is less developed in the Indian rhino than its African black counterpart. Therefore, the use of old dungpiles becomes an important factor in the communication system of the rhinos.

Adult males prefer to live alone, but cow and calf remain in constant communication and association, until the latter becomes more than 3 years old. Mating takes place when the calf is about two years old and the calf is usually driven away by the male at the time of courtship. Intermittent association of a male with an oestrus cow for three or four days before mating is normal and during this time, the calf may rejoin the female for short periods. Adult males normally avoid cow with calf.

Laurie's Report indicates that young calves become easy prey to tigers and deaths have also occurred as a result of injuries sustained in mutual fights among adult males. He estimates a population increase of 2.7 per cent per year and with poaching under control, the population is likely to show a slow increase.

He has recorded the calfing interval of 3.8 years. Rhinos in Chitwan do not have regular breeding season and 'birth normally takes place in seclusion. The cow disappears into thick forest for a period of several days before birth'.

Laurie has also studied the food habit of the animals. They feed mainly upon *Saccharum-Phragmities*, but show a preference to *Imperata*. They feed upon the charred stalks and visit the same area for eating the new shoots. 'Of the 29 common species of grasses and rushes around the wallows and along river beds, all seem to be eaten by animals. The preferred species are: *Cyperus sp.* (in wet areas) and *Cynodon dactylon* (in dry areas).'

Behaviour

Among the rhinos, variety of behavioural patterns have been observed. 'Greetings are common between calves and approaching strange rhinos and between sub-adults. A slow approach with nose stretched forward is usual. Noses are touched and there may follow a bout of sparring with one's horn circling the other's snout and clashing audibly and muzzling of the side of one's face with other's mouth. During muzzling, the mouth is often open and attempts at biting may occur.'

Though there is no shortage of food, rhinos invade cultivated fields because of encroachment of their 'home area'. They move

into the fields after dark and return with the daybreak to the forest.

Other Wildlife in Royal Chitwan National Park

Besides rhino, there are other animals in the Park: tiger, leopard, Himalayan black bear, sloth bear, Sambar, spotted deer, hog deer, barking deer, wild boar, porcupine, Jungle Cat, Rhesus and Langur monkeys, jackals, Gangetic Dolphin and crocodile. Bison is a rare bovine species, which inhabits the foothill region and is seldom found above 4,876 m. About this animal Prater says that with its huge head deep massive body and sturdy limbs, the Gaur is the embodiment of vigour and strength. 'In Chitwan they seem to be shy and elusive because of persecution by human beings.'

In National Park itself, the animal is quite rare, though some have been sighted near the foothills. It is quite likely that the animal is on the verge of extinction from the country.

The Pygmy Hog (*Sus salvanius*)

The Pygmy Hog, which once inhabited a large part of the foothills of Nepal and India has now almost disappeared. There are reports that this animal has been sighted in Kanchanpur. They are near relatives of the wild boar but barely exceed 25 cm in height. They live in herds of 5 to 20, and being nocturnal, are not seen easily. When forest fires break out in early summer, they come out. This is one animal whose status remains to be ascertained.

Tiger (*Panthera tigris*)

Morphological Characteristics

The tiger is a richly coloured and heavily striped animal. Tigers of Sukla Phanta are well built and larger than that of Royal National Park (Chitwan). The record is 3.3 m in length and 0.91 m in height at shoulder.

Tiger entered the IUCN Red Book in 1970 as an endangered and rare species, whose number in the sub-continent India, Bangladesh and Nepal, was put at 2,000. In Nepal any estimate of the tigers would be nothing but a guess. The main concentration of tiger, however, is in the Terai districts of Nepal as is shown in Table 20.

TABLE 20

DISTRIBUTION OF TIGERS IN NEPAL

Area	*Estimated Number of Tigers*
Kanchanpur	15-25
Bardiya	40-50
Nawalpur/Chitwan	20-30
Rest (Scattered)	1-20

Source : Mishra and Poppleton (1970), Operation Tiger (Typescript).

Behaviour and Habitat

Tigers prefer grasslands, swamps, while leopards are forest dwellers. They are intolerant of heat and so seek shade at mid-day and lie in water to keep cool. Having kept itself cryptically hidden among tall grass during the day, it emerges in the evening to stalk its prey, lying in ambush along the paths which run through forest or banks of rivers. The tiger's food habit is diverse: wild boar, chital, barasingha, *nilgai* and even fish, if nothing else is available. They drag the prey if it is too large to be taken in a single meal. Tigers do not mind putrefied meat and return to the same kill even though it is several days old.

No man-eating tiger has yet been reported from Sukla Phanta. The female species around Rani Tal, the biggest of them all, has defied the hunters thus far. Tigers of Sukla Phanta do not prey upon the cattle, which shows that deer and antelopes are in plenty.

Operation Tiger

The World Wildlife Fund has made an initial commitment of US dollars 132,192 under 'Operation Tiger' for the Kingdom of Nepal. This would involve proposed Royal Karnali Wildlife Reserve, Sukla Phanta Wildlife Reserve and the Royal Chitwan National Park.

A number of factors have contributed towards the drastic reduction in the tiger population of Nepal. The opening up of the forested areas of the Terai for resettlement after eradication of malaria led to large-scale killing of the animals by the poachers, as well as under licence from the government. As Mishra and Poppleton rightly point out: It needs to be emphasized that prior to 1970, when tiger shooting was banned, these animals could be legally hunted for a paltry sum of Rs. 500. The vast

road development programme was another contributory factor in the reduction of tiger population. Uncontrolled grazing has also brought about the destruction of the habitat. Development of roads and other means of communication and the introduction of modern weapons combined with a big demand for tiger skin in western countries, reduced the tiger population to a minimum. The preceding history of settlements in the Terai is also the history of decline of tigers in Nepal. Thus in the last two decades the tiger, once a common animal of Nepal, has been confined to a few isolated pockets.

Besides the reduction in habitat, poachers have taken a heavy toll of the animals by using insecticides.

Bardiya Wildlife Reserve

Besides Sukla Phanta, by far the largest concentration of the tigers is in the Royal Karnali Wildlife Reserve — an area covering 468 sq. km in Bardiya District. Mishra and Poppleton say in their Report: 'Except for Sukla Phanta, Bardiya probably has the maximum density of tigers in Nepal. Fresh signs of tiger were frequently seen in most parts of the area, particularly near Danwa Tal. For the last five years, this area has been closed for shooting, which extends from the foothills to the Churiya, and is criss-crossed by a number of rivers and streams.'

Besides tigers, other animals seen in the area are:

Elephants:	(7-9), which are part of a migratory herd that move in and out of the Reserve.
Leopard:	Common near agricultural land, mostly preying upon domestic stock.
Deer:	Four species — Chital, Sambar, Barking deer and Hog deer.
Swamp deer:	Once reported but is no longer seen.
Antelopes:	Blue bulls are common.
Blackbuck:	Non-existent now, though as recently as in 1973, a few were killed.
Four-horned antelope:	Very rare.
Serow:	Known to occur along the Churiya ridge.
Gangetic dolphin:	Rare

Gavial: Common in the Karnali gorge

Lesser animals: Boar, rhesus monkey, langur and jackals.

Future prospects for this Reserve are somewhat uncertain. The East-west Highway would cut through the Reserve, which no doubt, would disturb the habitat. Another factor is the proposed Karnali dam, which would bring into the area thousands of people. The dam site actually lies 20 miles north of the boundary, but still it is too close to the Reserve. Major irrigation channels are supposed to pass through the Reserve which would no doubt adversely affect animals, including crocodile.

Wild Animals of the Lowlands

Common Rhesus Monkeys (*Macaca mulatta*)

Monkeys are found everywhere, in the plains as well as in the hills. In the Kathmandu Valley, they are principally found in two localities at Swayambhu Nath and Pashupati Nath. Among the troops a distinct hierarchy is found. Only males are dominant. Another monkey, *Macaca assamensis* is also known to occur in the country and though the two species inter-breed freely in captivity, whether they do so in nature is yet to be ascertained. The Assamese Macaque is distinguished from the Rhesus by the absence of orange red hue on its loin and rumps. Monkeys eat almost anything; in the spring they are seen foraging flowers of the silk-cotton tree.

Entellus Monkey (*Presbytis entellus*)

These are long tailed slender with greyish white coat and a black face, hands and feet. The tail may be more than three feet long.

They seldom come near human habitation as the rhesus monkeys do. They inhabit a wide area from the plains to an altitude of 3,048 m. At night, they take shelter in trees and during the day descend to the edge of villages to feed upon crops, such as potato. They live in troops of 5-6 but old males stray out of the troop. They keep a close company of the spotted deers and give warning signals whenever a predator — leopard or tiger — appears in the area.

Bishop carried out research on the common langur monkeys

at Malemchi (Helumbu). They usually moved between 2,438 m to 3,657 m and lived in a mixed oak-rhododendron and hemlock forest. In one troop there were 31 animals, who spent most of their time on trees and came down only at feeding time. Langurs preferred oak fruits (acorns) and during winter were seen feeding upon *Ilex* berries. They consumed a lot of foliage — mostly hemlock and for days went without water.

Indian Elephant (*Elephas maximus*)

The Indian elephant is smaller than its African counterpart and has a maximum height of 3 m. They are found in the forests of Terai but their number seems to have dwindled considerably. There are scattered herds in Jhapa, Thori and Bardiya. In the far west there is regular migration of elephants between the forests of Kanchanpur and those in the adjoining forests of Uttar Pradesh (India). There are reports of the herd moving as far as the Corbett National Park. The size of the herd varies yearly and there are indications that some of the animals migrate regularly to India. They are known to inflict fatal injuries upon human beings.

Blackbuck (*Antilope cervicapra*) **Krishna sar**

'This animal,' according to Prater,[1] 'is the only representative of the genus *Antelope* in India.' In grace and elegance, it is hardly matched by anyone else. It inhabits open scrub land and avoids forest. In Nepal, in the past there were large herds in the west in the districts of Banke-Bardiya, and Kailali-Kanchanpur and though it is listed as one of the animals in the Sukla Phanta Sanctuary, no one seems to have seen it in the past few years. Few animals are reported in Dhaka Block. In Banke district, 'the main blackbuck areas were Khajura and Bhoj Bhagwanpur and in Bardiya, Mainapokhar,' these regions being 'typical blackbuck country, thorny scrub jungles or open grasslands covered with thorny shrubs and bushes'. Blackbuck habitats have been irreversibly destroyed. 'As recent as last year some blackbucks were sighted at Mainapokhar but according to unconfirmed reports, these were shot by poachers'[2] and in all

1. Prater, S. H. 1965. *The Book of the Indian Animals*. p. 270.

2. Singh, S. 'Black Buck — Already a Legend.' *Newsletter* No. 23. Nepal Nature Conservation Society, April, 1974.

likelihood, blackbuck is already a lost animal, having suffered the same fate as the Pygmy hog.[1]

Blue Bull, Nilgai (*Boselaphus tragocamelus*)

At one time this animal having a superficial resemblance with the horse, was distributed widely throughout the Terai, and caused much trouble to the farmers, who could not kill it because of religious taboo. But the animals are now shot for meat, which is turned into *sukuti* (smoked and dried meat). In Sukla Phanta Reserve there are still small herds of blue bull which include 10-20 individuals. Only males have horns and a greyish coat. They prefer open country to forest, feeding upon *Zizyphus* and other small trees. *Nilgai*, which is an antelope, deposit their droppings at the same spot, which may be a means of reassembling scattered members of a herd.[2]

In India *Nilgai* used to occur in vast herds in *Khadar* of the river plains, but these were hunted in large numbers by the members of the Diplomatic Corps of New Delhi, and eventually led to their virtual extinction from these parts.[3]

Swamp Deer (*Cervus duvauceli*)

Of the deer found in Nepal, this is 'one of Nepal's rare and endangered animal species'. It is now confined in a small area in the Sukla Phanta, where a sizeable herd of about 1,000 is known to exist.[4] The coat is woolly varying in colour from brown to yellow. It is much prized for its antlers, and for this reason alone, it is still poached.

In Sukla Phanta, in two days of aerial survey, 575 and 349 deer were seen. In 1968/1969, Peter Byrne[5] counted 1,250 animals in the central and southern areas of the Reserve, and this represented the largest number of swamp deer left in any areas in Asia today, 'the Central Indian herds being considerably reduced and the remainder being only scattered group in north U. P. and some areas of Kanchanpur, Kailali and Bardiya'. In Kanha National

1. Some animals have recently been sighted in Bardiya.

2. Prater, S. H. *Op. cit.* p. 273.

3. Dang, Hari. 1969. *The Endangered Animals.* Seminar. November 1969. Conservation. p. 25.

4. Schaaf, Dietrich. 1975. 'Barasingha or Swamp Deer (*Cervus duvauceli*) of Nepal.' *Newsletter.* Nepal Nature Conservation Society. No. 28.

5. Byrne, Peter. 1970. Report No. 7 (Typescript) UNDP.

Park, there is a population of about 200 which belongs to a different race (*Cervus duvauceli branderi*).

Bhatt and Shrestha[1] who visited Sukla Phanta in January 1973, have provided the information that the swamp deer population is distributed in three sites:

(*i*) near Mahakali River west,
(*ii*) Singpur beyond the bridge over Bahamana,
(*iii*) Sundari-Phanta.

It is obvious that the swamp deer population is a migratory one, but rarely do the deer come out of the Reserve for grazing.

The habitat is typical grassland, which is a bio-edaphic complex. The fires are either natural or started deliberately. In the burnt grassland *Khar* (*Imperata arundinacea*) becomes dominant. In many places, one comes across *dhap*, the local name for water-logged areas. In such places more characteristic species are: *Saccharum spontaneum*, *Vetiveria zizanioides*, *Eulaliopsis binata* and *Heteron contortus*. These grasses are characteristic of water-logged or clayey soils. *Dhak* or *palas* (*Butea frondosa*), which is gregarious in some places, is also indicative of clayey water-logged soils. Due to heavy fires, regeneration of the tree species is difficult. 'Like barasingha, these grasses can no longer be found in suitable abundance anywhere else.'

Wild Buffalo (*Bubalus bubalis*)

The wild buffalo (*arana*) male has scimitar like horns, which may have a spread of nearly 2.4 m. 'Wild buffalo,' according to Prater, 'is the boldest and most savage of the species', but those in Kosi Tappu are reported to be shy and elusive. They do, however, move long distances during night for crop raiding in the villages. During these excursions the stray bulls come frequently in contact with the domestic animals.[2] The possibility remains that at least some of the individuals in the area may be feral.

Wild buffalo was distributed over much wider area in the whole

1. Bhatt, Dibya Deo and Shrestha, Tej Kumar. 'The Environment of Sukla Phanta.' Tribhuvan University Press.

2. Upreti, Biswa N. 1975. 'The Last Home of Wild Buffalo — Kosi Tappu.' *Newsletter*. Nepal Nature Conservation Society. No. 28.

of the Indian sub-continent, but not more than 1,500 are reportedly left now; of these, 700 are in the Kaziranga Sanctuary in Assam.

In Nepal, a small herd of about 40 animals is known to be present in the Kosi flood plain (Tappu), not far from Biratnagar town. As late as in 1966, there were no less than 100 animals, but a sharp decline in the population set in because of encroachment upon their habitat, and due to over-grazing, poaching and disease (rinderpest). The floods of 1968 also destroyed much of the Wildlife in Tappu.[1] Habitat encroachment and floods threaten the existence of wild buffalo.

Besides the wild buffalo, hog deer, blue bull, wild boar and jackals have also been reported from the Tappu. There are reports of tigers but this needs confirmation.

Plans are now under way to establish a wildlife reserve covering 90 sq. km. This would involve acquiring land which is now under agriculture.[2]

The Gaur, Gaurigai (*Bos gaurus*)

Gaur or the Indian Bison is found in the foothill region and the hill (Churiya) upto about 1,542 m. Its main habitat is in the Rapti valley, not inside the Park[3] area but on the Someswar range. The animals occur in small numbers, though a herd of 14 was seen in the hills near the Harda Khola.[4]

Gaur (*Bovidae*) usually graze in the early morning and in the evening and take shelter in the shade of the forest during the day. They are powerful animals and magnificent in build. The animal is now a rare and endangered species.

Gangetic Dolphin (*Plantanista gangetica*) **sush**

There are reports about sighting dolphin in the waters of the Narayani River in the Rapti Valley. The Gangetic dolphin has a short neck and fusiform body, which is larger in the males than in the females. The length varies between 2.28 m to 2.58 m.

1. Upreti, Biswa N. *Newsletter No.* 28. Nepal Nature Conservation Society. Feb. 1975.

2. Gupta, Ram Bilas and Mishra, Hemant 1973. *The Asiatic Buffalo of Kosi Tappu Region: An Interim Report.* National Parks and Wildlife Office.

3. Visitors to the National Park on rare occasions are charged by these animals.

4. *Newsletter.* Nepal Nature Conservation Society. No. 24. June 1974.

Females are usually larger than the males. They feed mostly on crustaceans and cat fish living in the river bottom.

Bats

Many different kinds of bats are reported from the country. The Flying Fox (*Pteropus sp.*) is common around Kathmandu and can be seen roosting during the day on trees. In the evening they fly out in search of food — mostly fruits, both cultivated and wild.

Others like the Great Horse Shoe Bat (*Rhinolophus luctus*), Brown leaf Bat (*Rhinolophus feerum equinnus*), Large leaf Bat (*Rhinolophus macrotis*), etc. have all been recorded.

In the Arun Valley, two Himalayan Bats — the Great Himalayan Leafnosed Bat (*Hipposideros armiger*) and the Great Eastern Horseshoe Bat (*Rhinolophus luctus*) have been found. In the case of the Leafnosed Bat, the nose is in the form of a leaf which is lined with hairs. The nose is an organ of perception.

Bats are remarkably adapted to see in the dark. This is due to the presence of some sort of a 'Radar system' in these animals. They send out signals, which are reflected back by objects and picked by ears especially adapted for this purpose.

Mount Everest National Park

The Mount Everest National Park, covering some 1,243 sq. km of area, was first announced by Prince Gyanendra to the World Wildlife Congress held in Bonn in September 1973. It was also proposed to include this natural area of 'certain uniqueness' into UNESCO's World Heritage List. Besides Mount Everest, the highest mountain in the world, the proposed National Park would include the Sherpa homeland, which from the ethnographic view point has attracted the anthropologists and laymen alike. Apart from Pokhara-Jomsom trail, trekking to Solokhumbu is increasing yearly.

The proposed National Park will include the villages of Namche Bazar, Khumjung, Kunde, Pangboche, Dingboche, Phorse, etc. and it will, therefore, be desirable to 'integrate forestry and agricultural requirements of the Sherpas'.[1]

Vegetation

The vegetation of the area is made up of blue pine, rhododendron

1. Mishra, Hemant R. 1973. *Mount Everest National Park.*

and birch. The deep hill sides of Bhote Kosi, Imja Khola and Dudh Kosi are covered with blue pine, fir (*Abies spectabilis*) and Juniper (*Juniperus recurva*) at altitudes of 2,743 m to 3,657 m.

Birch and rhododendron forests (*Rhododendron campanulatum* and *R. campylocarpum*) occur between 3,352 m and 3,962 m 'extending further upwards along the upper slopes'.

Juniper-rhododendron scrub (*Juniperus wallichiana, Rhododendron anthopogon, R. lepidotum*) occur between 3,992 m to 4,693 m.

Along the river beds, *Myricaria rosea, Hippophe thibetans*, and *Salix sp.* are found. *Rhododendron nivale* grows at a height of 5,181 m.

Wildlife

The proposed National Park will have varied animal life. The Himalayan bear is found in the forests at a height of 3,657 m. Snow leopard occurs mostly above 2,743 m and preys upon blue sheep (*Pseudois nayaur*). Other animals are: Flying squirrel, mouse hare, jharal (Himalayan Tahr, *Hemitragus jemlahicus*), goral, musk deer, serow, wild boar, Rhesus Monkey, Grey Langur, Red Panda, jungle cat and wild dog (*Coun alpinus*). A number of mammals — Yak, pika (*Ochotona roylei*), wolves, foxes (*Vulpes vulpes*), and sheep 'wander above 6096 m to an approximate maximum of 6553 m'.

Langtang National Park

A National Park has been proposed in the Langtang/Gosainkund area, covering roughly 1,294 sq. km. The Park[1] would include such peaks as Jugal Himal (7,083 m) and Langtang Lirung (7,253 m). It will be the biggest National Park in the country of a varying topography from low river valleys to the high alpine country, with an average elevation of 9,144 m. There are also wide climatic variations within the area; the south facing slopes of Helumbu receive high precipitation, while the Upper Langtang is comparatively dry; here the winter temperatures may go down to 4-8°C. The snowline in this part of the Himalayas generally stays at 4,876 m-5,486 m.

The Park boundaries include part of the divide separating the large river systems of east and central Nepal. They will extend up the Trisuli River, 'excluding villages and cultivation along valley bottom eastwards to the Nepal-Tibet border, *Phurbi Chyachu*

1. Fox, J. 1973. Langtang National Park (Typescript). National Park and Wildlife Conservation Project, UNDP/HMG.

and *Nosem Dhara*, and from the southern flanks of the Gosainkund Langtang massif northwards to the border'.[1]

The park will also include all of the Langtang Valley, 'the heart of the park on which administrative and touristic development would be centred, the Gosainkund plateau, with its sacred lakes, and the ranges of high snow peaks lying north and south of the Langtang Valley'.

Langtang-Gosainkund area is a bewildering and bewitching country, very rugged with the razor sharp mountain tops, which send out spurs in a parallel fashion on either side. One has to fly through this part of the country to see the rocky moraines, snowy peaks, glaciers, deeply forested hill sides, *kharkas* (small hamlets) and, of course, the farms, which look like a flight of stairs.[2]

Vegetation

In the Park area distinct vegetational zones are met: subtropical, temperate, sub-alpine and alpine. At higher altitudes mainly cushion plants and scrubs are found. At lower altitudes in moist habitats, especially along courses of stream, generally below 1,524 m, Lower Temperate Mixed Broadleaved forests are found. At about 2,438 m *kharsu* oak is predominant. Higher up, between 2,438 m-3,048 m, in moist north-west facing slopes, alder, maple, beam (*Sorbus cuspidata*) are the characteristic species belonging to the Upper Temperate Mixed Broadleaved Forest. At these altitudes, in the more exposed sites, are found small stands of hemlock, which merge at the upper limit with *Abies*. In the drier slopes and at much lower altitudes are few stands of *Chir* pine, which often occur in association with *Quercus incana* — *Quercus lanuginosa*. Other constituents of the oak forests are: *Rhododendron arboreum* and *Lyonia ovalifolia*. In the moister sites, these are associated with blue pine also.

Spruce (*Picea smithiana*) occurs scattered between 2,133 m and 2,895 m 'in small steep valley tributary to the Bhote Kosi between Langtang and Linde Khola'. This occurs in association with blue pine or hemlock, the latter festooned with lichens, epiphytic ferns and orchids, such as *Pleione humilis*.

1. National Park Proposed: 'Twenty Questions and Answers. National Parks and Wildlife Conservation Project.' Kathmandu (Mimeogrpahed).

2. Bhatt, D. D. 1974. 'Langtang National Park.' *Newsletter*. Nepal Nature Conservation Society.

Extensive fir (*Abies spectabilis*) forests occur between 3,048 m and 3,505 m. *Rhododendron barbatum* occurs as an undershrub. Larch (*Larix potanini*) is another species which is found in the Langtang valley, but it never forms extensive forests. It occurs scattered up to 3,810 m, some being found near Kyangchin cheese factory.

Birch (*Betula utilis*) occurs extensively on the southern aspects of the Langtang valley — often extending to 4,267 m.

Two kinds of junipers are common in the Valley: *Juniperus recurva*, a tree 6-9 m high and occurring isolated and the common dwarf spreading *J. squamata*, growing among the boulders.

In the Langtang Valley — both 'Moist Alpine Scrub' and 'Dry Alpine Scrub' are met, the latter, however, being found only in the upper reaches of the Valley. The characteristic vegetation of 'Moist Alpine Scrub' includes: *R. anthopogon*, *R. lepidotum*, *J. recurva*, *Lonicera obovata*, *Potentilla fructicosa* and *Salix daltoniana*. In the meadows, *Iris kumaonsis* grows extensively. The spiny *Papilionate-Caragana gerardiana* is ubiquitous in the drier parts along with *Hippophae thibetana* in the old moraines.

Spiny dwarf bushes are characteristic of high dry Himalayan valleys. In Langtang, *Rosa sericea* is found in association with *Cotoneaster macrophylla* and *Berberis spp.* Of course, primulas, poppys and gentians are the commonest flowers. In late spring *Potentilla fructicosa*, *Potentilla aureata*, *Fragaria nubicola ex laciata*, *Primula atrodentata*, *Potentilla micropetala*, *Primula denticulata*, *Fritillaria cirrhosa*, *Meconopsis discigera* and *Clematis montana* are in flower. The whole ground is covered with *Rhododendron setosum* and in some places with *R. anthopogon*. *Euphorbia sikkimensis*, a poisonous plant, flowers in the open meadows. On the south side of the Langtang River, there are extensive forests of birch and at Kripanesa, where the Khampas have been resettled,[1] thick stands of hemolck interspersed with fir are met.

Wildlife[2]

At lower altitudes, the natural vegetation has been much disturbed, a thing which has its effect upon wildlife also. In the Langtang Valley itself, a variety of wildlife is reported. It includes the Snow Leopard (*Panthera uncia*), perhaps now becoming rare, Musk Deer, Himalayan Tahr, Serow (*Capricornis sum-*

1. They have since vacated.

2. Fox, Joseph L. 1974. 'An Ecological Survey of the Proposed Langtang National Park.' (mimeo.).

atraensis), Goral, Barking Deer and Leopard. In the bamboo forest, the Red Panda (*Ailurus fulgens*), is commonly sighted. There is a possibility that the Great Tibetan Sheep may be 'discovered' in the Park. Its normal habitat is an area lying at altitudes of of 3,900 m to 5,300 m. In the Park itself, Tahr is the commonest animal but it is seldom seen below 3,352 m and higher up it may live near the timber line, which lies at about 5,181 m. There is some winter migration down the valley from summer feeding grounds above Langshisha. According to J. Fox, 'Tahr living far up the Langtang Valley spend the summer and possibly all winter well above the tree line, as compared to those Tahr inhabiting the precipitous slopes above deep river valleys, where descent into forest is an easy matter. Males migrate down in search of females during mating period. In the Langtang Valley, the total population of Tahr has been estimated at 100 or more, with an additional group of about 30 in Upper Helambu.'

Serow (*Thar*)

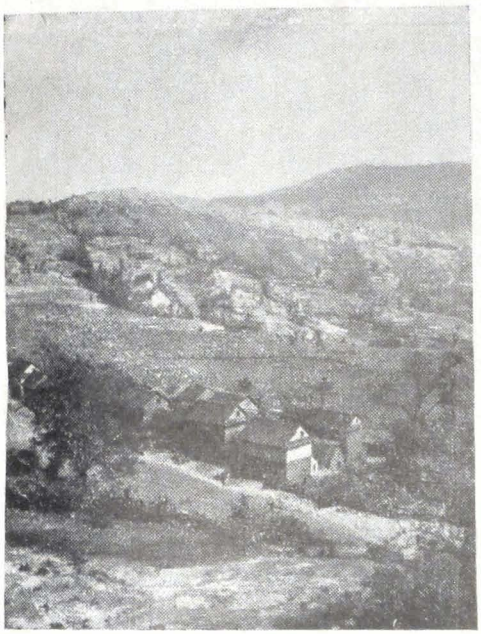
This animal, a goat antelope, is found at elevations below 3,352 m, where plenty of thick jungle and brush afford cover. Caughley reports locating it in dense bamboo jungle of Mailung Khola, where 'it reaches medium density'.

The serow is sighted in the fir forest of Upper Bhote Kosi, Lude Khola and other side of Ganesh Himal. The animal is secretive and usually leads a solitary life. It is hunted, to some extent, both for skin and meat.

Musk Deer (*Moschus moschiferus*)

Musk deer primarily inhabits rhododendron-juniper and birch forest at higher altitudes between 3,657 m and 4,267 m. There is some winter migration. Due to increased demand for musk, poaching of this animal is heavy. Local inhabitants, who do not kill the animals, report increased activity of the poachers, who lay traps spreading across miles and miles of territory.[1] Dogs are used for tracking the animals. As the musk deer has the peculiar habit of dropping faecal matter at the same place, it gives a clue to the poachers. The usual method of trapping is to construct a low fence of branches some 1 m in height extending across a hillside for a

1. Blower, John. 1974. 'Poaching of Musk Deer. *Newsletter*. Nepal Nature Conservation Society. No. 22.



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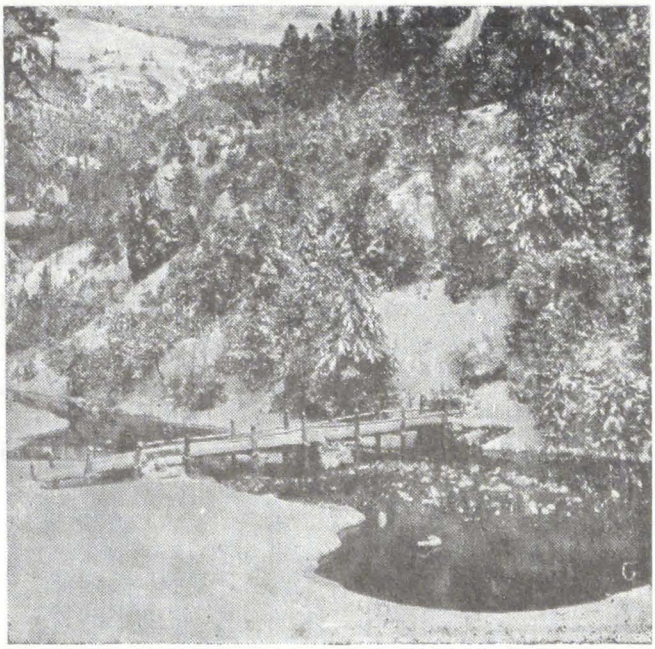

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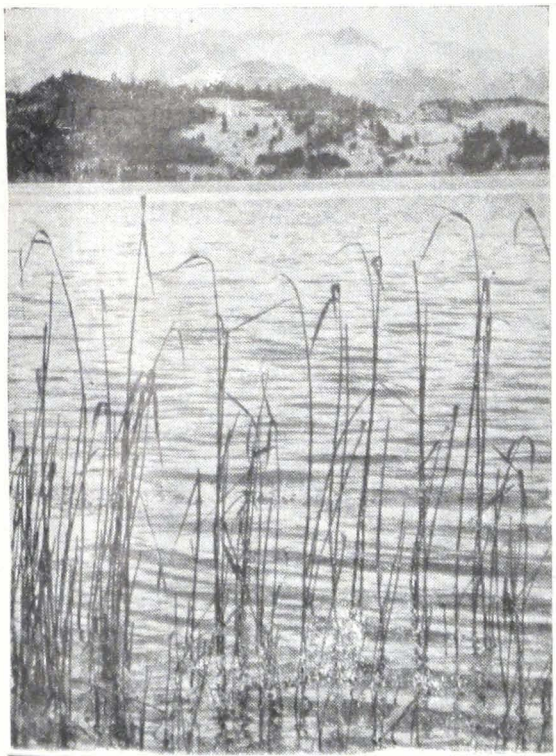

1. A view of rural landscape in the Kathmandu Valley. (Photo: United Nations)

2(a). Lake Rara in winter.

2(b). Lake Rara in summer. Reed beds around the edge of Rara are attractive to water-fowl. (Photo: Will Weber)

3. A typical farm in the Trisuli watershed region. (Photo: United Nations)

←2(b)

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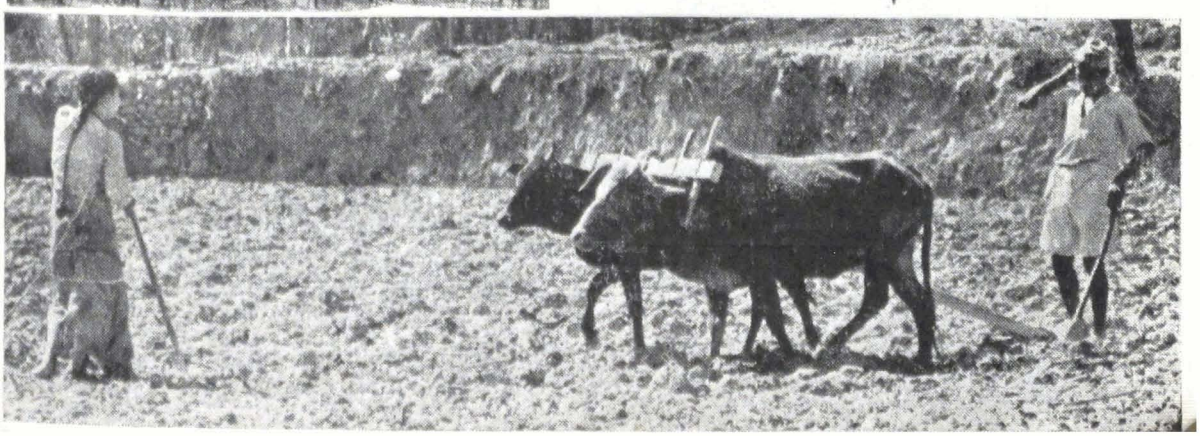

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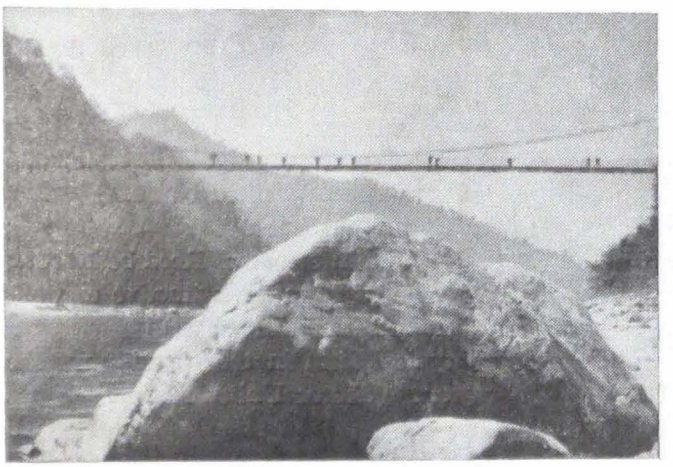
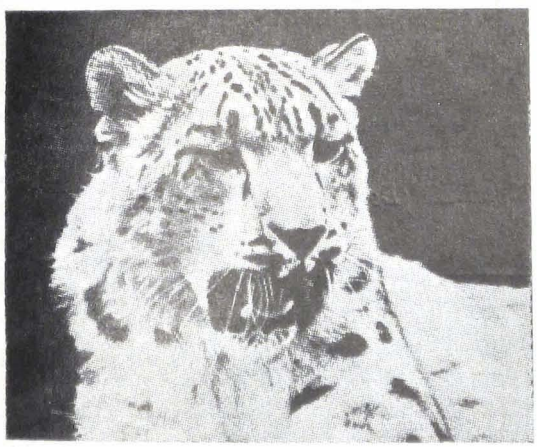


(6)

4. A group of Tamang porters in the mountains of Nepal.
(Photo: United Nations)
5. The Everest Mountain.
6. Bridge over Tamur river on way to Dhankuta.
7. Houses are mainly constructed of stones in the midlands and the trans-Himalayan region. Here is a typical house in Langtang.

(7)

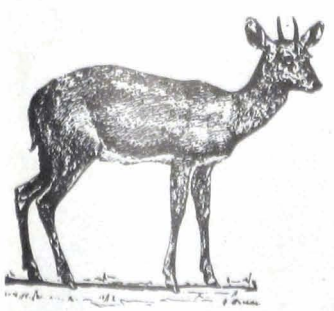
(1)



1. A tranquilized tiger waking up in the Royal Chitwan National Park. (Photo: Dietrich Schaaf)
2. Snow Leopard (Panthera uncia) is reported to occur in Langtang valley during certain seasons. (Photo: WWF Hosking)

←(2)

3. (a) Four-horned Antelope (*Tetracerus quadricornis*), (b) Serow (*Capricornis sumatraensis*), (c) Blackbuck (*Antilope cervicapra*), (d) Tibetan Sheep(*Ovis ammon*), (e) Himalayan tahr (*Hemitragus jemlahicus*), (f) Sambar (*Cervus unicolor*), (g) Swamp deer (*Cervus duvavceli*).



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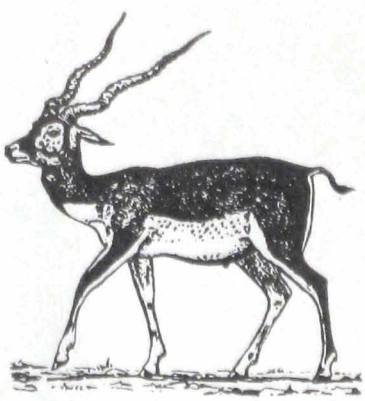
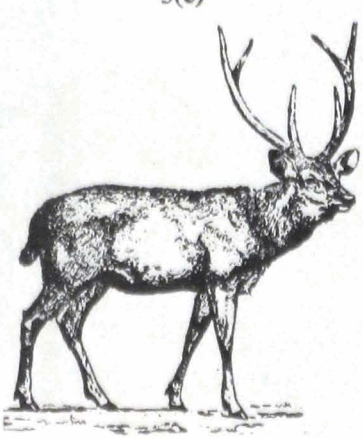
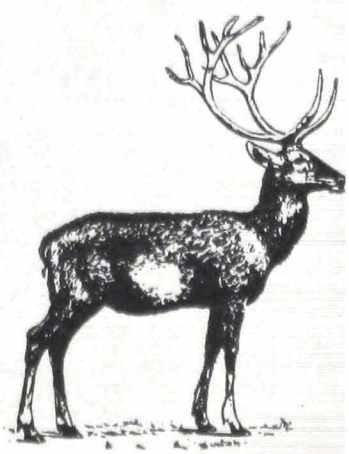


3(c)

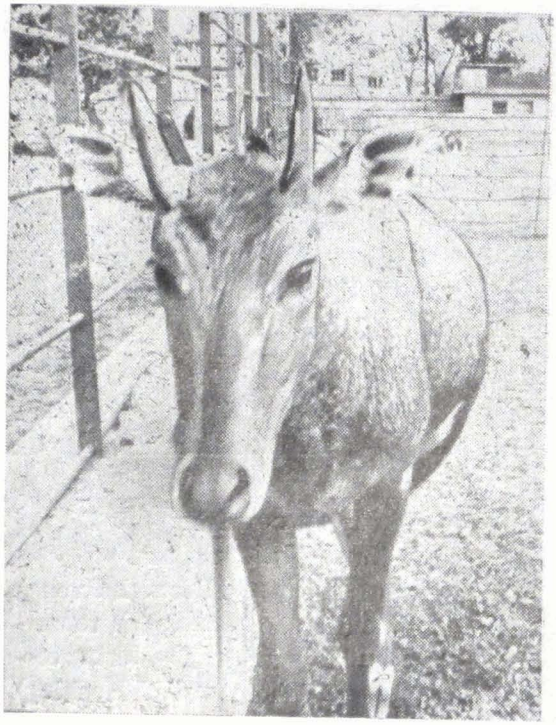
3(d)

←3(b)



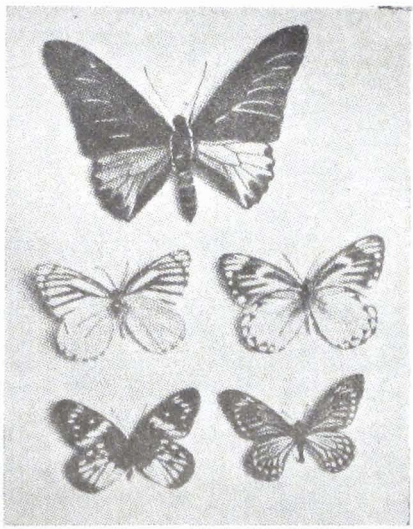


←3(e)

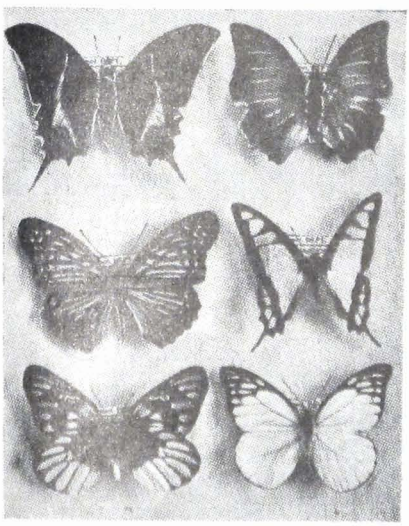


4. Blue Bull (*Boselaphus tragocamelus*).

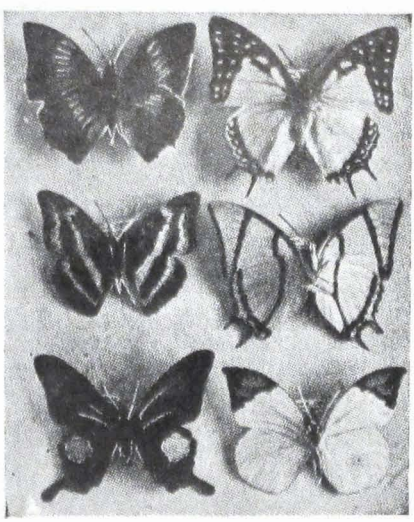
5. Royal Chitwan National Park.
(Photo: Jack Seidensticker)



6. (a) Butterflies visiting flowering trees. *Troides aecus, Delias agostina, Delias descombesi, Delias aglaia, Chilasa epycides.*

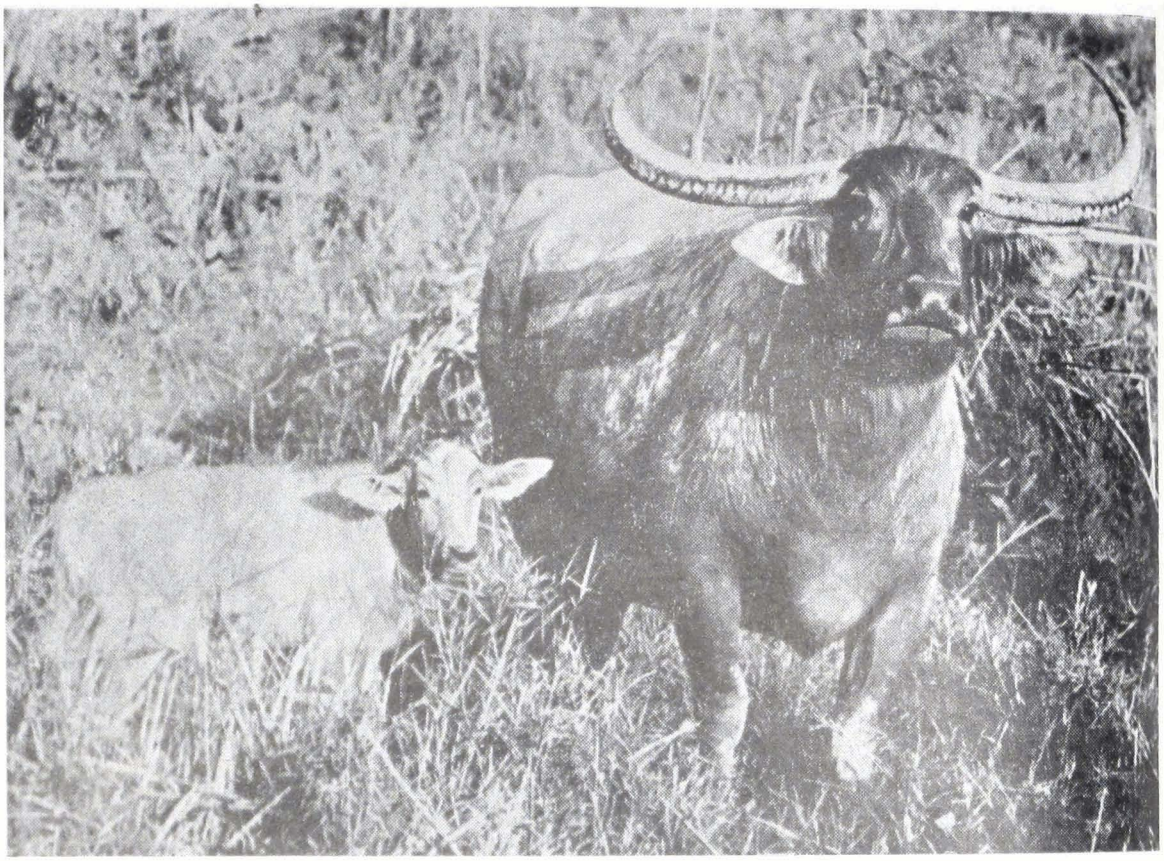


6. (b) Butterflies of Hilltops. *Teinopalpus imperialis, Hestina nama, Delias thysbe, Polyure eudamippus, Polyura dolon, Hebomoia glaucippe.*



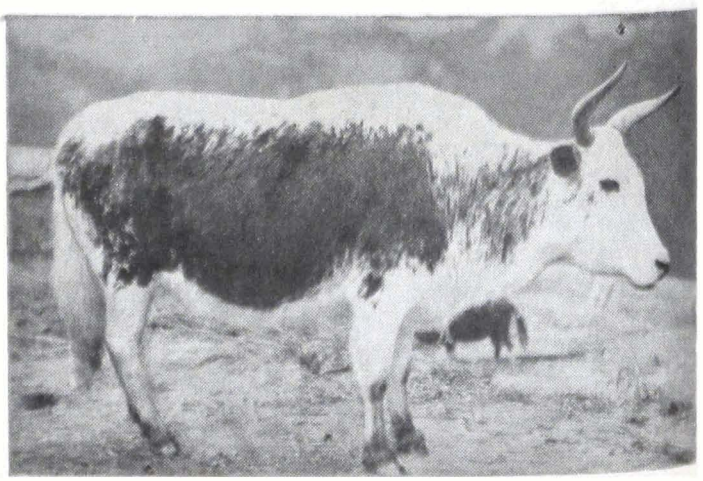
6. (c) Butterflies visiting water. *Charaxes polysena, Limenitis denava, Papilio paris, Charaxes marmax, Graphium cloanthus, Prioneris thestylis.*

(Photos: Colin Smith)

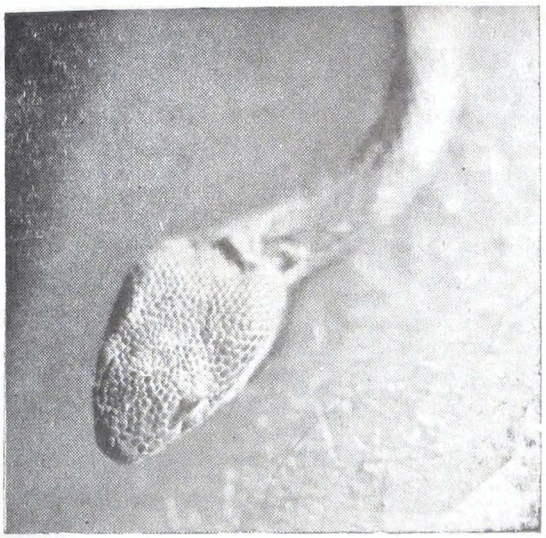


↑
7. Wild Buffalo (*Bubalus bubalis*).
(Photo: WWF)

←8. The Red Panda (*Ailurus fulgens*) is common in the Langtang Park.
(Photo: WWF)



9. *Chauri* in Langtang.
(Photo: FAO)

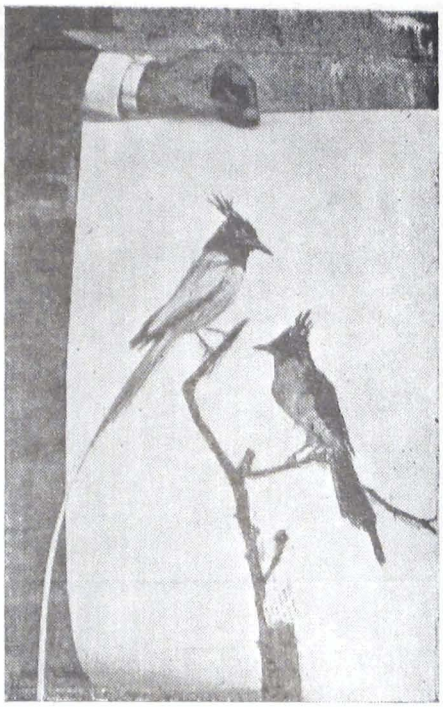


10. The Pit Viper (*Trimeresurus albolabris*) is common in the Kathmandu Valley. (Photo: Brian F. C. Sennitt)

11. The common Langur Monkey. (*Presbytis entellus*) (Photo: John Bishop)

12. One-horned rhinoceros in Royal Chitwan National Park. (Photo: Andrew Laurie)

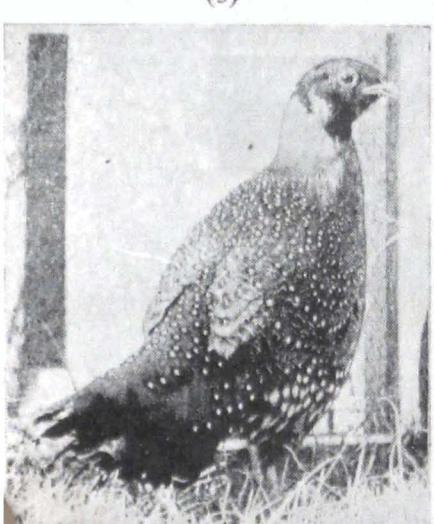
(1)→



←(2)

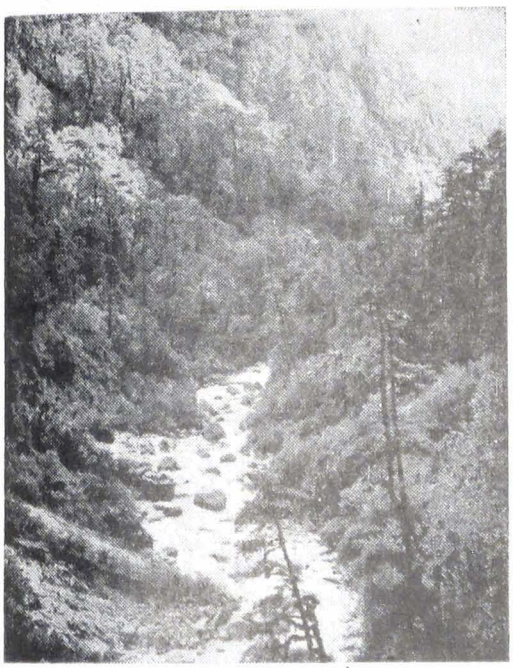
(3)

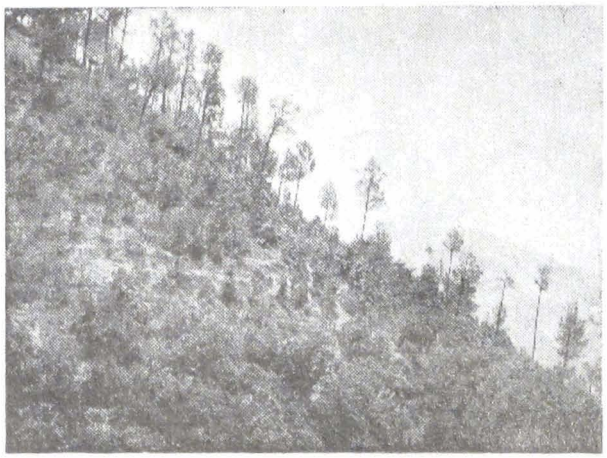
(4)



←(5)

1. *Tokus birostris*, Great Hornbill "Dhanesh".
2. *Terpsiphone paradisi*, Paradise Flycatcher.
3. *Leptoptilos dubius*, Greater Adjutant Stork.
4. *Anthracoceros malabaricus*, the Common Hornbill.
5. *Monal* pheasant in captivity.



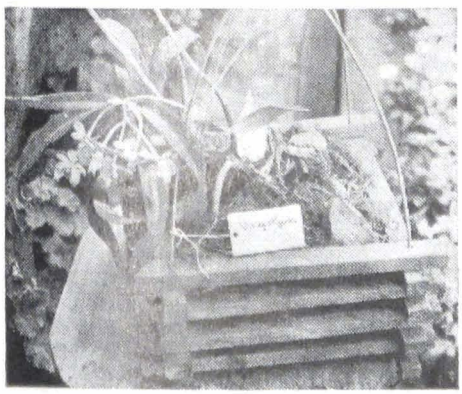


(2)

←(1)

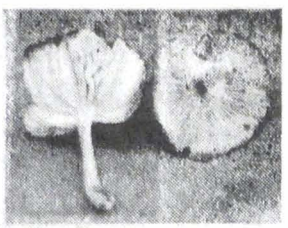
1. Native forest—Dense stands of fir and hemlock still line the upper Langtang Khola in proposed Langtang National Park.
2. Mixed forest of *Schima—Castanopsis*, higher up *chir* pine.
3. An Orchid (*Vanda* sp.).
4. (a) *Boletus* sp., an edible fungus found growing in the pine forest. (b) *Clitocybe* sp., (Photo: S.C. Singh). (c) *Agaricus Campestris*, the mushroom which makes its appearanee as soon as rains set in. (d) *Lipiota procera*.

(Photo: S. C. Singh)



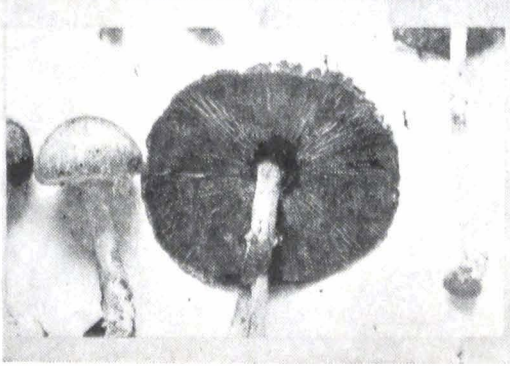
← (3)

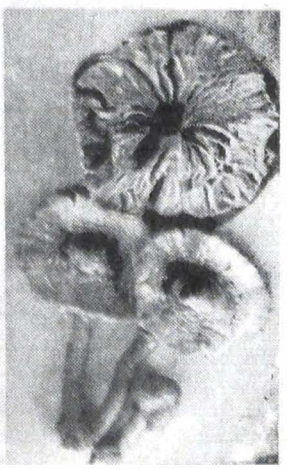
4(a)→



←4(b)

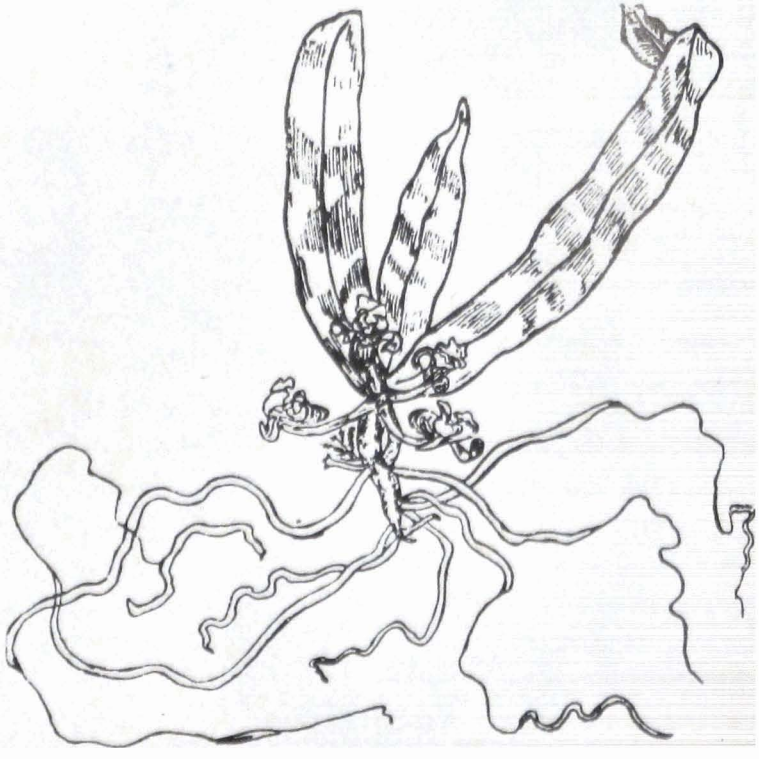
4(c)→





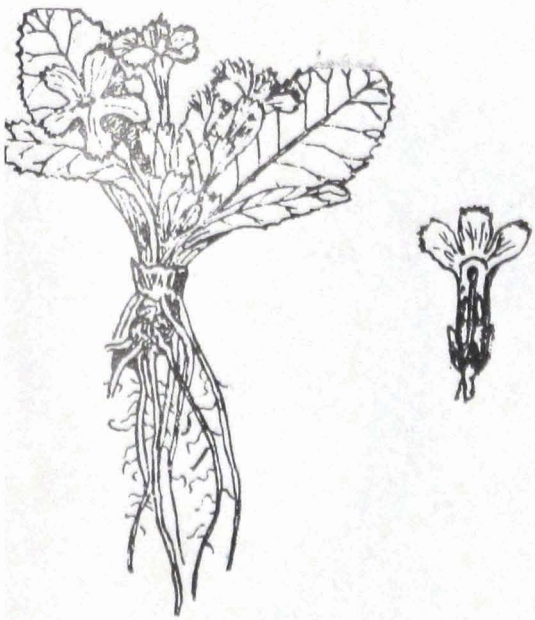
←4(d)

1. *Oxyspora paniculata.*

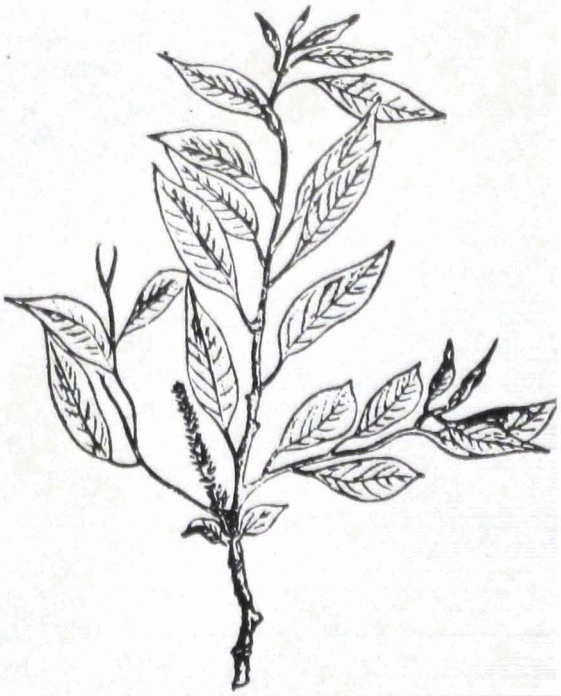


2. *Gastrochilus* sp. (Orchid).

3. *Castanopsis tribuloides* (Katush).

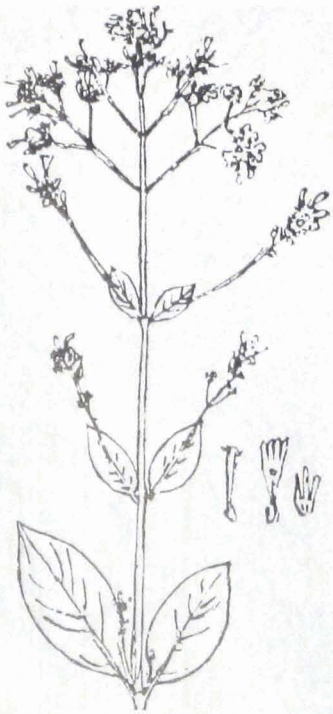


4. *Primula gracileps.*

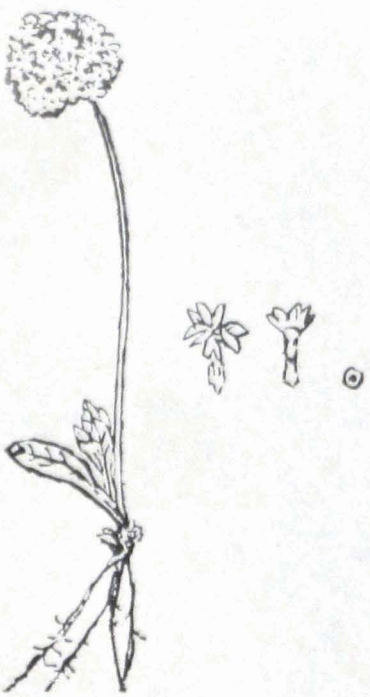


5. *Salix wallichiana.*

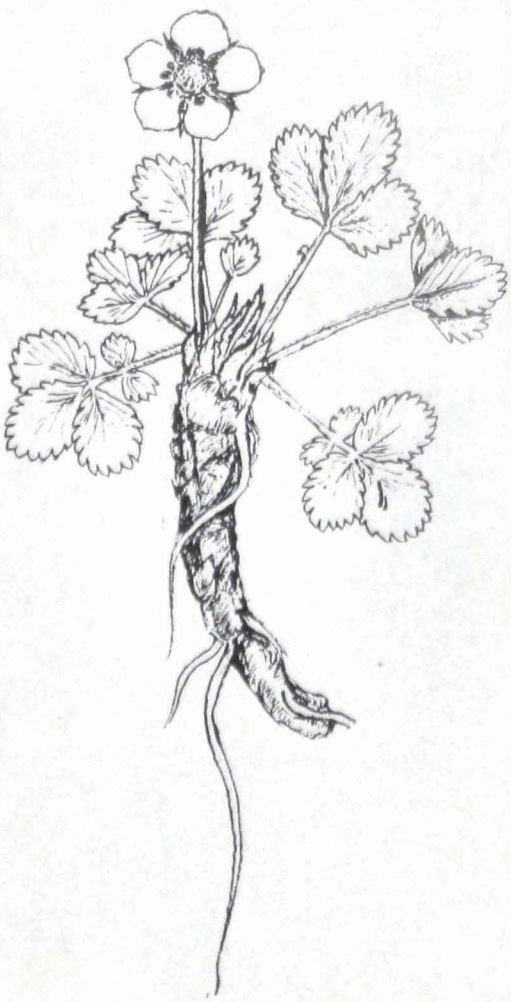
6. *Lobelia pyramydalis.*



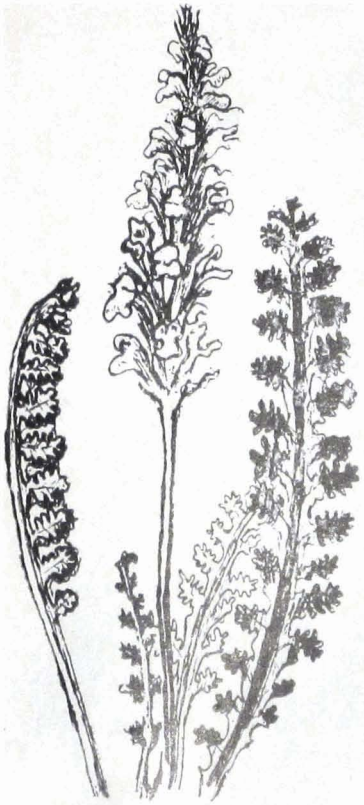
7. *Spermadictyon suaveolens.*
(Hamiltonia suaveolens)



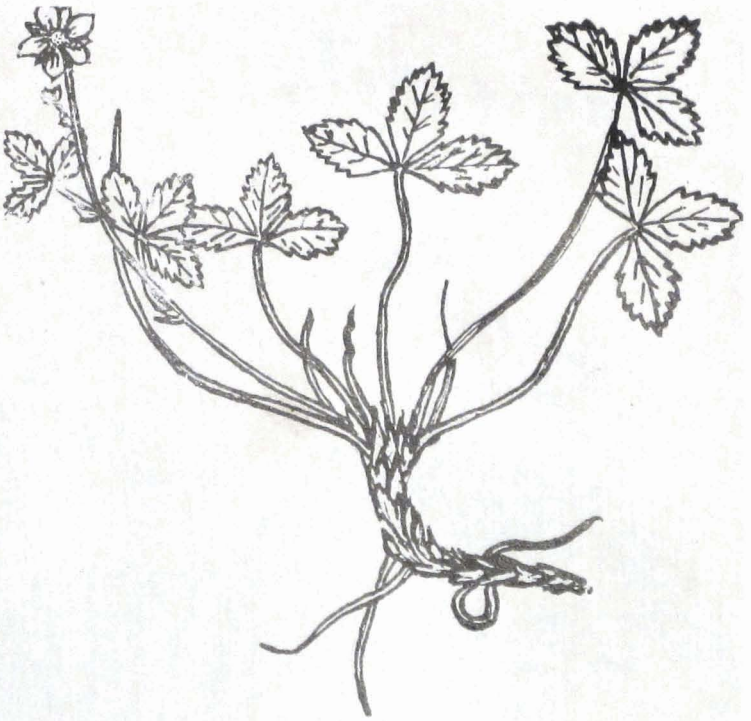
8. *Primula denticulata.*



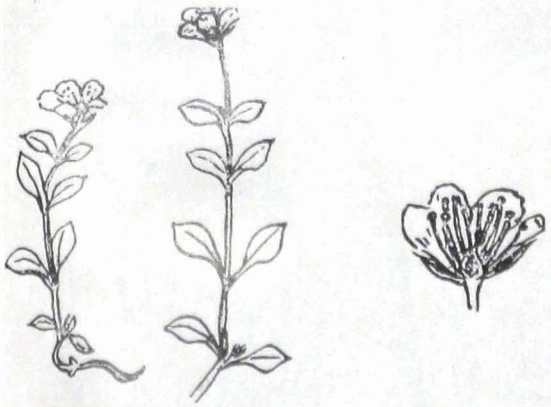
9. *Fragaria nubicola* (9,000 ft., Namche Bazar).



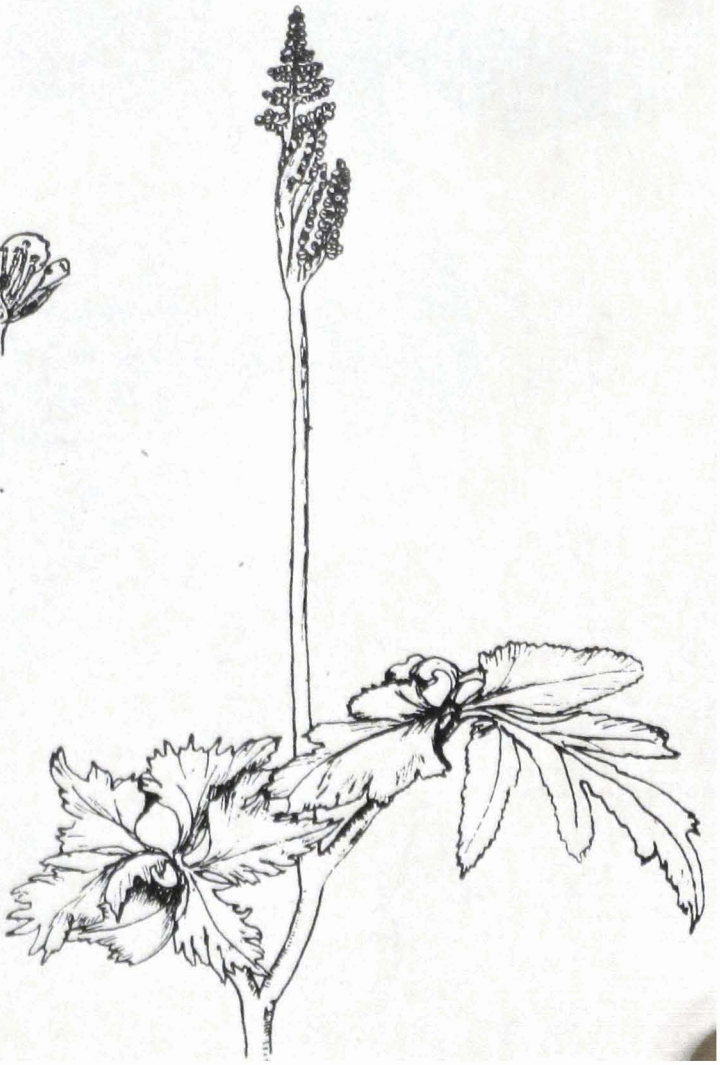
10. *Pedicularis* sp.



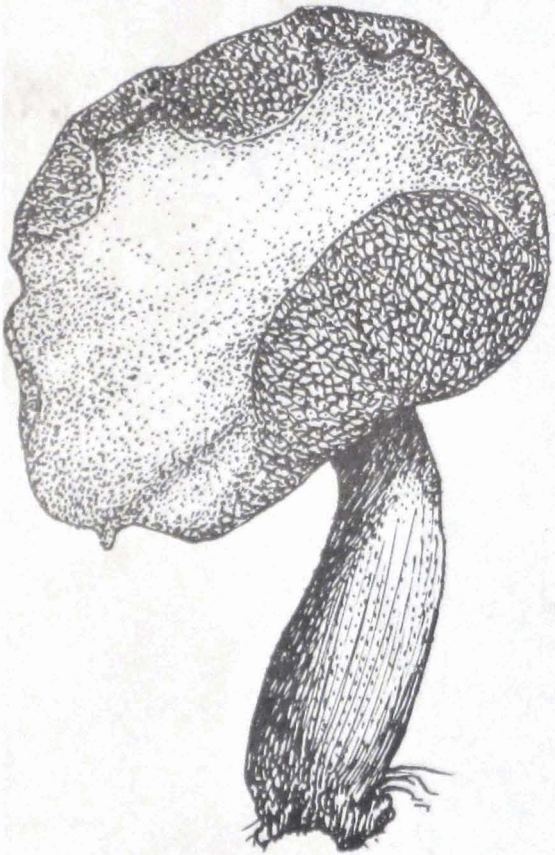
11. *Fragaria indica.*



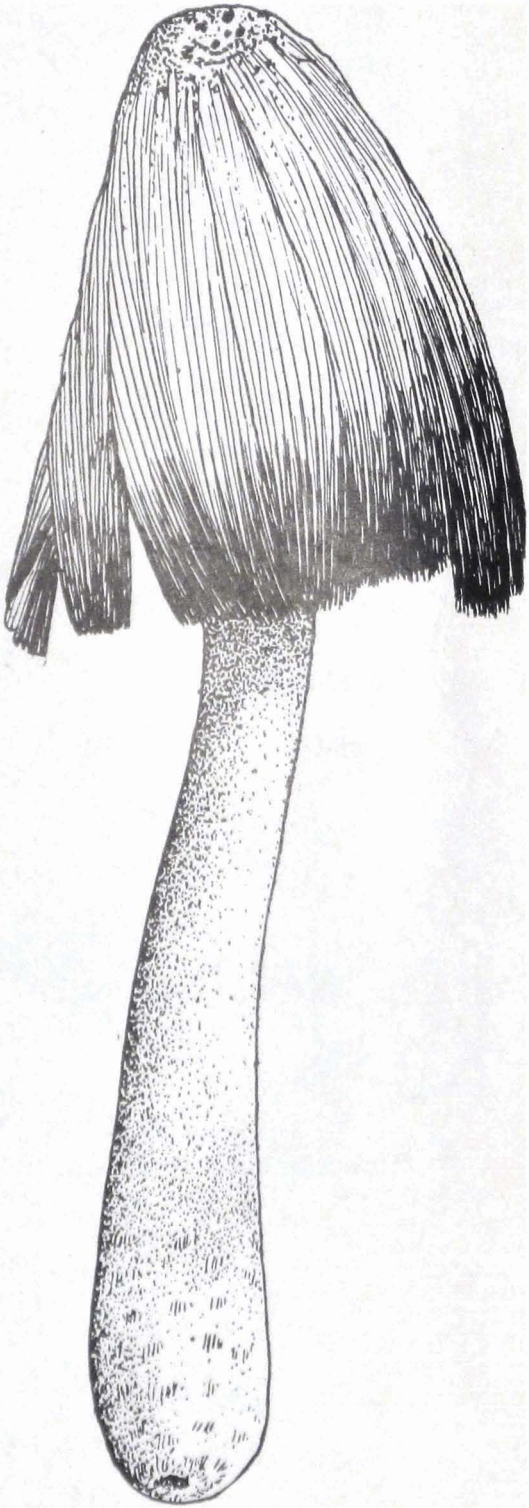
12. *Psudostellaria cashmiriana* sch.



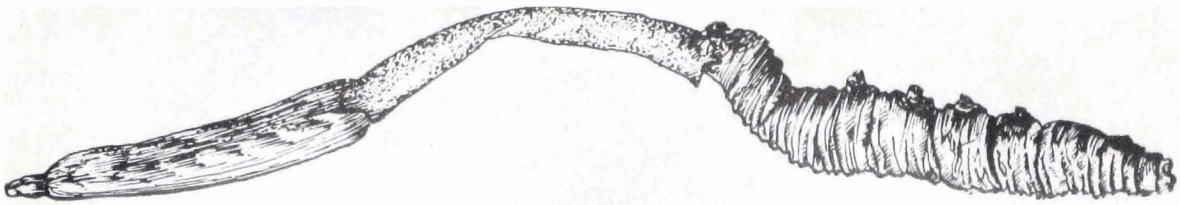
13. *Botrychium lanuginosum* wall.



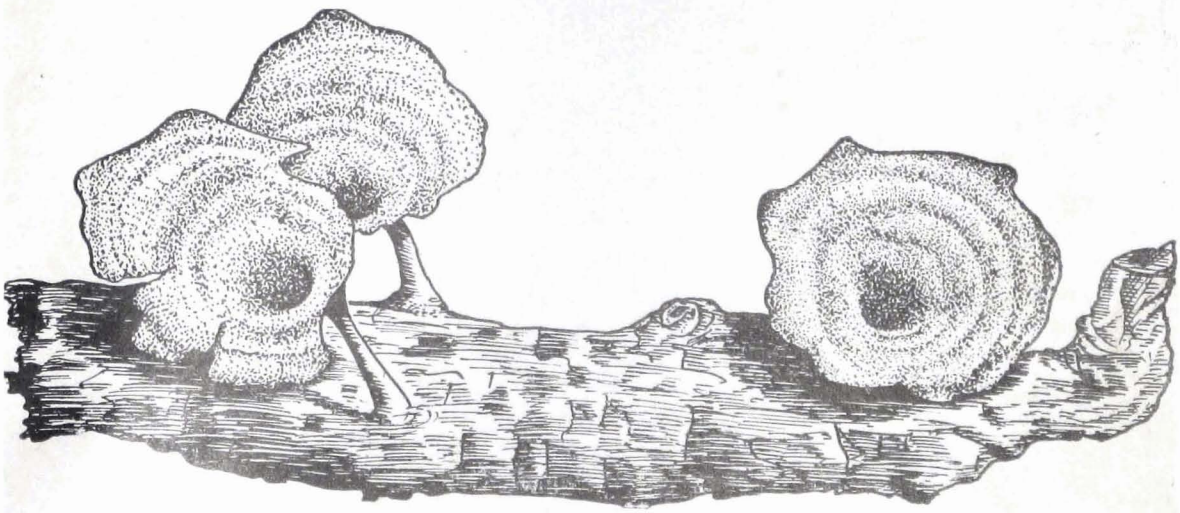
14. *Boletus edulis*.



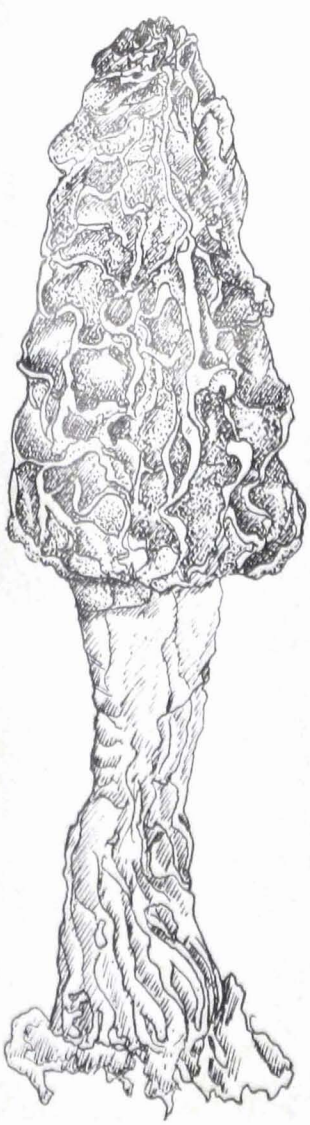
15. *Coprinus* sp.



(16)



(17)



(18)

16. *Cordyceps sinensis* (Yarsa gumba).
17. *Polystictus* sp. growing on a log.
18. *Morchella conica* is found in the pine forest in Nagarjun.

distance of up to about 914 m. Small gaps are left in the fence at intervals of 18 m to 45 m in which are set rope nooses attached to small saplings which are bent over and secured to a trigger mechanism incorporated in a platform of sticks. An animal passing through the gap actuates the trigger mechanism, thus releasing the sapling which draws the noose tight either around its neck or legs, depending on the way in which the snare has been set. It is then held until it either dies of strangulation or the owner of the trapline finds and despatches it. This system of trapping is particularly destructive and wasteful, since it is indiscriminate and kills both males and young, although it is only the mature male which carries musk.

Musk is purchased from the poachers by traders in Kathmandu, Jumla, Pokhara and other centres at about Rs. 400 per *tola* (about 12 grams). It is then sold to the exporters at a price three times this. Single deer may yield 36-48 gm of musk and so it is obvious that the profits from this illicit trade are substantial. There is some smuggling of musk from across the border (Tibet), where it is commonly obtained on a barter basis (12-24 gm of musk = wrist watch).

Wild Sheep

Blue Sheep (*Pseudois nayur*) has not been sighted but it may be found within the Park area.

Wolf (*Chougu, Canis lupus*)

These occur in packs or singly on ridges above the Upper Bhote Kosi and in the Gosainkund region.

Leopard (*Panthera pardus*)

It is found over a large area right up to the timber line. The animal is trapped by the local inhabitants by stone traps. Besides domestic animals, it preys upon musk deer, barking deer, Goral, sheep and goat.

Trapping of Leopard

Traps are regularly employed for capturing leopards which become a menace to livestock and poultry. Leopard is lured into a trap with two compartments each fitted with a trap door. A goat is kept tied in the inside compartment and when the animal enters the cage, it touches a wooden stick, which makes both the doors shut simultaneously.

Leopards eat a variety of food — deers, dogs, monkeys, porcupines, birds, reptiles, rodents, crabs, etc. Their chief natural enemy is tiger.

The Cat-Bear or Red Panda (*Ailurus fulgens*)

The Red Panda, locally called *Bhaloo Biralo* (*Wah donka* in Tibetan), belongs to the sub-family Procyonidae of the Carnivores. It has a cat-like white face with a chestnut red furry coat. It is distributed in Nepal eastward to Sikkim and southern China. It inhabits bamboo and fir forests and is one of the animals which a visitor to Langtang comes across commonly. In feeding habits, it eats besides the bamboo shoots, small birds, rats and mice. It is also reported to catch fish, for which its claws come in handy.

The Red Panda has been over-exploited by the poachers who find a ready market for this animal, which when kept in captivity, is a nice pet. In Nepal, it has now been put on the protected list.

Snow leopard, listed animal, is hardly seen, though there is a possibility that it occurs in Mailung Khola. Its main prey is blue sheep which, according to one source, 'are sometimes seen on the Chinese side of Chilme Khola (Janjink) and may therefore occasionally stray into the Nepal side of the Valley'.

Wild boar is a common animal in the forest and scrub, and it causes much damage to crops, including potatoes, the principal crop of the area.

Both Assam Rhesus monkeys, and Langur monkeys have been recorded.

Barking deer is the commonest animal. It is a hardy, adaptable species, inhabiting both forest and scrub land.

Goral, often called *goral thar*, is another common mammal. It is a goat-antelope living in the forest and scrub, coming out in the clearings in the morning and evening.

Mouse Hare, Rock Rabbit (*Ochotona roylei*)

This animal is common at elevations between 3,350 m and 4,900 m. It is the size of a water vole with a round whiskered face. It is mostly found at about 3,657 m during summer. It changes its coat — dark brown to grey.

Martens (*Martes sp.*), weasels, civets and Orange Bellied Squirrels (*Lokharke*) are common in the forest area, between 914 m

and 2,743 m. They are nocturnal animals and are found in the Shivpuri range.

Flying squirrel, locally called *udne musa* (*Petaurista albiventer*) is an inhabitant of oak-rhododendron forest, eating mostly nuts and fruits.

There are no reports of fish, but snakes and ambhibia have been recorded. Bamboo Viper (*Trimeresurus gramineus*), and frogs (*Rana polunini*) have been reported from Langtang.

Bird Life

The Park has a rich bird life. Besides the 40 species of birds recorded by Polunin, who came with the Tilman expedition in 1949, Fox has added 181 species. Along the river courses and streams, Red-start is common. Himalayan choughs, wild crows, Wagtails and Snow pigeons are the birds which are quite common in upper Langtang.

Ungulates

In the Nepal Himalayas, Ungulates (grazing animals) can be found right up to the snowline. One of the most important animals in these parts is the Himalayan Tahr, locally known as *jharal* (*Hemitragus jemlahicus*). Of the other animals, the Great Tibetan Sheep or *Nayan* is rare, but the *Jharal* 'an evolutionary link between the sheep and goat' is still fairly common.[1]

Jharals are excellent climbers and can be seen grazing in precipitous cliffs. During the cold season, they descend as low as 2,133 m and it is during this period that they are hunted. Their feet are well adapted to climb; their soft hoof pads, callused hocks and breast help them 'to traverse near vertical cliff faces and leap from one narrow ledge to another to outdistance their hunter or predator unwilling to risk a thousand feet (305 m) tumble'.

Tahrs are gregarious animals. Observers have recorded herds upto 20 individuals in Khumbu at an altitude of 3,962 m in October.[2]

Jharals have short and close set horns which may reach 17 inches in exceptional specimens. The meat of the female Tahr

1. Mishra, Hemant and Weber, Will. 'The Grazing Animals of the Himalayas.' *The Rising Nepal*. August 30, 1974.

2. Fleming, R. L. 1974. 'A Note on the Himalayan Tahr in the Khumbu.' *Newsletter*. Nepal Nature Conservation Society. No. 22.

is excellent but that of male is musky or goaty. The animal is poached heavily.

Blue Sheep (*Pseudois nayaur*)

Blue sheep shows resemblance to both sheep (*Ovis*) and goat (*Capra*), which is found 'at altitudes of 15000 ft (4572 m) to 19,000 ft. (5791 m)'.[1] It inhabits remote and barren areas beyond the main Himalayan range, above the treeline. In Nepal they have been recorded from many places — on the western and southern flanks of Dhaulagiri, along the upper reaches of the Arun river, Jumla, Humla and Langtang. Sizable herds are known to occur in Shey Gompa in Dolpo district and in Dhorpatan area, where private parties arrange hunts.

The animal gets its name from slaty blue colour of the males in winter. At close quarters they look like sheep. According to Schaller, 'they seem to avoid woody terrain, being usually found above thickets of juniper, birch and stunted trees that make the timberline — at altitudes above 3,500 m and upward at least 5,000 m'.[2]

Schaller watched 48 individuals in the Upper Kung Chun valley, and noted that they move up the mountain when herdsmen become active in the Valley below. The 'Courtship Displays' comprised curling of lip, low stretching, kicking, stretching and penis into mouth. 'Aggressive Displays' included broad-side display, horning, vegetation, jerking and lunging, head shake, jumping, butting and chasing. Males of sheep (*Ovis*) and goat (*Capra*) behave differently when they meet their opponents. Sheep run at each other sometimes from a distance, producing quite an impact. Goats, on the other hand, stand bolt upright, then lunge forward against the horns of the adversary. In this respect, Blue Sheep resemble goats.

Blue sheep feed upon dead vegetation and also on grasses, such as *Festuca*, *Trisetum* and *Panthonia*. They are also seen feeding upon legumes (*Thermopsis barbata*) and various shrubs: *Berberis*, *Cotoneaster* and *Ephedra*.

The herd at Shey Gompa are tame as they have received complete protection from the Lamas. Around Shey Gompa, a country of rolling hills, 'animals occur in groups of 20-30'. The proposed

1. Burrard, G. 1925. *Big Game Hunting in the Himalayas and Tibet.* Herbert Jenkins. London. p. 80.

2. Schaller, George B. 1973. *Jour. Bomb. Nat. Hist. Soc.* 69 (3): 523-537.

Shey Gompa Wildlife Reserve would provide further safeguard to these animals. In other parts, however, there is need to regulate hunting and curb the activities of poachers.

The Great Tibetan Sheep (*Ovis ammon hodgsoni*)

This animal reportedly occurs in eastern Dolpo. It is also known as Macro Polo's Sheep in some parts, and is a true sheep. It had a much wider distribution in the past, having been observed by J. D. Hooker along Nepal-Sikkim border.

Of the animals found below the treeline, is the Yellow-throated Himalayan Marten (*Martes flavigula*). It hunts squirrels, mice, hares, pheasants and partridges and, occasionally, even small deer. It varies its diet and when need arises, does not hesitate to eat snakes, lizards and insects. It is essentially an animal of the temperate forest and usually hunts alone.

Himalayan Striped Squirrel (*Callosciurus macclellandi*)

Himalayan Striped Squirrel is a small mammal—about 5 inches in length from nose to the base of the tail. It has a distinctive black-brown coat with stripes on its back. It inhabits temperate forests and feeds largely upon berries, particularly of *Ribes*.

An interesting aquatic animal—the Web-footed Water Shrew, known previously from West China and Sikkim has also been discovered in the Arun Valley area. This small rat-sized animal is highly specialized for aquatic life in the fast flowing streams. The body shape closely resembles that of the otter; there are suction cups on the bottom of the feet for gripping wet slippery rocks and the nose and feet are supplied with highly sensitive hairs which help the sightless animal find its prey of aquatic insects. It is reportedly found at 2,130 m in one of the tributaries of the Arun Valley.

The Scaly Ant Eater, Pangolin, Salik (*Manis pentadactyla*)

An odd looking animal, 'the Chinese Pangolin', which has a long cylindrical body covered with scales (in fact greatly flattened hairs) is found in the Langtang Valley as well as in eastern parts of the country. It is captured or killed by smoking the hole or flooding it with water and is frequently brought to Kathmandu by people from the eastern hilly districts. It lives in burrows, which it digs with sharp claws. It can climb trees well and is

nocturnal. When sensing danger, its whole body curls into a ball-like shape. Its food consists of vegetative shoots and ants, which it digs out from the ant hills. It does not survive long in captivity. Decoction of these animals is used as an aphrodisiac. Pangolin meat is edible, and is supposed to be of medicinal value. Chiefly, leopards prey upon it.

Tourism

Langtang National Park is an area of rich natural beauty, unparalled for alpine flowers. The Valley has an average altitude of 3,048 m, dry and mountainous with extensive pastures. The area is of considerable religious importance also, for there are many sacred lakes here — the Gosainkund — which is the largest of the three, looks like a green jade at about 4,380 m. The lake is sacred to all the Hindus, who visit it by hundreds every year — particularly during the months of August and September. In fact, the Gosainkund itself would be an ideal spot for the tourists once trekking facilities are improved.

Trekking

There are many ways to travel into Langtang Valley — trekking, flying by STOL and helicopter. It has lately become increasingly popular. A trek to Langtang and back, usually takes about two weeks. One could take either of the two routes — an easterly route, which is the more difficult of the two because of the high pass of *Ganja La* (5,119 m) and more easier western route by way of Trisuli, a town about 77 km away from Kathmandu, and connected with the latter by a motorable road. From Trisuli, the trek goes north. The first big village is Syabrubesi, which is reached after three days of hard walk from Trisuli. The village lies at the confluence of two rivers — Langtang and Bhote Kosi, which then become Trisuli River. From Syabrubesi, the path leads through steep grassy slopes, until at 2,438 m, a Sherpa village is reached. From here, the trek is less steep. The principal settlement is in Upper Langtang — at Langtang Village. It has about 30 houses, including an old monastery. Situated at a height of 3,352 m, the people are Bhotiya Tamangs, whose main occupation is agriculture and animal husbandry. The establishment of a cheese factory has helped the local people economically. A little way down is the new Khampa settlement at Tcherpa Nesa.

The Khampas live in neat wooden houses, the insides of which remind a visitor that the inhabitants are culturally distinct from the local Bhotiyas. Their population does not exceed 100, mostly males. Khampa is a nondescript word, used freely for Tibetan nomadic tribes, some of whom at least in the past, indulged in highway robbery. In the wake of the disturbances in Tibet in the late fifties, some groups entered Nepal to seek refuge. The group now at Tcherpa Nesa originally lived in Manang and it is only in 1971 that they moved into Langtang and settled down to farm.

The establishment of the National Parks and Wildlife Conservation office has created a sense of awareness among local population for nature conservation, but with a large herd of yak and sheep and an increasing pressure upon the local forest for firewood and timber, the future of the Park is uncertain. Excessive grazing by sheep has created the problem of sheet erosion and the fact that the authorities across the northern border do not allow livestock to enter their territory, the pressure on the local grazing grounds has become all the more serious.

Game Animals

The forests of the Terai and *duns* shelter some of the finest game animals. During the Rana regime, the ruling family possessed *carte blanche* authority to shoot wild animals. And how effective they were in using this prerogative is evident from the following account of *shikar*: 'In one hunting expedition, Jung Bahadur killed 21 elephants, 31 tigers, 7 stags, 1 rhinoceros, 1 boa constrictor, 11 wild buffaloes, 10 boars, 1 crocodile, 4 bears, 20 deer, 6 pheasants and 3 leopards.'[1]

Three successive generations of the British monarchs have shot in the Nepal Terai. King Edward VII, when he visited Nawalpur in 1886, bagged 23 tigers, 1 leopard and 1 bear. His son, King George V, shot 'in one day in Chitwan' 10 tigers, 1 rhino and 1 bear, in 1911. The Duke of Windsor, Prince of Wales, visited Bhikana-thori (Nawalpur) in 1921. At the end of *shikar*, he was presented by Maharaja Chandra Shumsher the following birds and animals—'all destined for the London Zoological Gardens'.[2]

1. Jung, Padam. *Life of Jung Bahadur*, as quoted by D. D. Bhatt in 'Wildlife in Nepal and its Preservation.' *Vasudha*. 1958. 1 ; p. 12.

2. Ellison, Bernard. 1925. *H. R. H. The Prince of Wales's Sport in India*. London, Heinemann.

MAMMALS AND VERTEBRATES

1 Baby elephant
2 Rhino calf
2 Leopard cats
2 Himalayan black bears
1 Leopard (Black)
1 Tiger
1 Tibetan fox
1 Mountain fox
2 Sambhurs
1 Thar
1 Unicorn sheep
3 Musk deer
1 Four-horned sheep
1 One-horned Tibetan Shawl Goat
2 Tibetan Mastiff
4 Tibetan Mastiff Pups
1 Monitor
1 Python
4 Nepali Kalij
1 White-crested Kalij pheasant
4 Monal pheasants
4 Cheer pheasants
2 Koklass pheasants
4 Chukor partridges, Swamp partridges
2 Green pigeons
10 Bronze-winged doves
3 Great Indian Adjutants
1 Hawk
Pea fowl

In the course of the *shikar*, the Prince shot 17 tigers, 10 rhinos, 2 leopards, 1 bear, 7 jungle fowls, 2 partridges, 15 snipe, 1 peacock, and a hamadryad — all during a period of 8 days.

Royal Hunts

The Royal Hunts (a thing of the past) were quite a spectacle. Scores of elephants were employed to ring the animal after it had succumbed to the bait—a buffalo. Expert *shikaris* went on probing rides through the dense jungle and once they had located the animal, word was sent to the camp. The tiger preferred to lie down in the sun after it had feasted on the bait. The process of ringing the tiger 'started with erecting a wall of white cloth about 4 or 5 ft. (1.2-1.5 m) high; then the trained elephants go into the ring and move around in the bushes and thickets. Once the tiger is disturbed, it always makes an angry growl. Thus we finally know that the tiger is in our ring and everyone becomes alert. Seldom are we unlucky enough not to locate it'.[1]

Ellison's[2] account of a Royal Hunt is interesting:

1. Shah, M. B. B. 1967. *A Handbook of Big Game Hunting*. Katl mandu.
2. Ellison, Bernard. 1925. *Op. cit*. p. 10.

'. . . . Again and again he is driven out only to such cover in the long grass away from the guns. A *shikari* climbs a tree and pelts him with stones. The manoeuvre succeeds and once again we get a half length view of the tiger as he makes a spring at his tormentor in the treetop. The ring closes in upon him but with a roar he dives into long grass: another roar and he shows quite near the Royal *howdha*. A moment's suspense and HRH fires, and a second afterwards two more shots ring out. The Prince has hit the tiger who though mortally wounded, has plenty to go in him and charges to the opposite side and is buried once more in the heavy cover. The ring closes in; a shot rings out and the tiger rolls over dead.'

Trapping of Wild Elephants

Wild elephants were once distributed over a much more wider region; in the middle of the last century, they were regularly captured by 'lasso' method in the neighbourhood of Hetauda. The wild elephants came all the way from the east (Morang) and entered one of the valleys leading into Makwanpur. After making sure that the herd had moved into the valley, the latter was sealed at the two ends. A large posse of army was deployed to drive these into a valley and incessant firing and beating of drums were employed to frighten the wild elephants, which were ultimately lassoed. With the help of expert domesticated elephants, the captured animals were tired out 'by running and pulling against the ropes, as an angler lets a large fish play and run off with the line — before he attempts to land him'.

Jung Bahadur was very interested in the capturing of wild elephants, a fact which is given credence when one goes through the account of Oldfield:

'. . . shortly before sunset, as I was sitting outside my tent smoking a cheroot with General Ranudate Singh, Jung returned to camp, bringing with him in triumph a fine female elephant, which he had caught after we left him. He had come upon a small herd of them, but only succeeded in separating and securing this one. The lasso having been well secured round her throat, one end of the long rope was fastened to one large tame elephant, who went before, leading the way, while the other was, in the same way, fastened to another large tame elephant (Jung's own

on which he was seated), who followed in order to administer a push or prod with his tusks as a reminder in case the newly captured one jibbed or objected to go on.'[1]

It seems that the method of capturing the wild elephants through driving them in a valley, firing volleys at them to force them up the valley and the use of domesticated elephants—whose expert *mahouts* threw ropes around the necks of the wild beasts—all unique to Nepal, are a thing of the past now. There are a few elephants which enter the territory in the east and west, but there is no sizable population of elephants in the country.

Principal National Parks/Wildlife Reserves and the wild animals which can be viewed here have been given in Table 21.

TABLE 21

Park/Wildlife Reserve	*Area*	*Wildlife*
1. Royal Chitwan National Park	533 sq. km	Rhino, Tiger, Leopard, Sambar, Barking Deer, Bison, Sloth Bear, *Chauka*, Spotted Deer, Wild boar, Crocodile, Gangetic Dolphin.
2. Thakur Dwara (Bardiya)	363 sq. km	Tiger, Sambar, Spotted Deer, Leopard, Laghuna, Barking Deer, Blue Bull, Blackbuck, Crocodile.
3. Sukla Phanta (Kanchanpur)	155 sq. km	Tiger, Leopard, Elephant, Swamp Deer, Spotted Deer, Sambar, Laghuna, Barking Deer, Blue Bull, Wild boar, Porcupine, Rhesus monkey, Langur monkey, Blackbuck (?), Pigmy hog (?).
4. Langtang (Proposed)	1,294 sq. km	Musk deer, Goral, Jharal (Tahr), Serow, Red Panda, Yak, Snow Leopard, Wild Sheep.

(Contd.)

1. Oldfield, H. Ambrose. *Sketches in Nepal*. Cosmo Publications, Delhi (Reprint).

TABLE 21 (*Contd.*)

5.	Kosi Tappu	31 sq. km	Wild buffalo, Tiger, Hog Deer, Spotted Deer, Blue bull, Wild boar, jackals.
6.	Mt. Everest National Partk (Proposed)	1,243 sq. km	Snow leopard, Black bear, Red Panda, Wolf, Weasel, Marten, Pika Mouse, Himalayan Tahr, Blue Sheep, Goral, Serow, Musk Deer.
7.	Lake Rara (Proposed)	104 sq. km	Leopard, Himalayan bear.
8.	Shey Gompa	413 sq. km	Blue Sheep.

In Nepal, the following animals and birds have been given protection and their hunting is completely prohibited:

Animals

1. Rhinoceros (*Gainda*)
2. Wild elephant (*Jungali Hathi*)
3. Wild buffalo (*Arna*)
4. Clouded Leopard (*Dhaunse Chitwa*)
5. Snow leopard (*Hiun Chitwa*)
6. Musk deer (*Kasturi mriga*)
7. Wild yak (*Junglee Chauri gai*)
8. Bison (*Gauri Gai*)
9. Blackbuck (*Krishna saar*)
10. Four-Horned Antelope (*Chauki, Chauka*)
11. Swamp deer (*Barasinga*)
12. Great Tibetan Sheep (*Nayan*)
13. Chiru or the Tibetan antelope (*Pantholops hodgsom*)
14. Brown bear (*Rato bhalu*)
15. Gangetic Dolphin (*Shosh*)
16. Red Panda (*Hokarpa* or *Habri*)
17. Pygmy hog (*Sano bandel*)
18. Hispid hare
19. Scaly anteater (*Salik*)

Birds

1. Impeyan pheasant (*Danphe*)
2. Crimson-horned pheasant (*Monal*)
3. Lesser Florican (*Phakras, Sypheotides indica*)
4. Great Hornbill (*Dhanesh, Tokus birostris*)

Chapter VIII

Fish and Herpetofauna

'Comparatively little information has been recorded in regard to the fishes of Nepal.'[1] Some account is, however, found in the writings of Gunther,[2] Regan,[3] Hora[4] and Menon.[5] Gunther had access to Brian Hodgson's, as well as Buchanan Hamilton's (later known as Sir Francis Hamilton) collections, which had been deposited in the British Museum.

Edward Migdalski of the Peabody Museum at Yale (U.S.A.) collected fish in 1948, both in eastern (Kosi river system) and western Nepal (Karnali and its feeders). This collection is in the Indian Museum at Calcutta.

A sizable collection of fishes was made by Swan 'during the California Himalayan Expedition to Makalu in 1954'. Swan collected amphibians and reptiles also, which have been described by Leviton, Myers and Swan.[6]

1. De Witt, Hugh. 1960. 'A Contribution to the Icthyolcgy of Nepal.' 7 (4) : 61-68. Stanford Icthyological Bulletin.

2. Gunther, A. C. L. Gotthild. 1861. 'List of Cold Blooded Vertebrata collected by B. H. Hodgson Esq. in Nepal.' *Proc. Zool. Soc. London.* pp. 213-27.

3. Regan, Charles Tate. 1907 (*b*). 'Reports on a Collection of Batrachia. Reptiles, and Fish from Nepal and the Western Himalayas.' *Rec. Indian Mus.* Vol. 1, pp. 157-58.

4. Hora, Sunder Lal. 1937 (*a*). 'Notes on Fishes in the Indian Museum XXIX on a Collection of Fish from Nepal.' *Rec. Indian Mus.* Vol. 39. pp. 43-46.

5. Menon, A. G. K. 1949. 'Notes on Fishes in the Indian Museum XLIV. Fishes from the Kosi Himalayas, Nepal.' *Rec. Indian Mus.* Vol. 47 pp. 237-87.

6. Leviton, Alan E, Myers, George S. and Swan, Lawrence W. 1956. 'Zoological Results of the California Himalayan Expedition to Makalu, Eastern Nepal. I. Amphibians and Reptiles.' *Occ. Pap. Nat. Hist. Mus. Stanford Univ. No.* 1. 18 pp.

Alan Taft, Fisheries Adviser to the United States Operations Mission in Nepal (now US/AID) spent three months in Nepal in 1955. He made collections in the Kathmandu Valley and nearby areas, as well as in Pokhara, Trisuli, Simra, Birgunj, Biratnagar, Chattra, etc. His report[1] listed not only the known fishes of Nepal, but also dealt with 'fisheries development of Nepal, both present and potential'.

Taft's checklist includes 94 species. He prepared his list on the basis of publications of Hora, Regan and Menon. He also went through the Migdalski collection, which was identified by the late Dr. Sunder Lal Hora.

Of the Nepalese collections in Calcutta, Menon's is from 'Kosi Himalayas in Nepal'. It is not known, however, to what extent, the Kosi of which there are seven principal tributaries, has been explored. Swan's collection points are along the Arun river, and its tributaries.

Taft visited both east and west Nepal. From Simra he flew eastward to Biratnagar, and observed the great number of ponds that dot the landscape in this region. He also 'jeeped' to few places in the vicinity of Biratnagar and Chattra—a point where the Kosi river leaves the hills and enters the flat Terai. He has emphasized the great potentiality of the Terai for fisheries development.

De Witt, who had access to both Taft and Swan's collections, reported some new species. His checklist contains 102 species of fishes, belonging to 21 families.

Common Fishes

In the Terai many kinds of carp and cat fishes are found, including the well-known *catla*, *rohu* and *bowari*. The fish ponds are mostly of small size (less than 2 acres), and they contain many predatory fishes (cat fish and murrels). *Bam* (*Macrognathus aculeatus*) is found throughout the Terai. It goes to the ocean for breeding.

Taft suggested the introduction of *Tilapia* in the Terai, a suggestion which is quite unacceptable to the Fisheries Department, as it would drive out all the indigenous species. This fish is a mouth breeder, and as such, breeds prolifically, becoming a nuisance in a short time.

1. Taft, Alan Cowie. 1955. 'A Survey of the Fisheries of Nepal, both Present and Potential. Kathmandu.' p. 34 (Mimeographed).

Although there are great possibilities for expansion of fish culture in the Terai, low price and absence of a steady market has stood in the way of fisheries development in this region. Lately, Kathmandu has developed into an important market for fish from the Terai. There is great demand locally for *rohu* (*Labeo rohita*), *catla* (*Catla catla*) and *bowari* (*Ompok bimaculatus*), a Cat-fish.

Often one finds in the Kathmandu market, *asla* (*Oreinus richardsoni*), murrel (*Channa orientalis*), a small carp (*Barbus stigma*) and species of *Puntia* and Silver Carp (*Hypopthalmys molifrix*). Trisuli, Indrawati and Sun Kosi rivers are well stocked with *asla*, *mahseer* (*Sahar*) and other species. As these rivers are well within a few hours driving distance from Kathmandu, there is a possibility that fishing as a sport will develop in the near future. On rare occasions, *asla* from Kulekhani and Godavari also appear in the market of Kathmandu. During the rains small *asla*—12.7 cm to 25.4 cm are caught in the Bagmati River also.

At Balaju, a place well known for its twenty-two water springs, two or three types of native carps (*Barbus* sp.) including the 'gamey mahseer' are found. The fish tanks provide an attractive sight to the picnickers that throng the place on week-ends.

Pokhara

Pokhara valley is famous for its many lakes, of which Phewa is the most famous. In Pokhara, there are 'several kinds of native carps in the lakes, most of which mature at under six inches'. Besides, murrel, garfish and spiny eels are also found. *Mahseer* (*Tor tor*), and *asla* abound in the lakes of Pokhara, and both of these are good game fishes.

Besides Phewa, there are five other lakes in the Pokhara valley. Rupkota Tal and Begnas Tal are two large lakes, situated some distance away from the Pokhara town. In both, *mahseer* is the common fish.

Asla is a common fish that inhabits the rivers of Nepal Himalayas — 'from 610 m upto 6035 m'. It is available round the year.

Many of the fishes of Nepal have a common distribution with those in the plains of India. To cite an example, *Barbus chagunie* has a common distribution 'from Orissa throughout Bengal, Assam, Bihar and N. W. Province to the Punjab'. This fish is found in Nepal also. But there are some species, e.g. *Diptychus annandalei*,

which has been called 'Nepalese fish', and, presumably, having a local distribution only.

The Fisheries Department has introduced into the country, mirror carp which is almost without scales when mature. It has proved a great success.

Government fish farms have been established at Hetauda, Parwanipur, Bhairawa, etc. (all in the Terai) to produce fish for an expanding market in the urban areas. Many farmers in the Terai have also gone in for fish farming and good possibilities exist for the cultivation of the Chinese grass carp in the temperate parts of the country.

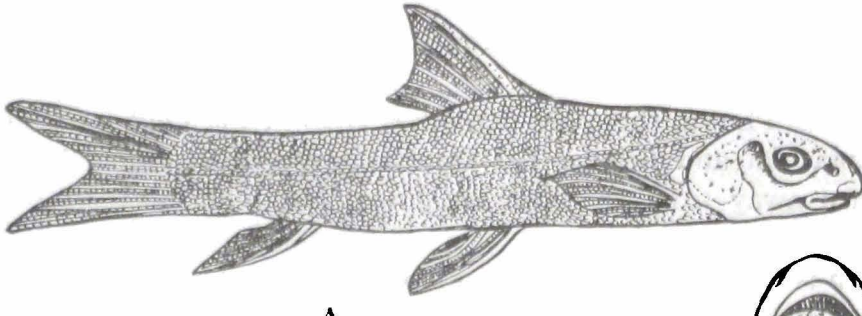
Fish pond culture in the Terai is prevalent, particularly, for raising carps. Those cultured are: *catla* (*Catla catla*), *mrigal* (*Cirrhina mirgala*), *rohu* (*Labeo rohita*) and lately, the European Carp (*Cyprinus sp.*).

Known collections of Nepalese fishes are in the British Museum and the Indian Museum, and at Stanford (U. S. A.). A good collection is also present in the Tribhuvan University at Kirtipur.

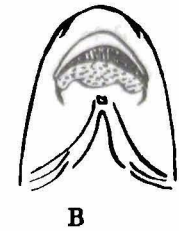
A check-list of fishes of Nepal is given in Appendix B.

Game Fishing

In Nepal, various methods are employed for fishing, viz. line, trammel nets, gill nets, cast nets, etc. Spear fishing is also reported. Poisoning of water is commonly practised, a method which produces a big haul of fish. Use of explosives is on the increase,



A



B

A—*Schizothorax plagiostomus* Heckel. (Lateral View)
B—Ventral Side of head of *S. plagiostomus* to show adhesive disc.

a thing which has endangered fishing grounds. The most important indigenous sporting fish is the *mahseer* (*Tor tor*), which thrives

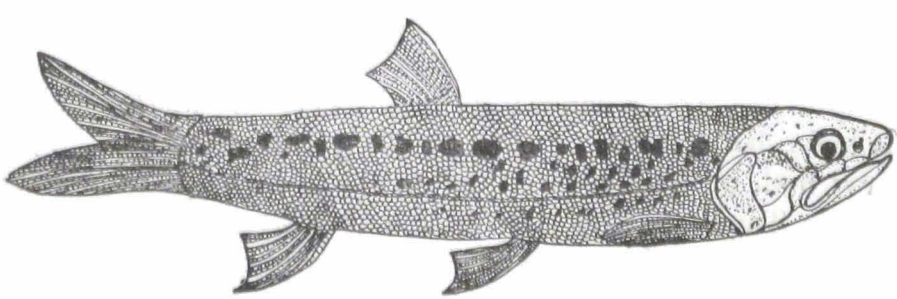
best in fast flowing cold waters. The local trout (*Schizothorax orienus*) is also an equally good sporting fish: both take fly and may reach a length of 20 inches. *Schizothorax*, of which three species are thus far recorded (*S. molesworthii*, *S. plagiostomus* and *S. richardsoni*), all locally known as *asla*, is a much prized fish. The distribution of one fish species (*S. plagiostomus*) is wide, having been collected at 2,743 m at Jomsom (Mustang District, Dhaulagiri Zone). Though these fishes are known as 'snow trout', they are not real trouts, but are sporting like the Red and Brown trouts of India.

In the Kathmandu Valley, as elsewhere, *hile* (*Ophiocephalus punctatus*) along with *singi* (*Heteropneustes fossilis*) is caught by net, as well as by an improvised rod made of reed. Shrestha[1] has described a new species of *Lepidocephalichthys*, *L. nepalensis*. This particular species has 'no bony spine beneath eye'. Otherwise, it seems to be identical to *L. guntea*.

Attempts have been made by the Department of Fisheries to introduce the well-known rainbow trout, but thus far the success is partial.

There are many excellent fishing spots in the country and one can fish in one or other part of the country during October and May. For *mahseer*, the ideal months are April and May, when the rivers carry large amount of melted snow.

All the big rivers of Nepal, such as Kosi, Karnali, Gandaki and Mahakali, have good fishing waters, but the most famous fishing spot lies at Chisapani, the place where the Karnali River



Jalkapoor (*Barilius* sp.).

descends into the plains. Here anglers have caught with a rod and line fish weighing nearly 45.3 kg. This place can be reached

1. Shrestha, Jiwan. 1973. 'A New Species of Cobitidae from Nepal'. *Jour. Tribhuvan University*. 8 (1) : 86-89.

by flying to Nepalganj from Kathmandu and then travelling on a dirt road by jeep.[1]

Of the other fishing spots in the country, Dolal Ghat and Sun Kosi Valley are as much reputed for scenery as for *mahseer* and *asla* fishing.

Of the fishes, the most famous is the *Jalkapoor*, a species of *Barilius* (Cyprinidae). It is said that the late Prime Minister Juddha Shamsher used to get a regular supply of this fish from Chatra Canal of the Kosi river.

The fish derives its name from the fact that if it is hung over fire, only the skeleton remains, while the flesh melts like camphor.[2] The fish is comparable to the Indian Rainbow Trout. This fish which may attain a size of about 30.5 cm has been collected from Hariucha, Birganj and Dolalghat. Another kind of fish by the same name, *jalkapoor* (*Ompok bimaculatus syn. Silurus bimaculatus*) inhabits fresh water and has a wide distribution.[3]

Of the other game fishes of Nepal, mention should be made of *Barilius bendelinis var Chedra*, which hardly exceeds 15.2 cm in length. This fish is a kind of trout. Another, *Barbus chagunio*, reaching a maximum length of 45.7 cm, is found in the foothill regions. Both these fish take fly. *Rohu* (*Labeo rohita*) and *Mrigala* (*Cirrhina mrigala*) are also good sport fish and can be caught with a rod and line.

In the Terai, *bowari* (*Wallago attu*) is also caught with rod and line. It is a voracious feeder and is 'one of the fresh water sharks'.[4]

Of the fishes found in the Kathmandu Valley, three need special mention: the 'mud-eel' (*Amphipnous cuchia*), *hile* (*Ophiocephalus gachua*) and *singi* (*Heteropneustes fossilis*). The 'mud-eel' is an eel-shaped fish, which hides itself in the holes of the rice paddies. As it looks like a serpent, many people avoid eating it. The *hile* is found both in muddy waters as well as in clear bodies of water, such as in Taudha. This fish forms an important dietary element of the local community and is available throughout the year. *Singi* is a dark brown slimy fish possessing sharp pectoral spines. The

1. *Fishing in Nepal.* Department of Tourism, Kathmandu. Nepal.

2. Shrestha, Jiwan. 1974. Nepal Nature Conservation Society. *Newsletter* No. 24.

3. Menon, A. G. K. 1949. Fishes from the Kosi Himalayas, Nepal. Rec. Indian Museum. XLVII ; 225-237.

4. Shaw, G. E. and Shebbeare, C. V. 1937. 'The Fishes of North Bengal.' *Jour. Roy. Asiatic Soc.* Vol. III. No. 1.

sting is poisonous causing fever in some individual. In size they vary, the maximum being 17.8 cm long. During the rainy season, when rivers and streams get flooded, they sweep across lawns and climb house fronts.

Adaptation

Thapa and Rajbansi[1] have dealt with fish of six different rivers at altitudes of 91.4 m to 1,828 m and their adaptation to the unusual environments, i.e. torrential streams.

Hill stream fishes fall into six different families: Cyprinidae, Psilorhychidae, Cobitidae, Amblycepidae, Sisoridae and Gobiidae. They show 'not only divergent modification but also the retrogressive evolution during the course of their adaptation to unusual environment, that is, torrential streams'. The fish gets itself attached by means of its mouth or adhesive organ which makes it difficult to take water through the mouth for breathing. This is, however, overcome by having the extended gill opening on each side divided in such a way that the water flows in through the upper part and out through the lower, e.g. *Nemacheilus spp.* Other fishes, however, are capable of tolerating a period without respiration and they make use of the high amount of oxygen which is dissolved in water of hill streams.

The majority of the hill stream fishes are vegetarian and many are bottom dwellers. They scrape vegetable matter from the bottom as well as slime which covers rocks and stones of the bed of stream. There are, however, well-known carnivores, such as species of *Barbus*. Reduction in barbels and flattening of fish from above downward are other structural modification found in hill stream fish. Furthermore, bottom dwelling fish lack scales or scutes or spines at least on the ventral surface. Therefore the majority of the big fishes of torrential streams, e.g. *Glyptothorax*, *Exostoma*, *Schizothorax*, *Oreinus*, etc. which are bottom dwellers, lack scales. In some hill stream fishes, e.g. *Nemacheilus*, a reduction in size takes place to enable them to hide beneath stones. All these fish are cylindrical in form and have large caudal peduncles. In *Amblycep*, eye is reduced to a dot-like structure at the tip of the head, an adaptation to intense light in shallow regions.

1. Thapa, Rohit Bahadur and Rajbanshi, K. G. 1968. 'Report on Few Hill Stream Fishes of Nepal.' Regional Seminar on Ecology of Tropical Highlands. Unesco National Commission, Kathmandu.

HERPETOLOGY

Historical

The zoo-geographical distribution of the Herpetofauna has been discussed by Swan and Leviton (1962). They say:

> 'The Tibetan Plateau herpetofauna directly north of Nepal and in places actually entering within frontiers of Nepal is therefore a curious mixture derived from two Palearctic sub-regions. The amphibians (and perhaps the relictal Tibetan snake, *Thermopsis baileyi*) live near water and have west-Chinese affinities, whereas the lizards have opposite origins and represent a Mediterranean extension into the area. Similarly, there is a west Chinese group of frogs and lizards in the Himalaya proper which are only weakly delimited by altitude from a small group of Himalayan lizards and snakes with Mediterranean affinities (*Agama tuberculata*, *Elaphe hodgsonii*, etc.) The Himalayan-Mediterranean fauna, however, is a minority conflux of species among the far more numerous Pan-Oriental, Indian, Indo-Chinese and Himalayan amphibian and reptiles. The confusion of faunal groups is an outcome of both vertical and horizontal patterns of distribution in the mountains.'

In Nepal a large number of species of both poisonous and non-poisonous snakes are found. In the warmer parts — in the Terai, foothills and inner Terai — the Cobra (*Naja naja*) is the commonest of the species. It is recognizable by the distinctive fan with spectacle-like markings. Though normally feeding upon rats and frogs, it is one of the deadliest of snakes. Normally it avoids man. Most of the snake bites occur during the summer and rainy months, May onwards, and contrary to the commonly held belief, snakes bite human beings both during the day and night.

Next to Cobra, Krait is the most poisonous of snakes found in the country. Fleming Jr.[1] has reported three species from Nepal: Ordinary Krait (*Bungarus caeruleus*), Banded Krait (*B. fasciatus*) and Black Krait (*B. lividus*). The Yellow banded Krait is more then 2.1 m in length; in Nepal, however, they do not exceed 1.2 to 1.5 m in length. A Krait is nocturnal in habit and normally is not aggressive — most of the bites from Krait are accidental.

1. Fleming, R. L. Jr. 'Nepal ka Sarpa.' *Swatantra Viswa*. No. 9, October, 1971.

The snake bites are mostly from Cobra, Krait, Russel's Viper (*Boiga sp.*) and *Echis* (*E. carrinatus*), a member of Viperidae. In the temperate and hilly parts, the most venomous snakes found are: Coral snake (*Calliophis maeclellandi*), the Lesser Black Krait (*Bungarus lividus*), the green Pit Viper (*Trimeresurus albolabris*) and the Mountain Pit Viper (*Trimeresurus monticola*).

The reported discovery of the Coral Snake in the vicinity of Kalimati has disproved the thinking that poisonous snakes are absent in the Kathmandu Valley.[1] This particular species lives underground and is not aggressive. It is reddish brown with a distinctive looking black head; a white band runs from eye to eye. In Nepal, it rarely occurs above 1,828 m.

Lesser Black Krait, though collected in the Swayambhu Hill, is normally found in the Terai and the possibility remains that it may have come with a load of firewood from the Terai jungles.

The Green Pit Viper has a characteristic triangular head and is common in the hills. It has pits on either side of the eyes, which help it to locate its prey—small birds, frogs, toads, etc. It is a poisonous species, but not to the same extent as the Coral Snake.

The Mountain or Himalayan Pit Viper (*T. monticola*) is a common species found throughout the Valley. The snake which has a mottled appearence also possesses the typical triangular head of the viper, but its bite is not as severe as that of the Green Pit Viper.

The deadliest of the snakes is the King Cobra (*Ophiophagus hannah*), which though found in Nepal also, is quite uncommon. It is very agile and can be easily marked by the presence of yellow 'v'-like marking on its back. It, however, lacks the fan so characteristic of the Cobra. This species found in the Terai and the inner Terai measures 5.5 m in length, though in Nepal none longer than 3.7 m have been seen.

Agkistrodon himalayansis, which injects its venom through a duct in the fangs, is a common poisonous species in western Nepal, as far west as Jumla (2,590 m).

In the Kathmandu Valley, many non-poisonous species of snakes have been reported. Of these, the Rat Snake or *Dhaman* (*Ptyas mucosa*) and *Hodgson's Racer* (*Elaphe hodgsoni*) are by far the commonest species. *Elaphe radiata* has been recorded in the Arun

1. Fleming Jr., Robert and David Bergsaker. 'Snakes of the Kathmandu Valley.' *The Rising Nepal*, June 19, 1974.

River Valley. By feeding upon rats, mice and frogs, they serve as important links in the food chain, and in fact, are beneficial.

Fleming Jr. and Bergsaker have reported the occurrence of Wolf Snake (*Lycodon aulicus*); measuring about 0.6 m with dark brown and yellow bands, it frequently enters houses. In the Valley four species of Keelbacks or the Water Snakes have been recorded: *Natrix stolata*, *N. piscator*, *N. platyceps* and *N. himalayana*. Of these, the Striped Keelback (*N. stolata*) is the commonest of the species in Kathmandu, as indeed all over Nepal. This species is readily recognized by its longitudinal dark and light stripes, which run from head to tail. It is also called 'grass' or 'garter' snake.

The other species — the Checkered Keelback (*N. piscator*) is common in ponds and wells. This species is of heavy gray colour with a checkered pattern. Of the other two Keelbacks, the Flathead (*N. platyceps*) is found among the bush at the edge of the forest and the Himalayan species (*N. himalayana*) is marked by the possession of 'bright orange skin between the scales of the neck'.

More recently, Cat snakes have been discovered: Himalayan Cat Snake (*Boiga multifasciata*) at Thankote and the Tawny Cat Snake (*B. ochracea*) at Balaju and Jawalakhel.

Two species of 'Blind' snakes (Typhloidae) have also been recorded from the Valley. They are common in the warmer parts also.

In the steamy humid jungles, pythons (*Python molurus*) are found. Its prey include small antelopes.

Amphibians

Toads and frogs are common. In early summer, *Bufo melanostictus* can be seen hopping around lawns and by the roadside. In the rice fields, during monsoon season, lives a small greenish frog about 2 inch long with longitudinal white stripes. This amphibian (*Rana limnocharis*) is perhaps the most perfectly camouflaged species seen in the paddy fields.

Tree frog (*Hyla sp.*) has been collected from Sundarijal (1,980 m). It has a metallic green colour with golden dark brown spots on the back and stripes on the legs. The under surface is dull white and the toes have sticky pads, which help these animals to walk perpendicular to the walls or smooth surfaces. They also have hygroscopic glands which are provided with pores through which the body absorbs moisture.

In the Checklist of the Nepalese Amphibians and Reptiles, Swan and Leviton (1962) report on *Microhyla ornata* from Khedbar (3,352 m) in east Nepal.[1]

Two species of frogs need special mention: *Rana polunini* collected in Langtang (at 3,352 m) and *Rana swani* at Dharan (305 m). *Rana tigrina* is a common species in the Kathmandu Valley, having been collected at Sundarijal also.

Salamander

The first reported discovery of the salamander in the country is by Dr. Douglas Burns, a member of the Arun Valley Wildlife Expedition, at an elevation of 5,119 m.

Reptilia

Gavial (*Gavialis gangeticus*) has a wide distribution in the Terai and foothill region. They are reported in the Narayani River and also near Chisapani where the Karnali enters the plains region.

Wall lizard (*Gecko gecko*), the Monitor Lizard (*Varanus monitor*) and the common lizard (*Agama tuberculata*) all have a wide distribution.

1. Swan, Lawrence W. and Leviton, Alan E. 1962. 'The Herpetology of Nepal.' Proc. Cal. Acad. Sci. G. *Dallas Hanna Anniversary Volume* 32 (6): 103-147.

Chapter IX

Livestock

In proportion to her size, Nepal has a large livestock population. The total livestock population of the country in 1969-70 was a little over 14.3 million, which was broken down as follows:

TABLE 22

ESTIMATED LIVESTOCK POPULATION

(in thousands)

Item	1966-67	1967-68	1968-69	1969-70
Cows	3,000	3,074	3,136	3,198
Oxen	2,850	2,911	2,969	3,028
She-Buffaloes	2,802	2,862	2,919	2,977
He-Buffaloes	475	485	495	505
She-Sheep	1,500	1,533	1,567	1,601
He-Sheep	475	485	496	507
Pig	300	307	313	320
He-Goat	450	460	470	480
She-Goat	1,650	1,686	1,723	1,671

Source : Ministry of Food and Agriculture.

The distribution pattern of the domestic animals closely follows human population. Seventy-six per cent of the total buffalo population is present in the hills, as against six and eighteen per cent in inner Terai and the Terai respectively. The buffalo is an important dairy animal in Nepal, as it provides the bulk of milk and *ghee* (purified butter). For many people in the hills, *ghee* is the only source of income. In the hilly regions buffaloes are taken

to pastures at higher altitudes during the summer and the rainy season, from where they are brought down to the warmer parts only at the onset of the winter season. *Ghee* is exported in substantial amount from central and western Nepal. During the financial year 1969-70 total production of milk products was approximately 64,000 tonnes, of which 9,000 was *ghee* and butter.[1]

In the Terai, buffaloes are mainly used for ploughing the fields, but in temperate parts (upto 3,048 m), large herds of buffaloes are kept in the *kharkas* (milk shed) which serve as the main centres for *ghee* production. In some parts of the country, however, a small sized cow is the only dairy animal in the farmer's family.

In spite of a large cattle population, the yield of milk is very low. According to one source:

> 'Only 17% of 28,50,000 cows are in milk giving a total production of about 101 million litres. Only 37% of 16,17,000 buffaloes are in milk and they yield only 500 litres of milk per buffalo per lactation giving total production of 299.2 million litres. The milk production in the whole counry is not evenly distributed but is very often localised to pasture-rich hills, Terai and low valleys. Because of the non-availability of the ready market for fluid milk around these milk-shed areas, most of the milk produced is converted into milk products—mainly *ghee*, curd, *khua* (milk cream) and butter and these products are marketed according to the chances available to the producer; he (the farmer) gets a much smaller return for his milk than he would have obtained by either selling the milk directly or by converting his milk into more economical milk products.'[2]

In order to alleviate the acute shortage of milk in the Kathmandu Valley, the Government has opened a number of milk collecting centres within a radius of 10-40 km around the city. The milk from the villages is collected at these centres, their quality judged, and payment made to producers after every fifteen days.

Cheese making is a new industry in Nepal but it has already created a good export market for itself. The annual production

1. Agricultural Statistics of Nepal. Ministry of Food and Agriculture, H. M. G. 1973.

2. Upadhya, R. M. 1964. 'Dairy Development Section Report.' Nepal Agricultural Conference II.

of cheese stands slightly over 18,144 kg. The cheese factories are located in East No. 2 (Thodung, alt. 2,743 m), East No. 3 (Pike, alt. 3,657 m) and in Langtang (alt. 3,810 m) at Kyangchin. All of these centres utilize the surplus milk product which is almost exclusively of *chauris* (Yaks). Most of the cheese is produced during the months of August, September and October. The establishment of cheese factories in these areas has no doubt economically helped the local farming community. It is estimated that each household nets an income of Rs. 2,000 annually from the sale of the milk. The problem of finding adequate pasturage, however, is becoming acute, more so, because there are now restrictions in taking cattle across the border into Tibet. Nepalese cheese is essentially a hard cheese, though soft cheese is also now being manufactured from buffalo milk.

Sheep

In the mountainous region of Nepal — the midlands as well as in the Trans-Himalayan region — sheep rearing is an important occupation. Baruwal is the most important nomadic breed. In the valleys of Kathmandu and Pokhara, the domestic breed — *kage* — is reared. Though the wool is of poor quality, it is woven into blankets, shawls, rugs, carpets, etc.

The nomadic breeds such as *Baruwal*, *Jumli*, *Bhotiya*, etc. are found at altitudes 'ranging from 1,524 m. to 5,791 m'.[1] During the winter months the flocks get down to the valleys (*Ca* 762 m), but during summer months they are taken to pastures at high altitudes. Summer pastures lie between the timber and snowline. In each herd there are 200 to 400 animals; usually 50 to 60 heads of goat are kept in the herd as they are needed for leading the flocks. Goats are common everywhere: some people keep a big herd, others one or two animals. There is always a big demand locally for goats, especially for the castrated ones. The sheep is a very economical animal; besides wool, it also yields meat and milk. The Bhotiyas (a term applied to a nondescript of Tibetan stock), keep dogs for shepherding flocks and to protect them from wild animals, panther, snow-leopard, wolf, etc. Shepherding is also done by hired hands who receive 25 sheep in lieu of their salary. The sheep are used to transport salt, wool, herbs and

1. Keshary, K. R. 1964. 'Sheep Management in Western Nepal.' Nepal Agricultural Conference II.

drugs which are either bartered for rice and sugar or sold for cash. Some sheep have a white coat, others have variable colours. Natural grey wool is much liked and is used for weaving blankets, rugs, shawls, etc. Local dyestuffs are used to dye wool, which are of fast colour. The Tibetan refugees have been very profitably engaged in the production of carpets and rugs; the motifs are Tibetan-dragon heads and ecclesiastical designs — all woven intricately by experts in this art. There is a ready market for these products, particularly outside the country. Total raw wool production in the country did not exceed 3.4 million tonnes in 1970/71. It was valued at Rupees 2.2 million.[1]

1. Pradhan, Shatrughan Prasad. 'Future of Sheep and Wool Industry in Nepal.' *The Rising Nepal*. March 23, 1972.

Chapter X

Agriculture in Nepal

The diversity in the topography, climate and altitude in Nepal has found expression in its diverse agriculture also. The differences in the agricultural patterns in the hills and the plains (Terai, as well as inner Terai) have helped to evolve diverse cultural and ethnic groups within the country. Nepalese farmers, through their sheer industriousness and fortitude, have succeeded in raising crops in a terrain which does not take kindly to the presence of humans. Between the Mahabharat and the outer Himalayas lie many valleys; of these, those of Kathmandu, Pokhara and Gorkha are well known from the agricultural as well as the historical standpoint.

In Nepal 94.4 per cent of the people eke out their existence from 6 million acres of cultivable land. It has been estimated that the agricultural commodities of Nepal contribute no less than 86 per cent towards the GDP (Table 23). They comprise 75 per

TABLE 23

AREA UNDER CULTIVATION, PRODUCTION AND YIELD OF DIFFERENT CROPS IN NEPAL, 1970-71

Crop	*Area under Cultivation in Hectares* (000)	*Production in Tonnes* (000)	*Yield in Tonnes/ Hectare*
Paddy	1,182	2,304	1.89
Maize	446	833	1.89
Wheat	228	193	0.94
Millet	115	130	0.97
Barley	27	25	—

cent of total export; over 80 per cent of convertible exchange is obtained from this source.

Between August and April of 1973, the country exported goods worth Rs. 80 million, of which the bulk was jute and jute cuttings, bags, etc. Of the exports, musk valued at one million rupees is also included. Cardamom, Cinnamon and dried ginger are now being exported in increased quantities.

TABLE 24

GROSS AREA UNDER DIFFERENT CROPS

(*in* 000 *ha*)

Crop	*Average Annual for the Triennial Ending* 1963-64*	*Average Annual for the Triennial Ending* 1969/70**	*Rise in Acreage*	*Percentage Rise in Acreage*
Paddy	1,053.34	1,198.00	144.66	13.73
Maize	423.00	475.00	52.00	12.29
Millet	58.34	95.00	36.66	62.84
Wheat	110.00	173.00	63.00	57.27
Sugarcane	7.00	12.00	5.00	71.43
Tobacco	8.00	8.00	—	—
Jute	23.00	39.00	16.00	69.57
Oil Seeds	93.60	97.00	4.00	4.30

Source : Pant and Jain. *Long Term Planning for Agriculture*. Vikas 1972. p. 22.
*Average for three years, 1961-62 to 1963-64.
**Average for three years 1967-68 to 1969-70.

The acreage under different crops varies in different parts of Nepal (Table 24). Cultivation of a particular crop is determined by such factors as soil, rainfall, temperature, altitude and terrain. Maize is grown principally in the hills. *Kodo* or finger millet (*Eleusine coracana*) is grown throughout the hilly region of Nepal. It is a *kharif* crop and is often rotated with upland rice. Its acreage in 1970-71 was 11,500 ha, with a total production of 130,000 tonnes. According to one survey,[1] the *per capita* consumption of cereal in the Terai is 195 kg and in the Himalayan belt 105 kg. It is also significant that while the hilly region contains 60 per cent of the total population, it contributes only 27.7 per cent of the total cereal production in the country.

1. Cereal Grain Production, Consumption and Marketing Patterns. 1965, p. 4.

The principal agricultural commodities and livestock for export are: paddy, wheat, grain and grain products (grains other than paddy and wheat), spices, sugarcane, milk products, fresh fruits, soyabean, mustard, split peas, tobacco, ginger, red pepper, turmeric, cinnamon, potatoes, onions, eggs, poultry, goats, buffaloes, etc. Nepal Terai, which covers one-seventh of the country's territory, is quite productive and naturally, it fulfills the needs for foodgrains of the hilly parts of the country as well (Table 25). It is the Terai and the inner Terai which produce and export foodgrains, oil seeds, tobacco, jute, sugarcane and hides and skins; a number of agricultural commodities are brought down by the hill people from the vast stretch of hinterland over difficult trails to the dozen or so important trading towns which lie all along the 800-km long Nepal-India border.

TABLE 25

AGRICULTURAL GDP BY SUB-SECTORAL ORIGIN

(in thousands of rupees)

Commodities	*Total Value* 1965/66	*Total Value* 1966/67	*Total Value* 1967/68	*Total Value* 1968/69	*Total Value* 1969/70
Agricultural Crops	3,529,390	3,088,777	3,961,500	4,420,195	5,138,691
Commercial Crops	292,476	204,867	292,561	375,216	320,092
Livestock Product	889,212	939,359	941,690	1,086,274	878,339
Forestry Income	17,964	16,110	20,909	18,125	17,727
Total	4,729,042	4,249,113	5,216,660	5,899,810	6,354,849

Source : Central Bureau of Statistics.

Nepal trades almost exclusively with India which roughly accounts for 97 per cent of her total trade. In the recent years, there has been a shift in this pattern with some diversification of trade. The bulk exports to India are made up of agricultural commodities: foodgrains, animals and vegetable oils, tobacco, hides, skins, herbs and crude drugs.[1] In 1972/73, according to one estimate, approx. 70,000 tonnes of rice was exported to India. Some amount was exported to Bangladesh also. It has been reported that during the year 1970/71, the country produced 3,485 million tonnes of

1. Agricultural Statistics of Nepal. 1972.

foodgrains (maize, paddy, wheat, barley and millet), an increase of 10 per cent over 1960.[1]

In Nepal export-import figures do not always present a realistic picture because items are often exported from one point and imported at another. Foodgrains are often transported across the Indian territory from a surplus part of the country to the deficit regions — the hills and big towns such as Kathmandu, Pokhara, etc.

Though the country has actually a surplus of foodgrains, there are pockets of scarcity areas in the entire hilly region. This rather paradoxical situation can only be improved through the development of a good system of transport which would allow both east-west and north-south movement of the agricultural and other commodities. In this connection, the importance of the road development programme in Nepal can hardly be overemphasized. The completion of the East-West Highway of which more than half is now complete, is bound to bring about important changes in the economy, particularly with regard to the movement of foodgrains from surplus to deficit parts of the country.

Long-Term Food Projections

Pant and Jain (1972)[2] have made Long-Term Projections for different foodgrains and cash crops in Nepal under the Fifth, Sixth, Seventh and Eighth Plans. According to their estimates, 'the output of foodgrains by 1975-76 appears to be of the order of 4,230.55 thousand tonnes on the lower side and 4,298.89 thousand tonnes on the upper side. By 1980-81, 1985-86 and 1990-91, the projections indicate that the supply of foodgrains might be of the order of 5,501.48, 8,459.61 and 10,076.45 tonnes respectively on the high side, as compared to 5,396.87, 7,283.84 and 9,750.97 thousand tonnes on the lower side'.

Food Deficit

By the end of the Fifth Plan Period (1980-81) for total foodgrains, 'Nepal is expected to have a surplus of about 84.94 thousand tonnes for "most probable" projections, and about 169.56 thousand tonnes under best conditions obtaining for Alternative II'. Under worst condition representing

1. *Ibid.*
2. Pant, Y. P. and Jain, S. C. 1972. *Op. cit.*

'Alternative I, the country will have a deficit of about 144.39 thousand tonnes. This situation may come true in case a wider gap between demand and supply takes place. However, under all three sets of projections, paddy would record a deficit ranging from 145.45 thousand tonnes under best conditions to about 426.65 thousand tonnes under worst conditions. Under probable conditions, the gap between demand and supply would be of the order of 240.29 thousand tonnes. Under any of the situations, therefore, import of paddy (rice) will have to be planned or market mechanism will have to be allowed to play its free role to set things right, which would mean diversion to other crops of higher value, and importing paddy.'

Agricultural production is conditioned by a number of factors: availability of seeds, fertilizers, irrigation, pesticides, and credit, and of course, favourable weather conditions. In a large part of the country, agricultural technologies are still primitive and the farmers have been denied the benefits of the agricultural services, which their counterparts in the Terai have received.

Agricultural Zones of Nepal

The agricultural zones of Nepal fit into the six natural regions (Table 26) already referred to earlier. Terai is the flat land abutting Bhabar towards the north and merging with the *cis*-Gangetic plain towards the south. Terai is broadly divisible into three regions: Eastern, Central and Western. Eastern Terai is the most fertile tract of land in the country; it includes the districts of Parsa, Bara, Rautahat, Sarlahi, Mahottari, Janakpur, Sirha, Saptari, Morang and Jhapa. This region alone produces two-thirds of the total foodgrains produced in the country. High rainfall, adequate irrigation and an alluvial soil favour the cultivation of two or even three crops in a year. Besides rice, such cash crops as tobacco, jute and sugarcane are also widely cultivated. Until recently, this part of the country had some good forests, but in many places they have been cleared to make room for cultivation. *Jhora* or encroached forest cultivation has brought in its wake many problems.

Inner Terai includes the districts of Udayapur, Sindhuli, Rapti *dun* and Dang-Deokhuri. From an agricultural standpoint this part of the country is also quite important. As in the Terai, paddy

again is the main crop of the region but oil-seeds — mustard, linseed and sugarcane — are also equally important. Normally, only one crop of rice is raised in a year. Two varieties of rice — early and late maturing — are planted. In the Terai irrigational facilities are being developed which will naturally lead to an improvement in agriculture.

TABLE 26

REGIONAL DISTRIBUTION OF AREA UNDER CULTIVATION

(*in thousands of hectares*)

Region	1967/68	1969/70
Eastern Terai	752	832
Western Terai	383	363
Inner Terai	140	206
Kathmandu Valley	47	48
Eastern Hill	193	193
Western Hill	330	338
Grand Total	1,845	1,980

Source : Agricultural Statistics of Nepal. 1972.

Western Terai

The region that is known as western Terai includes the districts of Nawalparasi, Rupendehi, Kapilbastu, Banke, Bardiya, Kailali and Kanchanpur. Here the rainfall is less than in east and so only one crop of rice is raised in a year. Mustard is an important cash crop in this part of the country which, on the whole, is not as fertile as the central and eastern parts of the country; low rainfall, poor soil and inadequate irrigational facilities have put limitations on agriculture. Ground water resources are being tapped to meet this difficulty. Every year floods (*bayia*) pose a serious threat to agriculture in the entire Terai. In the Terai, new settlers have come from the hills, which have been subjected to serious droughts during the last few years. The hill people in the past feared to come down to the Terai, because of the fear of 'awl' (malaria). Eradication of malaria, scarcity of land, poor production and successive crop failures are the principal reasons for large-scale migration of these people to these parts now. Waves after waves of migrants have descended on the forested land of the Terai and inner Terai

and have brought about changes in the ecosystems, a thing least conducive to the welfare of both man and wildlife.

Inner Terai

The region which is known as inner Terai is the region of the *dun*, lying between the Churyia (Siwalik) and the Mahabharat ranges. These Valleys, though fertile, were at one time highly malarious, but as a result of the concerted action of the WHO and the Government, malaria has now been eradicated and they are now bustling with activity. The Rapti Valley, which is about 80 miles from Kathmandu, has in the last decade and a half become the focus for resettlement of thousands of people from the vast hinterland.

The soils of the *duns*, though not as good as in eastern Terai, nonetheless favour the cultivation of maize, mustard, rice and a variety of tropical and sub-tropical fruits, and vegetables. Buffalo, once principal draft animal, is now being replaced by tractor.

The Mahabharat Lekh and the Nepal Midlands

Nepal is a hilly country. Most of its people (over 60 per cent) live in the mountainous region. This part of the country presents an uneven topography, from the river valleys with altitude as low as 457 m to the summit of the blue Mahabharat lekh which has an average altitude between 2,438 m and 2,743 m. The soil in general is rather poor because of the removal of top-soil. In areas which have recently been cleared of forests, the soil contains good amount of humus. Red or lateritic soils are not uncommon in this region. Rainfall is particularly heavy in the southern flanks of the cooler Mahabharat lekh which is enveloped in a thick mist during the monsoon. The effect of mist on vegetation is quite pronounced in these mountains. In central Nepal, 'at Tsumje (altitude 3130 m.) rain is frequently misty, while at Shiar Khola valley (*ca* 2000 m.), the rainfall seemed to have shorter duration but a higher density'.[1]

In central Nepal rice is cultivated upto an altitude of 1,890 m, while the upper limit of wheat and maize is about 3,048 m.[2] The terraces which the Nepalese farmers have successfully carved out from steep hill-sides are the finest monuments to their industry,

1. Kawakita, Jiro. 1956. *Land and Crops of Nepal Himalaya*. p. 16
2. *Ibid*. p. 72

courage and fortitude. The altitudinal limit for the cultivation of different crops that grow in this region is wide; in eastern Nepal, agriculture is primarily restricted below 2,134 m.[1] In central Nepal, however, 'the upper limit of cultivation exists as high as 4,000 m. in the highland'.[2] The altitudinal limit of the important food crops grown in the hilly region of Nepal is given below:

TABLE 27

ALTITUDINAL LIMITS OF DIFFERENT CROPS

Crop	*Region*	*Altitude (in ft)*
Buck Wheat	Central	14,000
Rice	Central	6,500
	Western	7,000
Maize	Central	10,000
	Western	8,000
Wheat	Central	10,000
	Western	8,000
Potatoes	Central	14,000
	Western	10,000

It is thus obvious that the altitudinal limit of crops varies from one part of the country to another. The upper limit is pushed up by about 300 m because of the milder climate and higher rainfall in the eastern part of the country.

All over the hilly region of Nepal and in some parts of the Terai also, millet is an important crop. It is a crop which adapts itself easily to diverse climatic and soil conditions and is equally at home in the warm river valleys, as well as in the cooler parts. Wheat is the principal *rabi* crop in the hills but temperature and day-length (photoperiod) become limiting factors at higher altitudes. In Jumla, it can be seen growing at a height of 2,743 m. Winter rains and snow make wheat the principal *rabi* crop in the western hilly parts of the country. All wheat varieties grown in the country belong to *vulgare* (*Triticum vulgare*) group and both awned and awnless varieties are grown.[3] 'The wheat of Nepal Himalaya

1. Swan, L. and Leviton, A. 1962. *Op. cit.* p. 123.
2. Kawakita, Jiro. 1956. *Ibid.* p. 20.
3. Durum wheat is now being grown in an experimental form.

has a strong relationship to that of south China and and this may be because it had dispersed from west to east to China through Himalaya.'[1] At around 2,438 m, wheat is replaced entirely by barley, the staple diet of the people in the highlands. People of the Tibetan stock make 'tsampa', a sort of gruel from the barley flour. Beyond 3,657 m, permanent settlements are rather scarce because of heavy snowfall during the winter months. During the brief summer season, however, local people are able to raise a quick crop of buckwheat (*Fagopyrum* sp.), barley, potato, turnip, radish, etc. Grain *Amaranthus* is intermixed with finger millet and soyabean in the midlands. Scarcity of vegetables obliges people to use *gabo* (*Colocasia* sp.), *bethu* (*Chenopodium* sp.), Watercress (*Nasturtium* sp.) and often *sisino* or nettle (*Urtica dioca*). Yams (*Dioscorea* sp.) grow wild in the jungles and supplement local peoples' diet during the lean winter months.

In western Nepal fertile tracts of land are available for cultivation in the river valley of Mahakali and its tributary, Chamiliya. These provide sustenance for large number of people of the Baitadi and Darchula districts.

Darchula District

In the far west, bordering the Mahakali river, is the district of Darchula. Towards north is Tibet, which is reached after crossing the famous Liphu *Lekh*. Large parts lie within the inner Himalayas. The district is inhabited by Thakuris, Brahmins, Chetris and Bhotiyas, the latter being mostly concentrated in two villages: Changu and Tinker. Bhotiyas are a close-knit group with a strong community feeling. In all there are 200 households; they trade with Tibet and India. Culturally they have much similarity with the Tibetans. The major rivers on the way to Darchula are spanned with ropes which are festooned with coloured buntings. This is done ostensibly to help the departed soul cross the river.

One social custom which is peculiar to the local Bhotiya community is that of *Rang Bang*. Boys and girls assemble together during the night for drinking, dining and dancing. In sexual matters, there is lack of inhibition and pre-marital sexual experience is not uncommon.

1. Nakao, S. 1956. 'Agricultural Practice.' *Land and Crops of Nepal*. p. 352.

The main trading centre is Taklakot, which remains snow-bound for six months in the winter. It takes six days to reach Taklakot from Darchula. In the past, this was the main route for pilgrimage to *Manasarovar* and people still talk about the 'poisoned air' which made them sick while crossing the Liphu *lekh*. This, in fact, is due to *Aconitum ferox*, a plant which grows wild here.

Agriculture in Baitadi

The vegetation in the valley floors is tropical and sub-tropical but as one climbs the steep hills which bound these 'V'-shaped valleys, more and more of the temperate species begin to appear. In the red pebbly soil, few hundred feet or so up from the valley floor, *sal* (*Shorea robusta*) is the dominant tree species but higher up, *chir* pine (*Pinus roxburghii*) replaces *sal*. Around the temples, small groves of these trees are left intact, and they are cut only for temple purposes.

Besides cereals, peanut, gram, sweet potato, radish, mango, guava, litchi, papaya, jack fruit, and several kinds of citrus fruits grow here. In most parts, three crops are raised in a year: maize followed by rice in summer and wheat in the winter.

Two varieties of sugarcane are grown: a thick yellow stemmed variety which grows in clumps and is exclusively used fresh; the other, the thin stemmed variety, is mostly crushed. The quality of the sugarcane (thin stemmed) is often poor; its sugar content is low and the plants suffer from diseases and pests. It is grown in the valleys as well as in the *lekh* regions. Crushing is done mainly by small crushers which are turned by the human hands, oxen being used rarely. The juice is boiled in large iron pans until it becomes sufficiently thick and it is poured into frames (small cups). *Gud* or raw sugar is somewhat sour in taste, especially, the one produced from canes grown in the *lekh* region.

Rice grows upto an altitude of 2,134 m in western Nepal. It is grown in both irrigated as well as non-irrigated tracts, and is rotated in the winter with wheat or barley. At higher altitudes, maize replaces rice, and barley takes the place of wheat. Legumes are widely cultivated. Urd or *mas* (*Vigna mungo*) and *gahat* (*Lens culinaris*, lentil) are the two important pulses, which are stored in *khoka* or bins made out of *Bauhinia* leaves. In the wheat fields *kolon* or *kerao* (*Pisum sativum* var. *arvense*) and *kosa* (*Vicia* sp.) are

grown as mixed crops. During the rains, *bhatmas* (*Glycine max*) is often planted along the edges of the rice paddies. Radish, spinach, *rayo* (*Brassica campestris* var. *oleracea*) and *pindaloo* (*Alocasia indicum*) are principal vegetable crops.

Two other crops of economic importance of this part of the country should be mentioned: potatoes and *churi*, the Butter Tree (*Bassia butyracea*). Potato grows well everywhere, and is the principal cash crop of the region. There is always good demand for hill potatoes in India, and at good price. *Churi* is a multipurpose tree. Its blossoms are tapped for honey which is turned into a form of sugar, which is highly prized for its nutritive value but of late, its production has declined. *Churi* fruit (a drupe) is edible, but is not very tasteful; the kernels yield a fat which supplement *ghee* and *phulel*, which is used as a base for face-creams.

Bhewul (*Grewia oppositifolia*) and *rittha* or soapnut (*Sapindus trifolium*) are two other trees which occupy an important place in the local economy. *Bhewul* is planted or more often, has a natural regeneration. This along with *Khad* or *Khari* (*Celtis australis*) provides bulk of the fodder for cattle. *Bhewul* shoots, stripped of their leaves, are steeped in slow running streams for a few months and the fibre is then peeled off. The white lustrous fibre is used for making ropes, while the sticks are used as firewood or light homesteads. Kerosene is a rare commodity in these parts. The *Bhewul* tree grows at an altitude of 610 m to 1,828 m. The fruits, which turn bluish-black on ripening, are edible.

The soapnut tree, also called soap-berry (*Sapindus saponaria*) and growing to nearly 30 m in height, often belongs to the whole community. The fruit (a drupe) on crushing yields a powder which is used as a detergent. Lemon and pummelo (grape fruit) are common fruit trees along with mango, pomegranate (*Punica granatum*), guava and banana. Apples and pears are new to the region and both have proved commercially successful. Lemon juice (*chuk*), dried ginger (*sutho*), turmeric, red pepper, pulses, honey, bees wax, molasses (*khudo*), butter nut (*Churi*) and purified butter (*ghee*), are all commodities which have an important place in the village economy. All these, along with cereals, vegetables, and other farm products are either marketed for cash or bartered for salt, sugar, etc. Every family raises some livestock but poultry keeping, due to the orthodox nature of the society, is confined to the 'lower class'

— the 'untouchables', who live in separate settlements. They have among them masons, carpenters, blacksmiths, etc. and they also plough land for the upper-caste brahmins. Nowadays, however, they have shaken off much of the centuries old servility and are economically better off than the so-called 'upper class' people in society. A new social and economic pattern is emerging throughout the country and the hills of Nepal are undergoing a similar transformation. Due to a near population explosion, low yield, deforestation, drought, etc. the economic condition of the people living in the hills has deteriorated. In recent times there has been a great pressure on cultivable land which has led to encroachment on the forest land, the ultimate result being depletion of fodder and firewood, a thing which has brought in its wake soil erosion, poverty and starvation throughout the hilly regions. Places where only few years ago virgin forests of oak and rhododendron stood, now present a bleak appearance because destruction of all forms of vegetation, not excluding such thorny plants as barberry, ribes and *Craetegus*. Excessive rains during monsoon and overgrazing have led to the formation of deep gullies, with the accompaniment of devastating floods every year. Indeed, the difficulties which the people in the hilly regions of Nepal face are primarily ecological in origin and upsetting of natural balance. To these must be added, the farmers' debt to the local *thalus* and the inevitable runs to the law courts.

Jumla and Humla Districts

The Karnali basin covers an area of roughly 14,504 sq. km and has a population of about 188,000. Jumla, Humla and, to some extent, Mugu and Tibrikot districts lie in the rainshadow of the Himalayan range and are in fact part of the Inner Himalayas and the Tibetan tableland. The inhabitants of Jumla and Humla are principally Chetris and Thakuris but in the Mugu and Tibrikot districts people of predominantly Tibetan stock are met. The principal crops of this part of the country are maize, millet and barley. Rice cultivation is confined to the lower altitudes though it has been found growing even at an altitude of 2,743 m, a 'remarkable contrast to the usual altitudinal limit at 1,524 m. in central Nepal'.[1] The upper limit of cultivation in Jumla district extends upto 4,267 m.

1. Stainton, J. D. A. *Op. cit.* p. 20.

Dolpo

Dolpo district (population 22,400) which has an area of 6,734 sq. km is regarded as 'one of the most difficult parts of the country'.[1] It is bounded towards south by Dhaulagiri, towards east by Godam Himalchuli ranges and towards north by the Tibetan plateau. To get into the district one has to cross Maure Valley, which has an altitude of 3,962 m. More than 50 per cent of the area is precipitous rocky mountains; the rest is a dry grey scrubland, with an average altitude of 3,657 m to 4,876 m. The tree vegetation is confined to below 3,657 m.

Agriculture is the main occupation of the people. In areas which are contiguous with the Tibetan region, a single crop of barley and potato is raised. Besides this, buckwheat and radishes are also grown. Livestock keeping is an important part of the local economy. Because of poor productivity of the soil and a harsh climate, the general economic condition of the people is extremely depressing.

Very few people are Brahmins and Chetris and the majority are of Tibetan stock (Khampas). The southern parts are inhabited by Mahtara and Buda tribes. In Dolpo, villages lie between 3,962 m and 4,267 m, the highest settlement being found at Charka at an elevation of 4,419 m.[2] The people are mostly of the Tibetan stock and keep yaks for which good pastures are available.

Tibrikot

This is one of the four districts (population 12,200) of the Karnali *anchal*.[3] It is bounded towards east by Dolpo, and towards north-west and south by Mugu, Jumla and Jajarkot respectively. It has an altitude ranging from 2,134 m to 5,486 m and during winter, is snow-bound.

Agriculture is the mainstay of the people. Main crops are: maize, rice, wheat, barley, buckwheat. Rice and barley are grown on irrigated lands only, more than 80 per cent of the area is covered with forest and there are meadows, which are ideal for grazing. Livestock breeding is an important occupation and locally the

1. 'Survey Report of the Remote Area Development Committee.' 2027 (1971). (Mimeo.)

2. Stainton, J. D. A. *Op. cit.* p. 20

3. A province.

people weave shawls, carpets and coarse blankets. The paper industry exists on a small scale and herbs — particularly *Orchis* and *Rheum*—are exported in large quantities. Barter trade with Tibet is carried on.

In Tibrikot, the climate is dry. Here Stainton has reported plants of 'typical dry middle eastern countries such as pomegranate, fig and even vine'. Villages are found upto an altitude of 3,657 m but most of these are occupied during the summer months only, as heavy snowfall in winter makes living at these heights very difficult. Between 2,438 m-3657 m, grass steppes with scrub vegetation are found, while the tree vegetation which is made up of spruce, cypress and deodar is mostly confined to the river valleys. The inhabitants of these western districts, i.e. Jumla, Humla, Mugu and Tibrikot, trade in horses, herbs, drugs and woollen goods, which find their way to the Indian markets through the Nepal-India border towns of Joljibi (Baitadi), Mahendra Nagar (Kanchanpur), Rajapur (Bardia) and Nepalgunj (Banke).

Jumla and Humla districts are famous for scenic beauty, including the lakes. Of these, Rara and Phoksumdo are well-known for their crystal blue water and scenic setting. Rara *Dhah* (lake) is the largest lake in Nepal. It is some three miles long and two miles in breadth and is situated at an altitude of nearly 3,048 m. Phoksumdo (Ringmo) is smaller than Rara but is situated two thousand feet higher (3,657 m) than the latter. Both these lakes are crater-like in appearance and are probably glacial in origin. Around Rara, blue pine and fir are the predominant trees.

Jumla

The district of Jumla covers an area of 2,558 sq. km, with an altitudinal variation of 730 m to 4,267 m. It has a population of 130,000 with a density of 43 per sq. km. Chetris and Thakuris are the prominent castes; superstition, ghosts and demons dominate the lives of the people. The houses are flat roofed. The rainy season is short — covering the period from mid-July to mid-August, with an annual average of 30 cm to 38 cm. It is snow-bound for long periods. Three climatic regions are found within the district: temperate, warm temperate and tropical.

The main exports of the area are: woollen blankets, shawls, *ghee*, borax, herbs and drugs. Better quality wool is imported from

Tibet, Mugu and Humla. Weaving is done on primitive looms. Horses are sold at Jauljibi. In the past they were sold in India also. The main items of import are foodgrain, sugar, kerosene and manufactured goods.

Bee keeping is an important occupation of the people. The main markets are Nepalganj, Surkhet and Rajapur.

A proposal to establish a National Park in Rara area is under active consideration of the government, a measure which will give protection to one of the most spectacular regions of the country. A weekly air service to Jumla has made this place accessible to tourists, but one has to walk for two days before the lake site is reached. There will, however, soon be a small landing strip for STOL planes.

Jumla is an important town of this part of the country, being once the capital of the Malla kings. It is situated in the Tila river valley at an altitude of 2,306 m. Freezing temperatures occur throughout the winter and it is not unusual to have snowfall in Jumla in the midst of spring. Agriculture is the mainstay of the people. Paddy, maize, wheat, barley and buckwheat are the principal crops. Sheep and goat rearing are both important occupations. There are reportedly 30,000 goats in the district. The climate here is ideal for fruit cultivation. Fruits such as apples, peach, citrus, pomegranate, walnut, and often grapes are grown. Wildlife consists of *danphe* and *monal* pheasants, chukor, partridge, barking deer, bear, musk deer, and the wild Tibetan sheep (*Ovis ammon hodgsoni*), locally known as *nawa*. Snow pigeons, choughs and ravens are also common. There is much intercourse between the Tibet region of China and this part of Nepal. As people on either side of the border are ethnically similar and no formal entry permits are necessary for them they cross the border freely with their merchandise. The trade routes lead through a number of passes, the more important of these being *Namja La* (*La*-pass, 4,947 m), *Merem Bhanjyang* (5,974 m), *Sehula Bhanjyang* or *Mendok Ding La* (5,077 *m*), and *Mohala Bhanjyang* (5,028 m).

Central Nepal Himalaya

The regions lying on the southern flank of Langtang, Machapuchre, Annapurna and Dhaulagiri mountains comprise roughly Central Nepal's Gandaki and Dhaulagiri *anchals*. It is an area of exceptional natural beauty. A solid wall of mountains (Dhaulagiri

— 8,222 m, Annapurna — 8,047 m, Himal Chuli — 7,863 m) cut off very effectively the South-West monsoon, which results in extreme dryness of the northern parts of the region. Mustang *Bhot* is typical of this type of country.

Mustang

Mustang (area 1,942 sq. km) lies in the rain-shadow of Annapurna and Dhaulagiri. It is a high, wind-swept country with an average altitude of 4,572 m. The capital is Lo Mantang. The country is desert-like, with *Caragana* as the dominant vegetation. Besides keeping yak herds, agriculture is the main occupation of the people; potatoes, maize and millet are the principal crops. Goats and sheep are also kept and yak cheese forms an important part of the diet of the people. Wild garlic (*Allium wallichii*) is collected, dried and sold in Pokhara.

Mustang is sparsely populated (27,890 people). The northern part is inhabited by Bhotiyas, the central by Thakalis and the extreme southern part by Magars, Chetris, and Brahmins. Villages lying south of Jomsom are quite prosperous. The northern part is not so productive and with great difficulty one crop of barley, wheat and legume are raised. Fruits and vegetables which grow in the southern parts are orange, guava, lemon, pear, peaches, pomegranate, banana, radish, potato, onion and garlic. In the river valleys of Marsyangdi and Kali Gandaki, rice is grown, while higher up wheat, maize, buckwheat, millet, pulses and potatoes are common crops. *Kuth* (*Saussurea lappa*), *kutki* (*Picrorrhiza kurroa*) and *bun lahsun* (*Allium wallichii*) are important herbs, which ultimately find their way to India. Tukucha is an important trading post of this region and at one time bustling town. The articles traded were: horses, salt, foodgrains, borax, wool, hides, musk, antimony, herbs and manufactured goods.

In the southern mountainous region are found goral, barking deer, jharal, leopard, bear, jackal, monkey, porcupine and rabbit. In the northern and central part musk deer, wild sheep, goral, jharal, barking deer, leopard, bear, wild yak, *danphe* pheasant, chukor, pigeon, dove and jungle fowl are met. Snow leopard inhabits inaccessible cave-like areas in the cliffs.[1]

Mustang has many places of Hindu pilgrimage, such as Mukti-

1. Peissel, Michel, 'Mustang, Remote Realm in Nepal.' *National Geographic*. October, 1965.

nath, Damodar kund, Kali Barah and Tatopani (hot water springs).

Central Nepal is drained by the Kali Gandaki, Buri Gandaki and Marsyangdi rivers. The region south of Dhaulagiri is inhabited by Gurung and Magar tribes. Although their faces betray Tibetan features, culturally they are more closer to the Hindus than to the Tibetans, as they worship Hindu gods and goddesses.

Pokhara

Pokhara is by far the most important town in Central Nepal. It is situated in a valley, smaller in size than Kathmandu, and has a sub-tropical climate. The summer temperatures are generally higher than at Kathmandu, as is the annual rainfall. The total rainfall in the 1964-65 period was 309 cm. The Pokhara valley is an example of Tectonic regional valley.[1] The valley floor shows ample evidence of glaciation. Snowy mountains provide a huge back-drop for the valley, the most famous peak being the *Machapuchre* (7,000 m) which casts its shadow on the crystal clear waters of Phewa lake. Phewa *tal* (tal=lake) abounds in native carp and the 'snow trout' or *asla*. The Seti River which drains the valley cuts a deep gorge across its floor, which at one place is 46 m deep but a mere 1.8 m in width. The river causes much erosion, the reason being that its swift flowing current dissolves the soluble part (lime) of the bed rock. Besides Phewa, there are a number of lakes in the region, viz. Begans, Rupa, etc.

Pokhara is now linked by a good highway — the Prithvi Raj Marga (170 km) with Kathmandu. This, besides bringing these two cities closer to each other, has helped tourism also. The construction of the highway has also encouraged farmers to intensify fruit cultivation; in 1974, for the first time 50 truck loads of fruits (mainly oranges and bananas) were brought to Kathmandu from Tanhu district alone.

Pokhara is an important trading centre and a variety of goods of agricultural origin — paddy, wheat, barley, etc. are exported from here to Tibet and *ghee*, oranges, fish, herbs and drugs, and woollen goods to India. One sees in Pokhara town mule caravans loaded with agricultural and manufactured goods heading for the

1. Pradhan, M. L., Basnyat, R. H. Singh and Maharjan, P. L. 1964. 'Soil Survey of some Areas of Pokhara (West No. 3) and Syangja (West No. 4). Gandaki Zone.' (Mimeo.).

northern parts. Oranges from Pokhara are always in great demand, but for about a decade now, the orchards have shown a rapid decline, the cause being ascribed to *Mycoplasma*-like organisms.

Pokhara is also connected with Bhairawa by the 145-km long Sunauli-Pokhara highway. The road starts at Sunauli — a village on the Indo-Nepalese border and passes through Butwal (198 m), Tansen (1,554 m), Walling (700 m) and ends at Pokhara (791 m). It crosses the Kali Gandaki at Ramdighat (365 m) at a distance of 90 km from Sunauli. Palpa district, of which Tansen is the headquarter, has a healthy climate and because of its proximity to the plains, it has all the potential to develop into a health resort. Fruits such as mandarin orange, shaddock, lime, lemon, papaya, bananas, mangoes, litchi and jack fruit are grown in the Pokhara Valley. Paddy and millet are the principal crops of this area, although wheat, sugarcane, maize, soyabeans, potatoes and vegetables are also grown. Good pasturage exists for the livestock; buffalo herds are moved down during the winter months and taken to high altitude *Kharkas* during summer. They look sleek and fat. In Baglung, on an average 5.7 buffaloes are kept by each household and dairying is one of the principal occupations of the people in this part. In Parbat district, besides dairy and agriculture, paper making is an important cottage industry.

People

Brahmins, Kshatriyas, Khas Chetris, Newars, and Gurungs constitute the majority of the population, although Thakalis, Sunwars and Kamis are also found in small numbers. While Gurungs occupy the hill tops, others — Brahmins, Chetris, etc. live in the valley floors and at lower altitudes. Although Gurungs are principally agricultural people, they go to join the British and Indian armies, while their womenfolk are left at home to work in the fields. Gurung women are expert weavers.

Gurungs as a group may well have existed for a long time in the hilly region (*pahar*) and they seldom come down. It is only in the recent times that they have ventured to inhabit the lowlands of the inner Terai and Terai.

Besides agriculture, they are also engaged in sheep and cattle herding. Buffalo is their main dairy animal and they earn some cash through the sale of *ghee*.

They have a unique social institution — called *rodi*, which is a

kind of social club for teen-agers. Usually, a group remains with a *rodi* until the couples get married. 'All the members of a *rodi* usually work together in the fields or go together to fetch wood from the forest. Sometimes one *rodi* invites another *rodi* from a different village to help them in the fields. During their stay, the boys may work in the fields, if it is an agricultural season and enjoy the feast in the evening. At the end of their visit, the boys make presents of money, bamboo cigarette holders or combs, which they make with great skill.'[1]

Tamangs

The Tamangs are mostly concentrated in the area immediately north-east and west of the Kathmandu Valley. There are, however, scattered communities in the east — as far as Darjeeling and in the Terai-Janakpur and Narayani Zones. There are groups which are culturally closer to the Tibetans and are called as Tamang Bhotiyas. Their staple crops are maize, potato, millet and wheat. Animal husbandry is common. They keep poultry, which they bring to the markets of Kathmandu and other towns for sale. Though extremely hardy, their economic condition is poorer than that of the other ethnic groups of Nepal. They reportedly eat tree frogs (*Hyla* sp.).

Tamang settlements lie mostly between 1,219 m and 2,438 m. They live in stone single story houses with wooden shingle roof. They are skilled craftsmen and weave woollens, bamboo packets, mats, etc. Lama Tamangs also paint scrolls.[2]

Thakalis

They are primarily inhabitants of Thak Khola, a tributary of the Kali Gandaki. Though culturally they are distantly related to their northern brothers, Hinduistic influence has pervaded their way of life. Tukuche in the past was a bustling town because of its importance as a trading centre; much of the traditional trade through Tibet was in the hands of the Thakalis, who now have moved to Kathmandu. But quite a few have set up roadside inns along the Pokhara-Jomsom trail. These resting places are known as much for their cleanliness as for the warm hospitality of the Thakalnis.[3]

1. Bista, D. B. 1967. *People of Nepal.* pp. 70-73.
2. *Ibid.* p. 80.
3. Wife of a Thakali or Thakali belle.

Among the Thakalis, at least in the past, there were 'forced marriages.' When a boy found a girl of his choice, he took the latter to a friends' house and the actual marriage rites were performed later by the parents. Polygamy was not uncommon among the Thakalis.

Magars

Magars have been the subject of an intensive study by Hitchcock.[1] They inhabit the Mahabharat range, between 1,828 m and 3,657 m. The Magar homeland is the mountain belt drained by the Narayani and its tributaries.

Magars speak a language which belongs to Tibeto-Burmese group (*Magar kura*). There are a number of tribes among them: *Ale Rana* and *Burathoki* (in the southern half) and *Bura, Gharti* and *Rokha*, who occupy the northern half of the country. Agriculture is diverse: in the southern half, millet, maize and irrigated rice are the principal crops, while in the northern part, barley, potato and maize are the main crops, though at lower altitudes rice is also grown. Livestock is an important occupation with these people and every Magar household keeps pigs and chickens. They occasionally move with the herd, taking cattle to the *lekh* during summer months. They are fond of liquor, which they distil from millet.

They engage themselves in the production of a number of cottage products, such as straw mats and woollens. They also go for fishing and hunting.

Culturally they are also influenced by Hinduism, though not to the same extent as others. According to Hitchcock: 'Customs and religious rites are similar to the Hindus, perhaps nothing of the Mongolian influence is left on these people. They have been absorbed by the southern cultural influences which the Brahmins and Rajputs (Thakuris) brought with them.'

In no case, among Magars do we find marriage by capture, a common practice among ethnic groups in Nepal.

Magars which comprise the largest of the ethnic communities of Nepal, are spread over a large area — from Dailekh and Jajarkote in the west to Pokhara and Gorkha in the east. They go in large numbers to join the Indian and British armies.

1. Hitchcock, John T. 1966. *The Magars of Banyan Hill.*

Rodi

Like Gurungs, the Magars have also *rodighars* which are roadside resthouses where a group of 20-30 people engage themselves in a question and answer session of love songs, always led by a female member. *Rodighars* are used during winter months; the girls bring liquor and food and the boys help bear the other expenses.

The two districts lying immediately west of Kathmandu, viz. Nuwakot and Gorkha, are principally inhabited by the Tamang people. They are primarily an agricultural community and are particularly good animal husbandrymen. Gosainkund, which lies in the Langtang river basin, is situated at an altitude of 4,319 m. There are a number of lakes in this area which are visited by the pilgrims during the summer months. Nathaniel Wallich, who succeeded Hamilton as Superintendent of the Royal Botanical Gardens at Calcutta, 'visited only one place outside Nepal Valley, viz., Nuwakot but persuaded pilgrims to bring back curiosities to him when they went to Gosainkund'.[1] *Saussurea gossypiphora* D. Don., 'which forms clubs of soft white wool from six inches to a foot high (first described as *S. gossypina* by Wallich in 1831), was brought to Kathmandu by pilgrims from Gosainthan'.[2] Langtang region is unparalleled in scenic setting and colourful vegetation. Stainton says: 'If anyone asked me where to go in Nepal in the spring to see the country at its best, I would without hesitation recommend the rhododendron-conifer woods which lie between 3048 m. and the treeline.'[3] This part of the country is equally rich in such medicinal plants as *Jatamasi* (*Nardostachys jatamansi*), *Kutki* (*Picrorhiza kurroa*), *Nirmasi* (*Delphinium denudatum*), *Kuth* (*Saussurea lappa*), etc. Pokhara and adjoining regions (Syangja, Parbat, Kusum, Gulmi, etc.) are drained by Seti, Bijayapur Khola, Kaste Khola, Tal Khola, Khudo Khola, Andhi Khola, Jagat, etc. all joining to form the Krishna (Kali) Gandaki which comes out as the Narayani River at Devghat. It is known as the Gandak in India.

Chauri, a cross between a yak and a cow, is well adapted to

1. Burkil, I. H. 1904. 'Notes from a Journey to Nepal.' *Rec. Bot. Soc. India.* 4. 59-140.

2. Bhatt, D. D. 1964. *Plant Collection in Nepal. Madrono.* p. 148.

3. Stainton, J. D. A. 1963. 'A Spring and Summer in Central Nepal.' *Jour. Roy. Hort. Soc.*

the cold climate which prevails over this region for most part of the year. It is said that this animal is unable to live below 1,219 m. The male animal is a beast of burden, while the female is the source of creamy butter (*ghee*) and cheese. Yak needs no shelter during winter and can stand a few feet of snow on its back. It is a sure footed animal and can carry a heavy load through trails across precipitous rocks. Yak meat is dried and stored, while its hair is used to make ropes, bags, carpets, and boots. Yak tail is used as a 'Fly whisk'. Once a year yaks are bled which provides a tasty dish. Yak dung replaces firewood which is always scarce. Yak is bred with the local cow, the resulting offspring, if female, is called *Jhum* or *doi*. The male offspring called *Jopkiyo* is, however, neuter.[1] In Langtang (altitude *ca* 3,353 m), there are extensive grassy meadows intersected by clear mountain streams, which support a large yak population. Here a cheese processing plant has been established to utilize the yak milk. This area is inhabited by the Tamangs, who are a sturdy people living in small villages. They are good agriculturists and grow wheat, barley, buckwheat and potatoes.

People of the Central Highlands

Nepal has been described as an ethnic turn-table.[2] The bulk of people who join the British and Indian Gurkha regiments come from the Rai, Limbu, Gurung, and Magar tribes. Of these, the Gurungs and Magars inhabit Central Nepal between the rivers Karnali and Rapti. The Magars are concentrated in the Kali or Krishna Gandaki basin. The Gurungs are basically an agricultural community. They live in the districts of Nuwakot, Gorkha, Tanahu, Kaski, Parbat, Lamjung, Pokhara and Nuwakot. 'The Gurung tribe is divided into two distinct divisions, known respectively as the *Char Jat* and the *Sorha Jat*. The *Char Jat*, as the name implies, is divided into four clans. Each of these clans is divided into a large number of kindreds. The *Sorha Jat* is divided into kindreds only and there is now no trace of the group of sixteen clans from which the division takes in its name.'[3] Scattered colonies of both the Magar and Gurung tribes are found throughout the country. The Rais or Khambas and the Limbus or Yakthumbas

1. Sharma, Gauri Prasad. 1954. 'Yak.' *Indian Farming*. Vol. 3.
2. Hagen, Toni. *Op. cit.* p. 61.
3. *Nepal and the Gurkhas*. 1965. Ministry of Defence. London. p. 89.

belong to a part of the country which is called *Kirat Pradesh*. According to some people, the word *Kirat* is all embracing, for it includes not only the Rais and Limbus, but also the Dhimals. It is said that the Kirats inhabited the Kathmandu Valley between 700 B.C. to A.D. 100, and it is also claimed that Kirats and Newars are identical people. Rais and Limbus mostly inhabit Sankhuwa Sabha, Terathum, Panchthar, Bhojpur, Dhankuta and Illam. 'The Limbus and Rais are rather more Mongolian in appearance than the Gurungs and Magars, and any attempt to place their origin in the South is probably due to their desire to show a Rajput origin, a sentiment not unknown amongst other Himalayan tribes.'[1]

Sherpas of Nepal

Sherpa is a term applicable to the people of Tibetan stock who live mostly in the Solokhumbu district of east Nepal. A small group also inhabits the Chautara district (Helambu), a place much frequented by the trekkers now. Sherpa villages lie at altitudes between 3,048 m and 4,267 m. There are many clans among the Sherpas. Though in language, religion and culture they show close affinity to the Tibetans, they also celebrate Hindu festivals with equal enthusiasm. Though the Sherpas are better known to the world as expert mountain-guides and high altitude porters, they are primarily an agricultural community. Tenzing Norgay was the first Sherpa to share honour with Edmund Hillary in 1953 for scaling the highest peak in the world — Sagarmatha (Mount Everest). In the Solokhumbu region are also found many Khambas who are migrants from Tibet. These people are closely akin to the Sherpas in language and customs, and are 'largely indistinguishable in appearance'.[2]

In common to all the other people inhabiting the high Himalayas, *tsampa* is a favourite food of the Sherpa also. *Tsampa* is prepared in the following way: 'Barley is fried with sand, and when the grain pops, the latter is sifted out through a fine-meshed sieve; after this, it is ground, the flour is mixed with butter, tea, or milk or beer and then eaten.'[3] A special kind of tea — the 'brick tea' is used in its preparation, which comes from Illam and Darjeeling.

1. *Ibid.* p. 98.
2. Haimendorf, Cristoph Von Fürer. 1964. *The Sherpas of Nepal.* p. 233.
3. Harrar, Heinrich. 1958. *Seven Years in Tibet.* p. 320.

Speaking of the people of this area, Stainton says: 'They keep herds of yaks, also some sheep and goats, but rather surprisingly they keep no dogs at all. They pen their sheep and goats at night in small semi-underground stone houses in a manner, I have not seen elsewhere; apart from keeping the animals safe, it ensures a good supply of manure for their small potato fields.'[1]

In Helambu, Sherpas live a sequestered life. The villages are scattered over a wide area, each belonging to a different clan. They all follow Buddhism and do not kill animals, though they are non-vegetarians. They live upon rice, barley, potatoes, yak milk and meat. They are very hospitable, although their economic condition cannot be considered satisfactory. Every year able bodied men and women migrate to Darjeeling (India) in search of gainful employment; however, in recent times, they do seem to be having a thriving business as porters and guides.

Social and Economic Life of the Sherpas

Agriculture and livestock are the mainstay of the Sherpa community. Potatoes, maize and buckwheat are the principal crops. In some places wheat and barley are also raised in the winter months. In the 'high valley of Dingboche, a bearded, short-stemmed barley is grown in irrigated fields'.[2] Potatoes are buried underground as soon as they are harvested and taken out when needed. The Sherpas are not sedentary people. They move from one place to another, reaching as far south as Kathmandu and cross the northern border through *Nampa La* (5,486 m) into Tibet, in search of good pastures and to trade in salt, wool, sugar, kerosene, and foodgrains. Being Buddhists, Sherpas do not kill any animals.

Instead of bullocks, human beings drag the wooden ploughs. *Zopkio*, a cross between a yak and a cow is, however, used as a draft animal. When fields are under crops, animals are kept away from the fields, and owners of stray animals are fined. Locally elected councils play an important role in the administration of the Sherpa villages with the village councils allocating civic tasks by rotation. New schools have been opened in this area, and more recently, Hillary has established a hospital also. The Sherpas manage their land quite efficiently and in sharp contrast to the forests of lower and climatically more favoured regions

1. Stainton, J. D. A. 1964. *Op. cit.* p. 28.
2. Haimendorf, C. V. 1964. *Op. cit.* p. 7.

which have been destroyed by the Chetris, Brahmans and other tribes, those of Khumbu have thus far escaped being axed. This is 'mainly due to an efficient system of checks and controls by a society which combines strong civic sense with a system of investing individuals with authority without enabling them to tyrannize their fellow villagers'.[1] The increased tourist traffic has brought about new ecological problems, including encroachment into forests. Tourists are reported to be burning yak dung.[2]

Agriculture in the Eastern Hilly Districts of Nepal

Agriculture in the hilly region is of a subsistence type. It is very rarely that a farmer has surplus yield. His main source of income is *ghee* and occasionally, poultry, livestock, fruits and cottage products, e.g. wooden containers, baskets, paper, etc. He needs cash to buy salt, sugar, kerosene and cloth. It is true that some farmers are more enterprising than the rest in this matter; work in the fields is at a minimum during winter months and so this time one finds farmers being engaged in such economic activities as building houses, transporting manure and on road construction projects.

Agriculture in the hilly region of Nepal is a hazardous occupation in which nature holds the destiny of the farmer. Drought, hailstorms and floods are constant threats to the crops. Agricultural conditions in the eastern hilly districts of Nepal, viz. Chautara, Ramechhap, Dhankuta, Okhaldhunga and Illam were studied by Gurung.[3] He travelled extensively in these parts to get first hand information at the behest of the erstwhile Rana regime. Apart from observing the conditions of the farms and the farmers, he also studied the 'economic and social life of the cultivators, farm practices which are commonly followed and its effects on the farmers' standard of life'.[4]

Gurung observed : 'The farmer in these parts of the country (as elsewhere) is illiterate without training, (and) with little ambition and much indolence, lives a contented life. He is very

1. *Ibid.* p. 15.

2. 'Tourism Pressures Increase in Khumbu.' *Newsletter.* Nepal Nature Conservation Society. Special Coronation Issue. Feb. 1975.

3. Gurung, C. B. 1949. 'Report on the Study of Agriculture Conditions of the Eastern Nepal Hills, East No. 1 to Illam.' (Mimeographed). p. 47.

4. *Ibid.* p. 2.

respectful and loyal to the Government and from the incessant toils, hardships and struggles which are his usual lot, he finds relief on occasions of *hath* (open market), festivals, fairs and marriages.' This picture of the Nepalese farmer drawn nearly three decades ago has basically remained unchanged; although it cannot be denied that he is now living in a new socio-economic and political climate with plenty of promises for the future.

Gurung (1949) has designated three cropping systems in east Nepal: Plain region (alt. 305 m to 914 m), Mid region (alt. 914 m to 1,524 m) and Lekh region (alt. 1,524 m to 3,657 m and above). The agricultural pattern in the hilly regions of Nepal is quite complex. Though cereals are given priority, poultry, livestock, fruit and vegetable cultivation are not entirely neglected. In the hills, dry farming is practised in many places but the farmers do not have varieties that can withstand drought. 'Agriculture,' as Gurung puts it aptly, 'in large parts in eastern Nepal hills is still a gamble in annual rainfall.'

The cropping systems in east Nepal are:

Plain region—*khet* (low land): alt. 305 m to 914 m.

1. 1 yr. Maize — March-July
   Paddy — June-November
   Fallow — December-March
2. 2 yrs. Sugarcane — April-January
   Paddy — July-November
   Fallow — November-March

Plain region — *Bari* (upland)

1. Maize — July-November
   Fallow — December-June

Mid region — *Khet* (lowland) alt. 914 m to 1,524 m.

1. 1 yr. Paddy — June-October
   Wheat — December-May (may be as single or mixed crop)
   Mustard — December-May
2. 1 yr. Maize — April-May
   Paddy — June-November
   Wheat — December-April
3. 1 yr. Paddy — March-June
   Paddy — June-November
   Tite fafar (*Fagopyrum* sp.) December-March

4. 1 yr. Paddy — June-November
   Tite fafar — December-March
   Fallow — April-May
5. 1 yr. Potato — March-August
   Maize — March-August
   Paddy — August-November
6. 1 yr. Paddy — June-November
   Fallow — December-March
   Maize — March-June
7. 1 yr. Paddy — August-November
   Fallow — December-June

Mid region — *Bari* (upland) alt. 1,524 m to 1,828 m.

1. 1 yr. Maize — April-July
   Millet — August-December

Mid region — *Bari* (upland)

1. 1 yr. Fallow — February-March
2. 1 yr. Maize — May-July
   Millet — August-November
   Wheat — December-April
3. 1 yr. Millet — August-November
   Fallow — December-July

Lekh region — *Khet* (lowland) alt. 1,828 m and above.

1. 1 yr. Potato — March-August
   Maize — March-August
   Fallow — December-February
2. 1 yr. Paddy — August-November (only one crop taken in a year)

Lekh region — *Bari* (upland)

1. 1 yr. Maize — March-July
   Potato — March-July
   Kodo[1] — August-November
   or
   Millet
   Fallow — December-March
2. 1 yr. Maize — May-October
   Wheat or Barley — November-May
   Mustard (grown as a mixed crop in winter)
3. 1 yr. Mustard — September-January
   Potato—March-July

1. African millet (*Eleusine coracana*).

4. 1 yr. Maize — March-September
   Mustard — September-January
   Fallow — March-July
5. 1 yr. *Kodo* — August-November
   Potato — November-March

The lowland (*khet*) is irrigated while *bari* or upland is a dry farming tract. As common to other hilly parts of Nepal, maize replaces paddy at higher elevations, other crops of importance being: *Uwa* (a local variety of naked barley), barley, and mustard. Some sugarcane is also grown. Sherpas as well as Tamangs practise shifting cultivation for potatoes, which is called *bhasme* system. They select a scrubby site, burn the bushes and then plant tubers. Usually only one crop is taken at one site, to which the farmers revert after 8-10 years.[1] From Illam, potatoes are exported in substantial quantity, 'about 2 lakh mds (5,400,000 tonnes)'.[2]

There are extensive orange orchards in Dhankuta and Bhojpur. During the winter months, villagers trek long distances (in some cases nearly a week), to market their produce in Dharan bazar, the bulk of which (95 to 97 per cent) ultimately reaches the markets of Forbesganj, Purnia, and Bhagalpure in India. Citrus trees throughout the country (as much as 54 per cent) have been reported to be suffering from a disease known as 'Citrus Decline'. At one stage, it was thought to be caused by a Greening Virus,[3] but now the causal agent has been identified as *Mycoplasma*. There is evidence that the disease spreads by a vector *Diaphorina citri*. Climatic and soil conditions are quite suitable for growing pome and stone fruits in the hills of Nepal, but it is only in recent years that the government has taken steps to carry out a programme of horticultural development in these parts.

Of the village industries in eastern Nepal, weaving, livestock raising, poultry farming, fishing, manufacture of bamboo mats and baskets are the more important ones. Another industry is concerned with the manufacture of Nepali paper which is prepared from the bark of the paper tree (*Daphne cannabina, D. bholua*),

1. Gurung, C. B. 1949. *Op. cit.* p. 14.

2. Mathema, P. R. 1964. 'Market Structure of Agricultural Commodities in Nepal.' Nepal Agricultural Conference II. (Mimeographed).

3. Knorr, L. C. and Shah, S. Moin. 1971. 'World Citrus Problems.' V. Nepal. *FAO Plant. Protect. Bull.* 19 (4) : 73-79.

Edgeworthia gardeneri (*Aryili*) and *Wickstroemia cannescence*.

The Kiranti People

The eastern hilly districts of Nepal — the *Kirant Pradesh* — is inhabited by two tribes, the Rais and the Limbus; of these, the Rais occupy the central or *Majh Kirant*[1] and they outnumber the Limbus. The principal settlements of the Rai communities are in Solokhumbu, Okhaldhunga, Khotang, Bhojpur and Udaipur. According to old chronicles, the Rais occupied a much larger area than they seem to occupy now.

Rai settlements lie between 914 m and 1,524 m. They live in small one storey houses built of stone, which are either thatched or roofed with slate. Houses are often built on stilts. Bamboo is extensively used in the construction of houses for walls, as well as roofing. The ground floor is used as a poultry pen.

Cultural traits of these people are equally interesting. Instead of brass pitchers, water is stored in bamboo pipes. Maize is the staple food, but other crops, such as millet, wheat, rice and beans are also grown. Cotton and and tobacco are used for household purposes. *Sisal* is used for ropes. Shifting cultivation is a rule rather than an exception in this part of the country.

Limbus

Limbus are closely related to the Rais. They live in an area east of the Arun river, called *Limbuwan*.

Agriculture is the mainstay of the people, though it is mostly of a subsistence type. Their lives are dominated by ghosts and evil spirits.

Tongs is a favourite social drink. Every man has a large wooden mug which is filled with thick millet beer and sipped through a bamboo tube.[1]

Sunwar

These are rather a small tribal group — ethnically related to the Magars. They live mostly in eastern hilly parts, in the districts of Ramechap, Dolakha and Okhaldhunga, along the slopes of the Mahabharat and river valleys. According to Bista, 'they go to Assam. Bhutan and Sikkim in search of seasonal employment and some settle there permanently'.

1. Bista, D. B. 1967. *Op. cit.* pp. 31-32.

Chapter XI

Agriculture in the Lowlands

Agricultural Pattern in the Terai

The Nepal Terai is a part of the Indo-Gangetic plain. It is a narrow strip of land with a width of 24 to 32 km and has a rich alluvial soil. Most of the land is now under cultivation and only a small area — less than 3 per cent — under forest.

Terai occupies 17 per cent of the total land area, and produces 60 per cent of the total foodgrains. In the Terai, paddy is the most important crop. In 1971-72, total rice export was 11.91 million tonnes, the bulk of which went to India. Agriculturally Terai is situated favourably; besides fertile land, major irrigation facilities are also in the Terai, where 29,632,000 hectares of land are currently under irrigation.[1]

Terai — the Granary of Nepal

The eastern Terai which includes the districts of Bara, Parsa, Rauthat Saptari, Sarlahi, Mahottari, Morang and Jhapa is most important from agricultural standpoint, for it produces almost two-thirds of the country's total food production.

In the Terai 77 per cent of the total area is under crops as against 16 per cent in the hills. In the Terai belt stretching from east to west along the entire length of Nepal, paddy and maize are the main crops. Besides these, the staple food crops of Nepal, a number of economically important crops are raised in this part of the country; oilseeds, sugarcane, tobacco, pulses, jute and lately wheat are grown in the Terai. In the Terai vegetables

1. Agricultural Statistics of Nepal. 1972.

such as brinjal, tomato, carrot, radish, bean, pea, pepper, potato, squash, cabbage, cauliflower, *parwal* (*Trichosanthes dioca*), etc. are also grown. Among the fruits are: mango, cucumber, lichhi, lime, guava, papaya, banana and *Kathal* (jack fruit). In the eastern districts of Morang and Jhapa, pineapple is now grown on a commercial scale. Great possibilities exist for the cultivation of avocado and other tropical fruits in the Terai. Gram, pigeon pea, *mung* bean, *urd* bean and field beans are extensively grown. In the Terai, besides buffaloes, oxen, horses, occasionally elephants and mules are employed for transporting men and materials. Every household keeps some livestock (cows and bulls); in Mahottari district, 49,273 households reported a total of 125,353 cows and bulls.[1] Tractors are now replacing draft animals, a thing which was possible due to extensive credit facilities provided by the Agriculture Development Bank.

The pattern of farming in the Terai is of an extensive type. Only one crop of paddy is raised in the western districts but in the eastern Terai, two crops are raised in a year. Early variety rice is planted in July and harvested in September and the late variety is planted in September and harvested in December. The average yield of paddy in central Terai has been estimated at 2 tonnes/ha which 'with the application of fertilizers has been increased to 2800 lbs/acre (3.2 tonnes/ha.)'.[2] Chemical fertilizer is now being extensively used in the Terai for paddy and wheat.

Green Manuring

In the Terai, as in the hills, very little of green manuring is done, although it is not uncommon to rotate legume with a cereal. Crops which are grown expressly for green manuring are: *Sanai* (*Crotolaria juncea*), *giara* (*Cyamopsis psoralioides*), *dhyanchiya* (*Sesbenia aculeata*), *seji* (*Melilotus parviflora*) and bean (*Vigna sinensis*). In the temperate regions crops used as green manure are: bean (*Vigna sinensis*), *bakula* or broad bean (*Vicia faba*), *bhatnas* or soyabean (*Glycine max*), *musuro* or lentil (*Lens culinaris*) and clover (*Trifolium* sp).

Bullock and buffalo-carts are the only means of transport in the rural Terai. In the monsoon season this mode of transportation is not available due to flooding of the tracks and streams and dense growth of elephant grass (*Pennisetum purpureum*), *Kans* (*Saccharum spon-*

1. Sample Agriculture Survey. 1962.
2. Thapa, B. 1964. *Op. cit.* p. 3.

taneum) and *munj* (*S. munja*). During the four long rainy months surface communication is cut off and each village becomes an island in itself. All the economic and social activities of the people come to a stand-still. In the winter months on bullock cart tracks — jeeps ply, which brings about a sudden spurt in the economic activities of this region. The building of 1,078 km long Mahendra highway — nearly two-thirds complete — has been instrumental in bringing the economic prosperity in this region. The benefits of the Green Revolution are already manifest and though the energy crisis has caused some set-back, the prospects are nonetheless quite promising.

The face of the Nepal Terai is fast changing with increase in the tempo of industrial activities; sugar, jute, match and plywood industries, are all located in the Terai — and with greater emphasis being put upon cultivation of food and commercial crops, a new economic order is in the offing in this part of the country. Furthermore, the entire Terai region provides seasonal employment to the hill people during the winter months. The winter exodus, which in many cases involves whole families, starts after the winter sowing of wheat. Those who come down to the Terai find employment as porters, on road construction projects or as workers in the tea gardens (*Chiya bagan*).

Inner Terai

In the inner Terai the total area under paddy in 1970-71 was 71,000 ha. The total cereal grain output of the inner Terai is estimated at 187,235 tonnes, of which rice amounts to 112,741 tonnes or 38 per cent of the total, millet 3,175 tonnes or 2 per cent of the total and wheat 209 tonnes or 0.1 per cent of the total.

It is thus obvious that inner Terai, from an agricultural standpoint, is as important as the Terai proper (Table 28). At one time, this was an area which was infested with malaria but this has now been brought under control. A large number of settlers from the hills as well as from India and Burma have settled down here.

In the inner Terai, rice, maize and mustard are the principal crops. In the newly cultivated tracts linseed and *rahar* (pigeon pea, *Cajanus cajan*) are grown. Fruits are grown where soil is good and irrigational facilities are available. Citrus, papaya, mango, jackfruit, pineapple and banana grow well in these parts of the country.

TABLE 28

TOTAL CEREAL GRAIN PRODUCTION, INNER TERAI BELT, NEPAL, 1965[1]

District	*Rice (tonnes)*	*Maize (tonnes)*	*Millet (tonnes)*	*Wheat (tonnes)*	*Total (tonnes)*
Udaipur	14,521	14,703	—	—	29,224
Sindhuli	6,914	10,855	—	64	17,833
Makawanpur	4,198	9,405	1,681	—	15,284
Chitwan	30,706	12,410	1,934	—	45,050
Nawal Parasi	25,692	1,501	—	145	27,338
Dang-Deokhuri	30,710	21,796	—	—	52,506

Source : Cereal Grain Production, Consumption and Marketing Patterns in Nepal. 1965. HMG, Ministry of Economic Planning.

Rapti Valley

The Rapti Valley is typical inner Terai region. It lies sandwiched between the Churiya and the Mahabharat ranges. The Valley is drained by three rivers, viz. Mahendra, Lothar and Khageni which are the main tributaries of the Rapti river. Narayangarh situated by the side of the Narayani River, an important town, is now linked with Butwal by a modern highway. It serves the vast hinterland districts of Gorkha, Kaski, Lamjung, Tanhun, Syangja, Dhading and Baglung. The soils of the Rapti Valley are mainly alluvial, with the top soil ranging from sandy loam to silty loam. The cereals grown in this Valley are: rice, maize and wheat. Citrus fruits — lemon, pommelo, lime, banana, papaya and pineapple also grow well. Groundnut and millet (*Eleusine coracana*) are grown on poor soils.

A good road links Kathmandu with the Rapti Valley and the Royal Nepal Airlines operates an air service to Bharatpur during fair weather. There is also an airstrip at Meghauli in the very heart of the Chitwan National Park. New schools, hospitals and factories are being established in this region and at present it has turned into a boom area. Hetauda is a case in point.

The Dang Valley is another inland Valley in western Nepal. It is inhabited mostly by the Tharus but other communities such

1. (*a*) Assume net yield (after processing, drying, seeds and wastage) of 60 per cent rice from paddy.
(*b*) Assume yield of 80 per cent after drying, seeds, wastage and processing.
(*c*) Assume yield of 81 per cent after drying, seeds, wastage and processing.

as Magars, Kshatriyas and a few Brahmins have also migrated from the hills to this Valley.[1] People live in thatched houses which are painted with red soils. Paddy is the principal crop, though oilseeds and pulses are also of some importance. Dang is now served by the RNAC which operates a service to this place and beyond to Surkhet, which is the 'Development Centre' for the Far Western Development Region.

In the inner Terai, the cropping system is — paddy : fallow : wheat : oilseed or legumes : maize : oil seeds. For paddy, the planting season is June and July and harvesting is done between November and December. Maize is planted in April and harvested in August; rice is planted in July and harvested between October and December. Wheat is planted between September and January and harvested between March and May.

Resettlement Programme

Due to extreme pressure upon cultivable land, and more particularly, the unprecedented floods of 1954, the people from the midlands had to come down to the Terai in search of land, food and shelter. In the Rapti Valley, between then and now, the population increased exactly ten times. Successive droughts in the hilly districts left the people in these areas with no option but to migrate to the Terai where they encroached upon virgin forest land. The government through the Resettlement Corporation is now engaged in the resettlement of these people in the districts of Jhapa, Nawalpur, Banke-Bardiya, Kailali and Kanchanpur.

In Nawalpur, forest land was cleared to make room for the settlers. New villages have been established for people from the hinterland districts of Nuwakot, Dhading, Gorkha, Tanahun, Lamjung, Kaski, Syangja and Baglung. A model agricultural farm has been set up in the district with a veiw to produce improved varieties of seeds and to demonstrate modern methods of agriculture to the local people.

In Banke and Bardiya, virgin forests have been felled to settle poor families from the Syangja, Baglung, Gulmi, Piuthan and Sallyan districts. Similar plans are now afoot in Kailali-Kanchanpur also. The Resettlement Corporation and the Timber Cor-

1. In Dang-Deokhuri, according to Charles McDougal, 84.7 per cent of the inhabitants were born outside the region in the hills; in Dang majority of the landlords are the *Paharis*, in Deokhuri, they are *Tharus*.

poration are now engaged in large-scale operations to settle 8,000 families in Kailali-Kanchanpur districts.

From agricultural standpoint, Nawalpur, as well as Banke and Bardiya, are quite fertile. Local climatic and soil conditions favour the cultivation of maize, mustard, paddy, wheat and millet. The farmers are being advised to go in for crop rotation — maize followed by green manure crops in the rainy season, and wheat followed by mustard in the winter season. In areas where irrigational facilities exist paddy grows well. Vegetables, which were unknown in these parts, are now being successfully grown. According to preliminary reports, long staple cotton has been successfully grown in Banke district.

The resettlement programme is a new phenomenon in the agricultural development of the country. This programme has twin objectives:

(1) It will alleviate pressure upon land in the hills, which can be left for a period of recuperation or could be used for the production of non-cereal crops. Potentially, all the hilly parts of Nepal are suitable for the production of fruit crops — apple, almond, peach, apricot, orange, olive, grape, etc. The economic well-being of the people living in these parts of the country would depend upon a change in the agricultural pattern which can only be achieved through sustained efforts by the government and people.

(2) To bring under cultivation land which is un-productive or under non-commercial type of forest.

Land Reforms

Although land reforms had been going on in piece-meal fashion since 1951, the Land Reform Act, 1964 was the first comprehensive agrarian legislation in Nepal. It is quite broad in outlook and very elaborate with regard to methods of implementation. The main features of the Land Reform Programme are: (1) fixing of a ceiling on land holding for each household (in the Kathmandu Valley about 2.5 hectares, in the hilly region about 4 hectares and in the Terai about 16.4 hectares); (2) ceiling on the holdings of land for a tenant at 2.5 hectares in the inner and outer Terai, about half a hectare in the Kathmandu Valley and about one hectare in the hilly region; (3) fixing of rent which in no case

is to exceed 50 per cent of the gross annual produce: (4) fixing of the compensation at 10 per cent in cash and the balance in interest bearing negotiable bonds; and (5) compulsory savings from land owner, tenants and owner tillers as a deposit for five years bearing a 5 per cent annual rate of interest, the quantum of such levy depending upon the area of the land, rental conditions and the kind of main crop raised.[1] It must be conceded that the Nepalese Land Reform Programme, which is primarily a tenancy reform measure, is beset with many difficulties, 'including the correct identification and accurate enumeration of the tenants and owners of land in the shortest possible time and since the existing land records are out-of-date, incomplete, haphazard in form and unreliable with regard to extent and, above all, a record of tenants is virtually non-existent, tenancy land reform depends upon the completion of a cadestral survey and the preparation of a new set of records in the land reform districts'. The cadestral survey work has lagged far behind and the co-operatives which were supposed to replace the private credit agencies have fa led to fulfil their role as the pivotal lending institution in the rural sector. In spite of these drawbacks, the Land Reform Programme has much to its credit. It has freed the tenants from the tyranny of the big landowners and has brought in a new climate in the country more conducive towards its development.

The Land Reform Act of 1964 was in principle 'implemented in such a way as to provide social incentive for agricultural development and for social and economic stability in the country'.[2] But problems with regard to the tenancy have cropped up. As Pant and Jain analyse the situation:

> 'Here the main intention is to provide security of tenancy to tenants, and to control, and if necessary, to reduce price of land use, i. e. rent. Under the Act, the customary rents were to prevail, but wherever the rents were at the exploitative levels, the same were to be controlled to 33 per cent in the Kathmandu Valley and 50 per cent in the rest of the country, as land owners' share. But in practice, there have been evictions as well as resumption of land by landowners for personal cultivation, a thing

1. This has since been dropped.

2. United Nations Economic Survey of Asia and the Far East. New York. 1969.

which also brought about connected problem of underground bases of land on a crop sharing basis.'[1]

New institutional arrangements for credit, supply and marketing of agricultural products, include Agriculture Development Bank, Agriculture Marketing Corporation and new Food Trading Corporation which is to handle the export of agricultural commodities, particularly paddy. Inadequacy of rural finance is being met basically through the Agriculture Development Bank which has provided generous credit for the purchase of tractors and water pumping sets in the Terai region.

Agricultural Credit

In a Sample Agricultural Survey conducted by the Rashtra Bank it was found that 'the overall proportion of the borrowing farm families during the Survey Year 1969/70 was 38.28 per cent and the proportion of indebted farm families at the end of that year was 65.19 per cent'. The survey further revealed that the farmers in the hills are much more indebted than those in the Terai. If improved technologies are to be adopted, the farmers would need larger amount of credit; in the 32 'accessible' districts of the Kingdom, the total credit need was estimated at Rs. 1,000 million; of this, the small farmers would need almost 50 per cent of the estimated total credit.[2]

A faster pace of agricultural development has become an absolute necessity to meet the basic needs of a rapidly growing population (2.07 per cent).

The centrality of agricultural development programme lies in proper implementation of the Land Reform Act, particularly in the matter of reducing debt of the farmers, easy accessibility of the credit, greater resource mobilization and strengthening of the land administration.

RIVER VALLEY PROJECTS AND IRRIGATION

Kosi and Gandak Projects

The Kosi river project is a multipurpose project and is designed to control floods, generate power, and draw out irrigation

1. Pant, Y. P. and Jain, S. C. 1972. *Op. cit.*
2. 'Agricultural Credit Survey.' Nepal Rashtra Bank (mimeo.). p. 14.

canals. The existing canal system irrigate only 56,500 hectares in the Sunsari and Morang district. The barrage site (Hanuman Nagar) and nearby territory, have been given to the Government of India on a lease of 199 years. The main dam (229 m high) is at Chatra.

The Gandak or Narayani river is the biggest river in central Nepal. The Gandak dam is located at Bhaisalotan (now renamed Valmiki Nagar) at the Indo-Nepalese border. Half of the 715 m dam lies in Nepal territory. Nepal will receive 15,000 kw of electricity, besides getting water for the irrigation of 28,200 ha of land in Bara, Parsa and Rauthat through the Eastern canal, and 9,750 ha in Nawal Parasi through the Western canal.

In the Saptari district 12,950 ha of land is irrigated by Chandra Canal, which was built by the Rana Prime Minister, Chandra Shumsher. With the completion of new irrigation schemes of which Kosi is the biggest one, crop production is on the increase. From the Kamla irrigation project, about 28,000 ha of land in Mahottari district has come under irrigation. Some other major irrigation projects are:

TABLE 29

IRRIGATION PROJECTS

(*in hectares*)

Project	*Location*	*Area to be Irrigated*	
		Total Area	*Area to be Irrigated during the Plan Period* (1970-75)
New Projects			
1. Sharada	Kanchanpur	25,000	25,000
2. Lohattar	Chitwan	12,000	12,000
3. Bagmati	Rauthat, Sarlahi and Bara	81,000	—
4. Banganga	Kapilvastu	8,000	8,000
5. Tube-well	Sagarmatha, Janakpur, Narayani and Lumbini	15,000	15,000
6. Minor Irrigation	In all the 14 Zones	21,932	21,432

(*Contd.*)

Table 29 (*Contd.*)

Continuing Projects			
1. Kamala	Dhanusha and Siraha	28,000	—
2. Pathraiya	Kailali	2,000	2,000
3. Rapti	Banke	3,000	3,000
4. Chapakot	Syangja	2,000	2,000
5. Chaurjahari	Rukum	250	250
6. Chatra	Morang and Sunsari	56,500	56,500
7. Gandak (East)	Bara, Parsa and Rauthat	28,200	28,200
8. Gandak (West)	Nawalparasi	9,750	9,750
Total		292,632	183,632

Source : Agricultural Statistics of Nepal. 1972.

Native Tribes of the Nepal Terai

The tribes of the Nepal Terai are all of the semi-Mongoloid origin; they speak Maithily and Bhojpuri according to their location.

Mechis

Mechis are the original inhabitants of the Terai — inner and outer — although scattered colonies occur in the hills also. Like the Tharus, Bhotias, and Dhimals, Mechis are immune to malaria. Their number, however, is dwindling because their habitats are being encroached upon by other people. Mechis are akin to Tharus and Boksas, and it seems that they can only be differentiated from Tharus and Boksas on the basis of habitat. The Tharus inhabit the western half of Nepal and the Mechis, the eastern half.[1]

Tharus

Tharus are found all over the Terai, but they are mostly concentrated in the western and central parts of the country. The Dangoras come from the Dang district and the Ranas are more common in Kailali-Kanchanpur. One comes across groups of these people during the winter months on move from one village to another lock, stock and barrel. On a wintry evening set against the golden rays of the setting sun, groups of these people are seen walking in a single file with small loads slung across the shoulders on a bamboo pole, a reed mat and a water bottle made out of bottle gourd (*Luffa aegyptica*), their total wordly possessions, crossing into

1. Sanwal, B. D. 1963. *Nepal and the East-India Company.*

India. A Tharu is truly a son of the forest and to this day he retains freedom of mind and movement, a rather uncommon feature among the tribes of Nepal.

A Tharu house has a neat look; the mud plastered walls are decorated with figures of elephants, horses, deer, bulls, etc. the handiwork of the young unmarried girls. Inside the house, there is a big parlour, the centre of which is occupied by a big hearth. On the walls, fishing nets, straw hats and agricultural implements are hung. Bins often serve as poultry pens. The parlour serves as a dining area also. The house has a clean and orderly appearance.

The Tharus love fishing, but it is the women who go on the 'big catch' when they get respite from the fields. Tharus are very good at poaching. Wild animals which come to graze the crops are caught in snares and done to death with blows from *lathis*.

A Tharu is always happy with a jug, his brews coming from many different sources — rice, maize, banana, etc. Addiction to drink makes him an easy prey to the caprices of the landlord and no wonder, therefore, he is always in debt.

Chepangs

This is one of the most imperfectly known tribes of Nepal, about whom Hodgson wrote: '. . . (they) live entirely upon wild fruits and have but little intercourse with the civilized world'. Hodgson thought them to be related to the *LHO* tribe of Bhutan.

Chepangs live in the north-western region of Kathmandu — Dhading, Makwanpur and in some parts of Chitwan and Gorkha.[1] They have distinct Mongoloid features and resemble the Rais of east Nepal but it is doubted whether their language has any affinity with that of the former. 'Of interest is the similarity of marriage practices of Chepang and Thami, who live in proximity with Tamangs.'

Chepangs are also related to Kusundas 'who are still more primitive. Their total population has been estimated to be about 16,000, according to the last census (1962). Chepangs are a peace loving people and hence much exploited by other groups of people. They occupy a particular ecological *niche*, between 761 m and 1219 m along the steeper slopes of the Mahabharat'. They work as unskilled labourers, having very little skill of their

1. Bista, D. B. 1972. *People of Nepal*. pp. 91-98.

own, except weaving of baskets. According to one source, less than 17,000 of these people remain.[1] They rarely settle down in one place and are always on the move. Smallpox seems to have taken a heavy toll of these people. They are truly forest people, who gather food and hunt in the forest.

Kusundas

Not much seems to be known about these people, who were once thought to be related culturally to the Chepangs. They have all but disappeared.

Rauts

They are small forest dwelling primitive groups of people inhabiting western hilly parts of the country. They are also known as *Ban Rauts*. They live mostly on roots and fruits of wild plants. They, however, make wooden dairy utensils which they trade for grain. They live in temporary settlements (thatched huts) and lead a nomadic existence. They wear a *toga* woven from *Cannabis* fibre and even their facial features bear an imprint of the primeval forest dwelling tribe on the move.

Lesser Tribes of the Terai

Of the lesser tribes of the Terai and inner Terai, are the *Danuwar*, *Manjhi*, and *Darai*, all of whom show striking cultural and physical similarities to the Tharus.[2] This fact alone brings out the possibility of a common origin of all these people, a group of aborigines scattered throughout the Indian sub-continent.

As with the Tharus, they inhabit warm humid parts of the country — in the midst of the forest, along river valleys penetrating far upstream along the deeply cut narrow gorges and valleys co-inhabiting with Brahmins and Kumhals, farmers and potters respectively. They speak Tibeto-Burman language.

Of the three ethnic groups, only Danuwars have a sizable population. They are 'scattered throughout the low hills of eastern Nepal and in the Terai, besides those found in the Kathmandu Valley'. Majhi is a small group 'of about 6000', inhabiting mostly the eastern part of the country. Majhis, as the name suggests, are agriculturists, but they seem still to be attached to forest.

1. *The Rising Nepal*. May 30, 1977.
2. Bista, D. B. 1972. *Op. cit*. p. 123.

About these people Bista says: 'Socially and ethnically all these three tribes taken together are totally independent and different. None of them have any social sub-divisions found in the majority of other Nepali groups. They appear a race apart, and none, except Danuwars, have reached the stage of organizing their communities into social, economic and political organizations.'[1]

Besides these three, there are other minor groups found mostly in the eastern Terai: Rajbanshi, Bodo, Dhimal, Sattar, etc. all showing strong cultural affiliations with the Tharus. Rajbanshis and Sattars are in sizable number and are perhaps the remnants of larger tribal groups which once inhabited whole of north-east India. The Sattars are said to be related to the Santhals of India and they hardly remain settled in one place. Some of them practise shifting cultivation but due to influx of a large population from outside, they have been forced to stay in one place.

Agriculture in the Kathmandu Valley

The Kathmandu Valley has an area of 76,000 ha and is the most populous part of the country, with a density of 828 per sq. km. Maize and paddy are the principal kharif crops. Wheat as a winter (rabi) crop is also now becoming increasingly important.

Since ancient times the Kathmandu Valley has provided subsistence to the local people. In the Valley there are 86,441 families of which 57,927 or about 67 per cent are engaged in farming. The industriousness of the local Newar community evoked eloquent praise from a Chinese pilgrim who visited the Valley in the eighth century. He described the country as 'full of mountains and valley...favourable for the production of grains'. He also noted that the 'country abounds in flowers and fruits and also copper, yaks and birds'.[2] This famous Chinese pilgrim, who visited Nepal, during the reign of Amshu Verman observed that the King 'understood the significance of agricultural prosperity and they (he and his successors), therefore, ran a network of canals for the purpose (*tielakam*) which in the end produced untold advantages for the peasants'.

In the Kathmandu Valley, paddy is the principal crop which is mainly transplanted. It is reported that, 'out of 71,000 acres (28,732 ha.) of land which is under cultivation in the Kathmandu

1. Bista, D. B. quoting Hodgson. *Ibid.* p. 124.
2. Regmi, D. R. 1952. *Ancient and Medieval Nepal.* p. 87.

Valley, slightly more than 44,000 (17,806 ha.) is under irrigation'.[1] Normally plants do not survive a water-logged condition, but rice is an exception. Its roots respire anaerobically. Stagnant water in rice fields keeps the weeds down.

The soil of the Kathmandu Valley contains a high percentage of humus, and is quite fertile. The Nepal valley is perhaps the most intensively cultivated part of the country. Farmers use night soil as fertilizer, though of late chemical fertilizers are also being used in increasing amounts. The use of chemical fertilizer in the three districts of Kathmandu, Lalitpur and Bhaktapur was nearly 2,500 tonnes (1969/70) which was biggest for any single geographical region in the country. Of the legumes grown, soya bean (*Glycine max*), broad bean (*Vicia faba*), pea (*Pisum sativum*) and cow pea (*Vigna sinensis*) are the more important ones. During winter months, one gets a rich variety of vegetables, such as cauliflower (*Brassica oleracea* var. *botrytis*), *chanshur* (*Lepidium sativum*), radish (*Raphanus sativus*), *tori* (*Brassica juncea*), broad leaved *rayo* (*Brassica juncea* var. *foliosa*), *Palak* (*Spinacea oleracea*), french bean (*Phaseolus vulgaris*), *bodi* (*Dolichos biflorus*), *seto simi* (*Dolichos lablab*), onion and asparagus. Green gram and *kerau* (*P. sativum, V. arvense*) are also common during early summer months. (*See* Appendix for a list of vegetables and fruits of the valley.)

Tilling is mostly done by hand. The local farmers (*Jyapus*) use a very short-handled spade or *kodali* for this purpose. Farmers keep buffaloes, sheep and poultry. The exclusion of draft animals from the farms is said to be on religious grounds, but it is equally possible that the hard clayey soil which is not amenable to wooden ploughs, may have led to this practice. It is worth noting that some of the agricultural practices in the valley, viz. the use of fresh night soil as fertilizer and the carrying of loads on two shallow baskets suspended from the two ends of a short bamboo pole are common to other countries in South-East Asia.

Newars

Newars are mostly concentrated in the Kathmandu Valley, the last census having put their population at 225,819. In eastern Nepal, they are found in Biratnagar, Sindhuli Gadi, Udayapur and Birganj. In central Nepal, they are in sizable number in Palpa and Butwal In the extreme west, they are found in Doti

1. Sample Agriculture Census. 1964.

(Silgadi). Outside the valley they specialize in retail trade of household commodities, which are of Kathmandu origin.

In the three main towns of the Valley, Kathmandu, Patan and Bhadgaon, 'they form 68.44, 78.44 and 79.74 per cent of the local population, respectively'.[1] Newars are also found in Darjeeling, Sikkim, Bhutan and Tibet, in the latter case, exclusively in the Capital town of Lhasa, where they number at around 20,000.[2] In Tibet they have freely inter-married with the local inhabitants and during the Malla period, they had a monopoly in trade with that country.

In the Kathmandu Valley, however, the bulk of the population (*Jyapus*) is engaged in agriculture. Most of the religious festivals in Kathmandu are intimately associated with the sowing or harvesting of crops, but quite often they commemorate a particular event or invocation of the rain-god or *Machhendra Nath*. Music, dancing and singing are inseparable parts of the *Jyapu* community. They find respite from back-breaking chores in innumerable festivities. A feast is a must whether it be for transplanting paddy or at the time of sowing wheat or its harvest time. *Cheura* (beaten rice) is the main dish, which is served with potato curry, *achar* (pickle) and beans, all washed down with sumptuous amount of a white turbid drink — *Jand* (a kind of rice beer). There is very little cash payment, each household joining the other, a system prevalent in other parts of the country as well.

Dasain is no doubt celebrated with great enthusiasm. Weeks before the actual start of the nine day festivities, groups of peasants go on a round of temples early morning playing flutes, drums and cymbals. Fresh ginger, sugarcane and marigolds are symbolic of *dasain* as of course, the sprouted barley shoots.

The Newars enjoy feasts, which cause a perpetual drain on their earnings. More often than not, community feasts are paid for by local *guthis*, which in effect, is a piece of rent-free land. The income acquired from these is utilized for the furtherance of religious and social interests.

Besides agriculture, the Newars engage themselves in a variety of trades — wood and metalcraft, masonry, distillery, pottery, etc. The historical monuments in the Valley of Kathmandu are a tribute to the artistic excellence of this community. Nepalese

1. Nepali, Dr. G. S. 1964. *The Newars*. p. 24.
2. *Ibid*. p. 38. Only about 150 traders are left now in Lhasa.

architecture in its original form found new patronage from the Chinese Emperors. It was a young Newar architect, Ariniko (Aa-ni-ko)who directed the construction of many temples and buildings in Lhasa and Peking in the 13th century.

Every *Jyapu* household meets a part of its requirement for cloth; the *Jyapus* still wear homespun fabrics — both cotton and woollen.

The Newars have brought about a near synthesis of Hinduism and Buddhism, thus imbibing the best of the two: hardly any distinction is made between a Hindu and a Buddhist god. 'The Newar pantheon also shows conflict which, however, results in mutual compromise, toleration, co-existence and peace. The three equations made between Siva and Buddha, Buddha and Narain, and Narain and Siva are a reflection of Newars' own attitude towards co-operation and mutual tolerations. This feeling permeates their entire social organization.'[1]

Opinions differ about the origin of this group of people. Scholars like Sylvan Levi hold the view that they came down to the Valley from the north; while others, like Gopal Singh Nepali, are of the view that 'they may have originated in South-India, with ties or distinct similarities to a Hindu community on the Malabar coast called the Nair or Nayar'. Haimendorf[2] is, however, of the opinion that 'bulk of the Newar people had been settled in the Nepal Valley since pre-historic times'.

Whatever may have been their origin, Newars have been subjected to much outside influences, both Hindu and Buddhistic, and despite appearances, Buddhist Newars are definitely in a minority. The Malla kings, who were high caste Hindus were as much responsible for their cultural advancement as the introduction of Hindu caste hierarchy among the Newars of the Kathmandu Valley. Some of the Newar sub-groups, Shresthas for example, follow many of the traditions of the Chetris.

1. Nepali, G. S. *Op. cit.* p. 341.
2. Quoted by D. B. Bista.

Chapter XII

Food Crops

Rice

Rice (*Oryza sativa*) is perhaps one of the oldest cultivated crops of the world. A large number of wild varieties of rice are known to occur in nature. There are two principal cultivated varieties of rice: *indica* and *japonica*. Rice is believed to have been first cultivated in the Ganges delta, although the Chinese claim to have been the first to cultivate this as a food crop in Honan, some three thousand years ago. The present varieties of rice have been derived from continuous natural breeding and selection — spread over a period of thousands of years. It is the staple diet of nearly half of the world population and it is still cultivated by primitive methods.

Upland or rain-fed rice accounts for 65 to 70 per cent of the world's total production. Yields of rice vary from 1.8 to 1.5 tonne/ha. Improved varieties such as IR 20 and IR 26 have yielded upto 10 tonne/ha.

The new high yielding varieties of rice bred at IRRI are dwarf and have many desirable agronomic qualities: the stem is short and strong which helps the plant to absorb more fertilizer and produce heavy heads of grains without toppling over. Short upright leaves make better use of solar energy and allow denser stands. The new varieties are specially bred for disease and pest resistance, and their growing period has been reduced from 160 days to a little over 100, which enable a farmer to grow two or even three crops in a year.

The new rice varieties which ushered an era of 'Green Revo-

lution' have changed the economies of developing countries. In all, about 20 per cent of the rice land in South and South-east Asia is now planted with high yielding rice. There are, therefore, real possibilities for its expansion, if irrigational facilities and fertilizer supply are augmented.[1]

Rice is the staple food of the Nepalese people. The crop is grown in more than 56 per cent of the available land (11,82,000 ha) with an annual production of 23,05,000 tonnes in 1970/71. The yield of rice (paddy) is 1,941 kg/ha, while the world average is 2,030 kg/ha. Between the Triennial 1963-64 and by 1969-70, there was a rise in acreage of paddy by 13.73 per cent which, however, is lower than other crops—notably wheat, sugarcane, and jute.

Beaten rice flake (*cheura*) is prepared by steeping paddy in hot water and beating it on a stone beater. Both *chang* and *rakshi*, two popular drinks of Nepal, are made from rice.

Rice straw is used for weaving mats (*sukul*) and for filling mattresses. It is also used as fodder and as thatch.

TABLE 30

Paddy: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(in thousands)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	640	1,108	650	1,187
Western Terai	276	469	282	507
Inner Terai	69	130	71	149
Eastern Hills	73	188	77	213
Western Hills	97	24	102	248
	1,154	2,119	1,182	2,304

Rice is raw material for pulp and paper manufacture. Some of the paper mills use exclusively this material. Rice straw, which is short fibered, is used along with long fibered bamboo or fine pulp to manufacture paper.

Paddy (unhusked rice) is the principal export commodity from Nepal. Over 90 per cent of the rice mills along the Indo-Nepal

1. According to official estimates despite an increase in cultivable land by 5,000 ha, production of rice has gone down by 8 per cent.

border depend upon Nepalese paddy. In 1966/67 the country exported 18,148,000 tonnes of paddy to India.

The recommended varieties of improved seeds for different parts of the country are:

For Hill Region	*For Terai Region*
Chinan — 1	I. R. 8
Chinan — 2	B. R. 34
Taichung — 176	C. H. 45
Chinung — 242	Taichung Native — 1

Diseases

Principal diseases of rice are: rice blast, bacterial blight, bacterial leaf streak, grassy stunt and *tungro* virus; of these, the first two are quite serious in Nepal. The indigenous varieties are less susceptible to rice blast.

Maize

Maize (*Zea mays*) is the second important crop in Nepal. Throughout the hilly regions maize is the principal food crop. The average yield is 1,906 kg/ha, which is extremely low as compared to other countries. New varieties capable of yielding as much as 4,000 kg/ha are now available.

Maize is grown both in the Terai as well as in the hills — from 152 m to 3,657 m. The area under maize in 1970-71 was 446,000 ha with an annual production of 833,000 tonnes. The quality of maize is poor throughout, but the Department of Agriculture is encouraging the farmers to use hybrid maize seed. New varieties 'Rampur yellow' and 'Hetauda composite' for warmer regions and 'Kakani yellow' for hilly areas are now being grown; the former matures in 100 days and the latter in 200 days. A maize developmental programme is also under way with the assistance of the Rockefeller Foundation and USAID. In the last decade, cultivation of maize was pushed in the following districts: Dang, Dhading, Kailali, Banke, Baglung, Palpa, Sindhulipalchok, Dhankuta, Terathum, Ramechap, Kathmandu, Lalitpur and Bhaktapur.

Maize in Nepal is eaten green, puffed, or is turned into flour. Its use as a cattle feed is rather limited. Dry stalks are used as firewood, but these are sometimes woven into mats also. Cobs are used as firewood. Maize is intermixed with soyabeans or

potatoes. Though there is a distinct possibility of maize products (dextrose, starch, corn flakes) being produced locally from synthetic improved varieties of corn, all these are thus far imported from outside.

Maize varieties with high lysine content are now being introduced.

TABLE 31

Maize: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(*in thousands*)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	38	54	43	64
Western Terai	55	79	59	89
Inner Terai	52	99	55	107
Eastern Hills	124	236	130	257
Western Hills	143	278	159	316
	412	746	446	833

Wheat

Wheat (*Triticum vulgare*) is the principal winter crop in the hilly regions. The existing area under wheat has been estimated at 228,000 ha. During the last Five Year Plan (1970-75), 65 per cent of the land was to be brought under wheat cultivation, with a target production of 76,000 tonnes. Very little wheat used to be grown in the Terai, but in the last few years large acreages have come under this crop. With intensification of irrigational facilities and availability of new high yielding varieties, wheat now occupies a significant place in the agriculture of Nepal. Between 1968 and 1971, there has almost been 88 per cent increase in area under wheat (205,000 ha) resulting in a total production of 193,000 tonnes. In 1973-74 wheat production was estimated at 328,000 tonnes.

In the hilly region trees and brush are often removed to make room for wheat cultivation. The cleared land or *Khormi* is put under crop for a period of 15 years, after which it is abandoned as the yield falls.

New high yielding varieties — S 331, S 227 and R. R. 21 — have produced extremely good results. All need high application of

fertilizer and irrigation. The yield has been reported to be as high as 1,273 kg/ha.

Large acreages of wheat are now grown in the western part of the country which receives rain and snow during winter months. In Nepal both awned and awnless varieties of wheat are grown. In the *lekh* region, the awned variety is preferred, as it is not liked by the bears who find it difficult to eat.

Loose and covered smuts, rusts and mildews are serious diseases of wheat in Nepal.

TABLE 32

Wheat: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(in thousands)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	46	39	55	37
Western Terai	41	36	51	37
Inner Terai	10	9	12	9
Eastern Hills	24	40	39	38
Western Hills	62	81	71	72
	182	205	228	193

Job's Tear

Job's tear (*Coix lachryma jobi*) is a wild grass. Its fruits are often turned into flour and used for bread making particularly when other cereals are unavailable. Hence it is also called the 'poor man's cereal'. Fruits which show resemblance to pearls, are used for ornamental purposes.

Oat

Oat (*Avena sativa*) is rarely cultivated in Nepal. In the wheat or barley fields, however, a weed (*Avena fatua*. L. Sub. sp. *fatua* (L) var. *intermedia*) is found growing but this is quite different from the oats found in the Indian plains. It shows closer affinities to the Japanese or Chinese varieties.

Millet

Millet (*Eleusine coracana*) is a crop of major importance after rice and maize. It is grown in the Terai, as well as in the hills.

It is the principal *kharif* crop in the midlands where irrigational facilities are poor. It is often grown in marginal land and is intermixed with maize or soyabean. There has been an increase in acreage under millet, which is mainly a subsistence crop.

Millet often replaces rice in the hills, but its upper limit of cultivation is higher than rice.

Barley

Barley (*Hordeum vulgare*), principally a crop of the temperate parts and one of the oldest crops of the world, is cultivated in Nepal between 1,828 m and 3,657 m. According to the available statistics, 65 per cent of the crop is grown in the western hills. It needs a drier climate. In the dry Himalayan valleys, where it is called *uwa*, along with potatoes and radishes, it forms the principal food crop of the region. Total acreage (1970/71) under barley was 115,000 ha with a yield of 130,000 tonnes.

In the Tibet region of China (Phari area) 'a bumper harvest of barley' was reaped at 4,300 metres above sea level.[1]

According to this report, the Phari area has only 46 frost free days a year and can be considered 'one of the highest regions of the world'. Barley is a spring crop and in order to save it from early frost, smudge towers are built.

TABLE 33

Barley: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(in thousands)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	5	3	5	4
Western Terai	2	1	2	1
Inner Terai	1	1	1	1
Eastern Hills	2	3	3	3
Western Hills	15	15	16	16
	25	23	27	25

Buckwheat

Three varieties of buckwheat (*phapar*) are found growing in Nepal. These are: *Fagopyrum esculentum*, *F. tataricum* and *F. cymosum*; of these,

1. *China Reconstructs*. December 1966. p. 42.

the first two are cultivated, while the last one grows wild. It is a crop which is found growing mostly in the temperate parts. *Tite phapar* (*F. tataricum*) is bitter in taste and is probably a Tibetan variety. Buckwheat replaces *uwa* in the Trans-Himalayan region of Nepal.

Grain Amaranth

Amaranth is grown at altitudes of 1,219 m and above. It replaces rice at higher altitudes. In Nepal, both *Amaranthus leucocarpus* (*latay*) and *A. caudatus* (*kaun*) are cultivated. The grain is either ground into flour or turned into porridge. Amaranth is often inter-planted with millet and maize. Both red or pink seeded varieties are grown in the country. Amaranth grains are often popped, this being the only foodgrain which can be served on certain festivals.

Pulses

A number of pulses are grown in the hilly as well as the Terai regions. In 1972-73, the production of pulses was 66,000 tonnes. Some of the more common pulses grown in the country are: *masur* or lentil (*Lens culinaris*), *bodi* or cowpea (*Vigna catjang*), *semi* (*Dolichos lablab*), *chana* or Bengal chickpea (*Cicer arietinum*), black gram *kalo mash* or *urad* (*Vigna mungo*), *mungi* (*Vigna radiata — Phaseolus aureus*), *kerau* or field pea (*Pisum arvense*) and *arhar* or pigeon pea (*Cajanus cajan*). There is, however, no big acreage under these crops. In the hills, *urad* and *gahat* (*Dolichos biflorus*) are by far the most important pulses, the former being grown in the *dils* or edges of rice paddies, while the latter in stony, marginal or in scrub lands. *Kerau* is eaten green also. *Arhar* is grown in the warmer parts, in the Terai and *duns*. Total acreage under different crops are not known, but taking the country as a whole, they are of minor importance from the agricultural standpoint.

Potato

Next to cereals, potato (*Solanum tuberosum*) is the most important crop of Nepal. From the lowlands of the Terai to the high dry alpine areas, potato is an integral part of croping pattern in the country. In areas beyond 2,438 m or so, potatoes and buckwheat are the staple crops of the local people. In the Rolwaling valley, potato cultivation was observed by Stainton at 4,205 m, the limit of the tree line in this area.

In Nepal, potatoes are grown both as winter and summer crops. In the Kathmandu Valley, potatoes are harvested in the summer, the same fields being then used for rice planting. In the hilly areas potatoes are often planted on the newly cleared lands. Potatoes grow well in lighter soils.

In the country both red and white varieties are grown, and Nepalese potatoes find a good market in India, where they are used for seed purposes. Potato in Nepal is mostly a rain-fed crop.

At present potatoes are being grown in 49,000 ha of land. The total production in 1970-71 was 273,000 tonnes. Principal potato growing areas of Nepal are: Illam, Makwanpur, Dhankuta, Nuwakot, Terathum, Palpa, Kathmandu, Sindhu Palanchowk, Kavre Palanchowk, Baitadi, Doti, etc.

Wart (*Synchytrium endobioticum*), nematodes and blight take a heavy toll of potatoes in Nepal. Work is now in progress to replace the indigenous varieties with ones that are resistant to disease and have a high yield. The present yield of potatoes in Nepal is 66,000 kg/ha.

TABLE 34

Potato: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(in thousands)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	6	34	7	40
Western Terai	3	19	4	24
Inner Terai	2	13	2	14
Eastern Hills	21	123	23	130
Western Hills	11	56	13	66
	43	245	49	274

Chapter XIII

Commercial Crops

Tobacco

There are two principal species of tobacco: *Nicotiana tabacum* and *N. rustica*. The first one is also called as virginia tobacco, and is used in the manufacture of high quality cigarettes, while the latter (*N. rustica*) is a small plant bearing yellow flowers; its tobacco is mainly used for the hubble-bubble and for chewing purposes. The existing area under tobacco has been estimated at 8,000 ha. In 1972-73 season, Nepal produced 7,000 tonnes of tobacco. The districts of Saptari and Mahottari are the main centres of tobacco production in the country. The bulk of the tobacco from Nepal is exported to India but with the establishment of a cigarette factory in the heart of the tobacco producing region of the country — at Janakpur, a substantial part of the production is utilized locally.

In the mountainous region of Nepal, camping sites are set aside for the Bhotiyas when they come down with their flock to the warmer parts of the country during the colder months, October through February. These camping sites which contain plenty of organic manure are utilized to grow tobacco. One often comes across a patch of lush tobacco in the midst of a barren landscape in the hills of Nepal. As more and more people are getting habituated to cigarette or *biri* smoking, tobacco cultivation is on the decline. Moreover, it is a difficult crop to grow as it needs much care and is particularly sensitive to frost. It also suffers from such diseases as bacterial wilt (*Pseudomonas solanacearum*), mosaic (a virus disease) and black shank (*Phytophthora parasitica*), a fungal disease.

Curing is essentially a fermentative process, in which the leaves

loose water and turn yellow. The quality of tobacco depends upon the process of curing, which is either carried out in barns or in the sun.

High grade tobacco, such as virginia, is not grown in the country.

TABLE 35

Tobacco: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(*in thousands*)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	7	6	7	6
Western Terai	1	—	1	—
Inner Terai	1	—	1	—
Eastern Hills	—	—	—	—
Western Hills	—	—	—	—
	9	6	9	6

Sugarcane

This crop is increasingly becoming important in Nepal as new sugar mills have come into existence. Sugarcane (*Saccharum officinarum*) is grown in the hills as well as in the plains. The principal centres for the growing of sugarcane are: Banke-Bardiya, Palhi-Majkhand, Bara-Prasa, Rauthat and Morang. Areawise, sugarcane occupies 1.40 per cent of the total under food and cash crops; of this, nearly a third (0.37 per cent) lies in the eastern Terai (7,400 ha in 1970-71). Though there is a large area under crop in western hills (0.77 per cent), the total production does not exceed 21,000 tonnes. Many indigenous varieties of sugarcane are grown in the country, but new Co-varieties are now being introduced. In the hills, the thick yellow cane (*gannda*) is perennial in habit, and is mostly used for chewing. The quality of the cane grown in these hills is poor. This factor coupled with attacks by insects and diseases, greatly reduces the yield of the crop. In the Central and Eastern Terai, sugarcane production is on the increase due to the establishment of new sugar mills, as well as an increase in the production capacity of the older mills. Molasses, a by-product of sugarcane production, is used in the preparation of tobacco mixture. It is also widely used in the manufacture of candy, rum, alcohol, etc. It is also an excellent food for cattle.

The dry residue left after extraction of the juice is called bagasse; it is used as fuel in the sugar mills, as well as for making paper, wall-boards, etc. In Bhairawa, a sugar mill produces from cane rum as well as other hard liquors — whisky, gin, etc.

In 1972 total production of sugarcane was 245,000 tonnes.

TABLE 36

Sugarcane: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(in thousands)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	5	84	7	131
Western Terai	4	57	4	67
Inner Terai	—	5	1	7
Eastern Hills	1	6	1	9
Western Hills	1	17	1	22
	11	169	14	236

Oil Seeds

Vegetable oils have an important place in the economy of any country, whether developed or developing. Vegetable oils are used for cooking, varnish and paint, burning, lubricating, medicine, perfumery, soap, etc. In Nepal total acreage under oilseeds in 1970-71 was 106,000 ha, with a production of 55,000 tonnes.

Tori or Mustard

In Nepal mustard or *tori* (*Brassica campestris*) is the principal oilseed crop. It is cultivated throughout the Terai and there are large acreages in the inner Terai — in the districts of Chitwan, Nawal Parasi, Dang-Deokhuri, Banke-Bardiya, Kailali and Kanchanpur. It is often intermixed with wheat or barley.

As there are few oil pressing mills in the country, the bulk of the crop is exported to India. In the rural parts, oil is pressed from the seeds by *Kolhu*, an indigenous oil press which is driven by bullocks or human hands. Mustard cake is much valued as fertilizer.

Mustard oil is mainly used for burning and cooking.

Soyabean (*Glycine max L.*)

This is by far the most important legume grown in Nepal. It is

grown as a mixed crop, with maize or millet. Green pods are steamed, and the cooked seeds when mixed with salt and pepper provide a tasty dish. Roasted seeds often provide a whole meal to the poor people. Soyabean flour is used in making pan-cakes and in the preparation of curd. It is quite nutritious with a high protein content, 30 to 45 per cent, and has about 20 per cent oil. The whole plant is used as fodder. Soyabean cakes are used as animal feed. Soyabean oil, for which there is so much demand in the paint and varnish industry, is not produced in Nepal. Soyabean meal has a high protein content (44 per cent) and is, therefore, highly nutritious.

Sesame

Sesame, til (*Sesamum indicum*) is a plant belonging to the family Pediliaceae. The seeds yield oil which is used for cooking, in oil lamps and in the production of margarine, shortening, soap and grease. Sesame oil cake is regarded as a good cattle feed. In Nepal it is a minor crop. Sesame is a kharif crop and is raised in the hilly regions along the edges of rice paddies. The seeds are used in religious ceremonies and for preparation of *Chutney*. Dry cakes are a good fodder.

Groundnut (*Arachis hypogea*)

This is an annual plant and grows best in well-aerated, sandy or loamy soil. Groundnut is also a kharif crop and in eastern Terai (Bara, Parsa and Rauthat) large acreages are under this crop. The pods are roasted in sand and sold in the market by vendors. Groundnut oil is used in salad or as cooking oil. The cake is rich in protein and is used as animal feed. 'Peanut-butter' is widely used as a breadspread. Groundnut is also used in the preparation of candy bars.

Guizotia

Jhuse til (*Guizotia abyssynica*) is a small herbaceous plant belonging to the family Compositae. It is cultivated in the warm parts of the country. Its oil has a good demand as a lubricant; it is also reported to be useful in the treatment of rheumatism.

Linseed (*Linum usitatissimum*) is a useful plant belonging to the family Linaceae. It is also called flax. Linseed oil is used in paint, varnish, linoleum, oil cloth, printing ink and soap industries. Dry

stalks are used for packing. The plant yields a fibre from its stem. Linseed oil cakes are used as fodder. When linseed oil is mixed with sulphur, linoleum or wax cloth is formed.

Linseed is grown mostly in the districts of Bara, Parsa and Rauthat, the latter being called 'Linseed Bowl'. In the Bara and Parsa districts, 11 per cent of the total cultivated land is under linseed and 15 per cent in Rauthat and Saptari districts.

Linseed is often grown as a mixed crop with mustard and pulses.

Nepalese linseed has an oil content of 33 per cent.

Cheuri

Cheuri or 'Butter Tree' (*Madhuca butyracea, Bassia butyracea*) kernels yield a fat which finds many uses. It is used as cream (*phulel*), as a cooking medium and for making soap and candles. In the hills, its use as an adulterant of *ghee* is fairly common. *Gud* (raw sugar) is made from the nectar of the *Cheuri* flowers, a commodity for which there is always a great demand. It is reported to be of medicinal value also.

Castor

Castor (*Ricinus communis*) is an important oil yielding plant. The plant grows wild in Nepal in tropical and sub-tropical parts, but as yet no effort has been made to grow it commercially. Castor oil is used as a purgative and also in the manufacture of soap. Castor oil is popular as hair oil. It is used in 'finishing' textiles, and as a lubricating oil for engines. Castor oil cake cannot be used as cattle feed because it is poisonous but it can be used as a fertilizer.

TABLE 37

Oil Seeds: AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(in thousands)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	21	9	23	9
Western Terai	26	15	28	15
Inner Terai	33	21	36	22
Eastern Hills	9	4	10	5
Western Hills	8	3	9	4
	97	52	106	55

Chapter XIV

Fibre Crops and Wood Products

Cotton

There are many wild and cultivated varieties of cotton in the world. Wild species of cotton do not produce good lint. *Gossypium herbaceum* (chiefly Asian) and *Gossypium arboreum* (tree cotton) are the common species of cotton. Not much is known about the types of cotton and its acreage in Nepal. It is not unusual to find a few cotton plants of short stapled Indian variety in the villages. Spinning and weaving from locally grown or imported cotton is an old cottage industry in Nepal. A hilly terrain and the landlocked nature of the country forced the people to produce cloth for their requirements locally. In the forties, during the last World War, cottage industries including cotton textiles were started in order to meet acute shortage of cloth in the country, but this indigenous enterprise received a severe setback at the end of the decade due to the flooding of the market by imported cheap mill-made cloth. Cottage textile industry has survived in the rural Newar community who wear home-spun cloth. Locally, cotton is grown in many places like Jumla, Acham, Bajura and more recently, in the Terai — Bardiya, Nawalpur, etc. Very high quality 'sacred threads' are made by Thakuri women from home grown cotton.

Ramie

The Ramie plant (*Boehmeria nivea*) belongs to Urticaceae. Unlike common nettle (*allo, Urtica dioca*), it has no stinging hairs. Ramie fibre is obtained from a number of species of *Boehmeria*, viz. *B.*

platyphylla, B. hamiltoniana, B. macrophylla, B. polystachya, B. cuspidata, B. rugolosa and *B. sidaefolia,* all of which have been recorded in Nepal. None of the above plants are, however, cultivated for fibre but nettle is used for forage and its fibre is used for making sacks and sandals.

Hemp

Hemp (*Cannabis sativa*) yields a strong and durable fibre, which is of a better quality than flax. It is unaffected by water, but bleaches with difficulty. The fibre, in natural colour, is ashen grey. It is used to make ropes, twine and to weave sack cloth which is used as a toga (*gado*) by the poorer people. Hemp seeds are used as food and as a source of oil which is used in soap making. The narcotic properties of hemp are well known. The plant yields a milky fluid (latex) which is turned into *charas.* It is a black plastic-like substance — a pure alkaloid, and it fetches a high price in the Indian market. Dried inflorescence and young leaves are used as a smoking mixture. A large acreage is under this crop in Bajhang, Bajura, Baglung, Bara, Parsa, Rauthat, etc. Cannabis cultivation was banned some time ago, but in the hilly parts this caused great hardship to the people, who seem to have resumed its cultivation.

Sisal

Sisal (*Agave sisalana*; *henequen*) fibres are obtained by beating leaves, and are used to make ropes, twine, ship's cables, etc. Sisal is also used as fodder. It has certain glucosides of fermentable sugars and hence is often used for making beverages. It is of minor importance in Nepal.

Jute

Jute is the most important commercial crop of Nepal. Jute fibre is obtained from two species of *Corchorus* (*C. capsularis* and *C. olitoreus*), both belonging to the family Tiliaceae. The plant reaches a height of fifteen to twenty feet. The jute plant requires a warm and humid climate, and a high rainfall, between 152 cm and 254 cm a year. It needs a plentiful supply of water during the growing period and is planted just before the monsoon. A high temperature between the range of 15.6°C to 37.8°C is needed for the proper growth of this plant. A good supply of water

is essential for retting and cleaning the fibre. Jute fibre is not very strong but still it is commonly used for making gunny sacks and lining linoleum. Jute twine is used for wrapping packages. Jute is easily affected by water and is difficult to bleach.

Nepalese jute, cultivated in the districts of Morang, Sunsari and Jhapa, is mostly of medium quality. The total acreage under jute has been estimated at 55,000 ha with maximum yield of 53,000 tonnes. In 1972-73, jute production exceeded 53,000 tonnes and in the coming season (1973-74) is expected to touch 65,000 tonne mark, an increase of 35 per cent over 1969-70. In some other parts, viz. Saptari, Siraha, Janakpur, Bara, Parsa and Rauthat also jute is grown, but it is of lesser importance than tobacco.

TABLE 38

Jute : AREA (IN HA) AND PRODUCTION (IN TONNES) BY REGIONS 1967-68 AND 1970-71

(in thousands)

Region	1967-68		1970-71	
	Area	*Production*	*Area*	*Production*
Eastern Terai	45	44	52	51
Western Terai	—	—	—	—
Inner Terai	2	2	3	2
Eastern Hills	—	—	—	—
Western Hills	—	—	—	—
	47	46	55	53

In the past, jute used to be primarily exported to India. Since the last few years, a good part of the production finds its way to countries other than India, accounting for almost 80 per cent of the earned foreign exchange in the country.[1] In 1970-71, this was equivalent to Rs. 33 million. Besides, in the same year, jute cuttings and goods worth Rs. 257 million were exported to overseas countries.

The acreage under jute is being expanded, and nearly 20,000 ha will be under improved varieties.

[1] Tourism has now emerged as the foremost foreign exchange earning industry in Nepal, In 1975 the earnings reached $ 9,692,000, which is an increase of 26.2 per cent compared with those of the previous year.

WOOD PRODUCTS

Turpentine

In Nepal conifers are present in abundance. Between altitudes of 1,219 m and 3,657 m, 20 species of pine, fir, hemlock, spruce and other gymnospermous plants are found. *Pinus roxburghii*, one of the important sources of resin and turpentine, grows extensively between 914 m and 1,828 m and covers nearly 27 per cent of the hill region. But so far pine trees have almost exclusively been used for timber. Cedar once covered large areas in the Karnali basin but now they are confined to a few spots along the Tila River. Cedar oil is sold in the markets of Rajapur and Nepalganj. It is useful in treating skin diseases and ulcers.

Crude turpentine is a thick yellowish fluid which comes out of the resin canals if a cut is made in the trunk of the tree. In practice, a longitudinal cut about 15.2 cm long and 10.2 cm wide and 1.9 cm deep is made in the stem so as to expose the wood. At the base of the cut a metal or earthenware cup which receives the resin is fixed. A single tree can be tapped continuously for 20 years, and if the operations are carried out scientifically, it does not in any way impair the quality of the timber. Tapping starts in the middle of February and lasts until the end of November. Twice in the week, the channels are 'refreshened'. The substance which oozes out is called resin or crude turpentine, which on distillation gives turpentine (16 per cent) and resin (83-84 per cent), the latter being the solid, thick, viscous residue. Resin is used in the manufacture of textiles, paper (sizing), soap (as a fixative), paints, varnishes and also in the manufacture of synthetic resins. Fractional distillation of turpentine yields products which are used in the manufacture of perfumes and many other kinds of chemicals. Pine tar, which is the residue of turpentine distillation, is used in the manufacture of rubber products. For some time, an Indian concern — the Nepal Resin and Turpentine Factory, undertook tapping operations in Baitadi (western Nepal) but this has since closed.

Oil of turpentine or spirit of turpentine is widely used in the paint and varnish industries. It is a solvent and finds its use in textile, medicine as well as in the manufacture of such substances as grease, shoe polish, sealing wax, etc.

Tar is another product of pine which is obtained by incom-

plete destructive distillation of its wood. Creosote, which is used as a wood preservative, is obtained from tar.

Rubber trees (para rubber, *Ficus elastica*) are found in the eastern part of the country — notably in Dharan and Jhapa. No large-scale plantations are present in the country. Rubber is obtained from the sticky white liquid (latex) which oozes out when a cut is made in the stem of the rubber tree. A series of cuts are made in the stem to remove bark and the latex is received in cups — a process similar to that employed in the extraction of resin.

Methyl Alcohol

Methyl alcohol is obtained by heating wood in retorts. The products are wood alcohol, which through further distillation, yields methyl alcohol, wood tar and gas, the latter being used as fuel. This is called 'hard wood distillation'.

CANE AND BAMBOO PRODUCTS

Mats

Several species of bamboo grow in the country. Bamboos grow extensively in the foothills and to an altitude of 1,828 m to 2,133 m. In the midlands, they are found growing in the shady ravines. One of the commonest use of bamboo is for weaving of mats and *doko* (baskets). In the western part of the country mats or *mosta*, as these are called locally, are made exclusively from *nigalo* (*Arundinaria falcata*). These are put to various uses, viz. drying grains, temporary roofing and as floor mats. Throughout the country, bamboo (*Dendrocalamus strictus*) is used as structural timber.

Baskets

Doko, the 'multi-purpose' basket is made of bamboo, but the best ones are made from *Arundinaria* sp. which grows throughout the temperate parts. These baskets are put to different uses: they are used to carry farm manure or bring firewood and fodder from the forest; others are used to carry people — a sort of sedan chair. *Kharpan*, a wide-rimmed shallow basket is also made of bamboo. Other products of bamboo are: *nanglo*, a saucer-shaped structure used for chaffing; *suppo*, a spade-like structure used in winnowing; *dalo*, a barrel-like thing used for storing grain and *bhakari*, which is an open air bin and is much used in the Terai.

Bamboo and cane furniture is produced in Biratnagar, and at the Balaju Industrial District, near Kathmandu.

Bamboo is used for making brushes, tooth picks and scaffolding. It is also used for making hubble-bubble pipes, which are often decorated with wildlife figures. Khaptad in the Doti district is especially famous for these.

The most common bamboo growing naturally in Nepal is *Dendrocalamus hamiltonii*. Jalthal forest in the Jhapa district has large quantities of bamboo.[1]

Cane, *bent* (*Calamus tenius*) grows naturally in the foothill (*Bhabhar*) forests, but has been over-exploited, so much so, that bamboo furniture manufacturers are now importing this from India.

Paper

Bamboo is an important raw material for paper manufacture. Sabai grass or *babio* (*Eulaliopsis binata*) is found throughout the Terai. It occurs on the slopes of the hills, in the Bhabhar and *duns*. Large quantities of Sabai grass are purchased annually by the Indian mills from the Forest Department. It is used locally for weaving mats and ropes and for making brooms. Other grasses which can be used for pulp production and occurring naturally in the Nepal Terai are: *Munj* (*Saccharum munja*), *Khar* (*Imperata cylindrica*) and *Ulla* (*Anthesteria gigantea*). Bamboo is a raw material for paper, but thus far it has not been used locally for this purpose.

Daphne bholua, the *Kagat pate* or paper plant, is found throughout the hilly regions (alt. 1,424 m to 2,133 m), and is used in making paper. *Daphne cannabina* is a medium sized tree, which bears drupaceous fruits. Its bark (baruwa) which is tough and leathery is hand-beaten into a pulpy mass and then spread over a thin white cloth fixed on two wooden frames. Often rice straw and waste paper are also mixed with *Daphne* pulp. The paper which is formed thus is rather coarse, but is very durable. Most of the Nepali paper is used as stationery, and lately, for taking rubbings of icons. In government offices where old records are kept, it is still exclusively used. But Nepali paper meets only 10 per cent of the demand for paper in the country. The total consumption of Nepali paper does not exceed 150 tonnes.

Nepali paper is essentially a cottage industry which is confined to the hilly parts of the country, particularly Okhaldunga, Helumbu,

1. Grant, Dr. Julius. 1964. *Feasibility Study: Pulp and Paper*. NIDC.

Baglung and Doti (Phalendi). In India, Nepali paper (hill paper) is still in good demand where it is used to maintain records of land settlement.

Semul: Cotton Tree (*Salmalia malabarica*)

The cotton tree or *semul* is an important tree in the Terai and sub-tropical parts of the country. In April and May, the red flowers of this tall tree provide a pretty colour to the landscape. The generic name *Salmalia* is derived from the Sanskrit word *Salmali*. The boat-shaped mature fruit yields fleecy material, and is used to stuff pillows and mattresses. The wood is used for match sticks.

Dairy Containers

Mulberry, walnut, *toɔni* (*Cedrela toona*), *saɔna* (*Oroxylon indicum*) and *pani saj* (*Terminalia myriocarpa*) yield timber which is used to make dairy bottles, churners, etc. by the gypsies of west Nepal — the Rauts. Fir wood is also used in the Himalayan region for this purpose.

Utis (*Alnus nepalensis*) wood is now being used for the soles of high platform ladies shoes.

Rice Straw

Rice straw is used as fodder. It is also a raw material for paper. Rice fibre mats, ropes, shoes, etc. are goods of great utility.

Chapter XV

Fruit Crops, Spices and Beverage Crops

Nepal is favourably placed from the standpoint of horticultural crops. Extremes of topography and agro-climatic conditions favour growth of a wide variety of fruits and vegetables. Fruit growing constitutes a good source of income to the people, who are always hard pressed for cash. And, as means of communication develop further, fruit cultivation will become a productive enterprise for the hill people.

In Nepal, different climatic zones allow diverse kinds of fruit production.

1. Terai: mango, litchi, pineapple, papaya, banana, etc.
2. Lower hills and valley areas: sub-tropical fruits, such as oranges, lemons, limes, guava, pomegranate, etc.
3. Middle hills: stone fruits like peach, plum, apricot, persimmon and hard variety pears.
4. Higher hills: apple, cherry, pears (soft type like Bartlett), walnuts, chestnuts, hazelnuts, etc.
5. Cold and dry zone: raisins, grapes, dry apricots, prunes, nectarines, etc.

Demand for fresh fruits is on the increase in the urban centres. Locally grown fruits, such as peach, plum, pears, etc. are of poor quality, but gradually better varieties are appearing in the market.

In 1969-70, 21,000 hectares of land was under fruit cultivation with a total production of 266,000 tonnes.

FRUITS

Apple

It is in the recent past only that apple orchards have been established in the country — in Baitadi, Jumla, Lamjung, Helumbu, Kakani, Dhankuta, etc. At Daman (altitude 2,285 m) temperate fruits — apple, peach, apricot have been planted. From the standpoint of climate, the western hilly region of the country is quite favourable for the cultivation of apples. In Jumla and Tibrikot, orchards on a commercial scale have been planted and some are already in production. At the Marpha Agricultural Farm, apple orchards have been planted along with grapes, apricots, almonds, walnuts, and peaches.

Peach

Peach, *aru* (*Prunus persica*) is the most common stone fruit in Nepal. It grows between 1,219 m to 2,133 m. It prefers calcareous soil. Improved varieties of peach are now being grown in many parts of the country, including the Kathmandu Valley.

Plum

Plum, *alubokhara* (*Prunus communis*) grows between 1,524 m and 2,133 m and throughout the country.

Apricot

Apricot, *khumani* (*Prunus armenica*) is a fruit tree which is grown in the home gardens throughout the temperate zone of Nepal. The quality of plums and apricots, however, is rather poor.

Pear

Pear, *nashpati* (*Pyrus persica*) is the most common pomaceous fruit in Nepal. Often it grows wild in the evergreen temperate forests. The quality of fruit varies from place to place. Much, however, remains to be done to improve their quality. Regular pruning can — to a large extent — improve the quality of fruit. Pears grow well in the clayey water-logged soils.

Loquat

Loquat (*Eriobotrya japonica*), a tree native to China and Japan, is also grown in Nepal — upto about 1,828 m. It prefers a well-

drained and light soil. The tree is middle sized, 6 m to 9 m tall and bears fruit during October-November. The fruit, which is of golden yellow colour, is quite delicious.

Pineapple

Pineapple, *bhuin kathal* (*Ananas cosmosus*), is cultivated in the warmer regions of the country — particularly in the Jhapa district, where recently a canning factory has been established. The crop is grown on a commercial scale in Dhunbesi, Rapti, etc. In the river valleys pine apple is a cash crop. The fruit has a high nutritional value, and is in great demand — fresh or canned. The crop needs good care, including frequent irrigation. The plant is propagated through suckers, cuttings and crowns.

Fig

Fig, *anjir* (*Ficus carica*) is a small tree. The fruit (*Syconus*) contains a high percentage of grape sugar (dextrose) and is very delicious. The upper limit of cultivation of this fruit tree is around 1,524 m. Usually two to three crops can be raised in one year. In the Kathmandu Valley and elsewhere, it is planted in home gardens. It grows best in well-drained soil.

Litchi

Litchi (*Litchi chinensis, Nephelium litchi*) belongs to family Sapindaceae. It is essentially a warm climate plant, and grows well throughout the Terai and the warmer valleys of the midlands. It can neither withstand frost nor survive drought. The fruit which ripens in April, May and June, is eaten fresh. In China, which is its native country, the fruits are dried and are stored for long periods.

Papaya

Papaya, *mewa* (*Carica papaya*) is essentially a fruit of the Terai and inner Terai. It is also found growing in the hills but cannot survive temperatures below 15°C. It grows well in sandy, well-drained soils and requires a high summer temperature.

Guava

Guava, *amba* (*Psidium guajava*) is a common fruit in the Kathmandu market during late autumn. The quality varies from small, green

and hard fruit to fair sized, tasty ones — comparable to the Indian varieties. Guava cannot withstand frost, which limits its cultivation to 1,524 m-1,828 m. The fruits that one sees in the local market often show unsightly lesions caused by a fungus (*Pestalotia*), a thing which considerably lowers their quality.

Mango

Mango, *amp* (*Mangifera indica*), a plant belonging to the family Anacardiaceae grows best in the Terai, although its upper limit of cultivation is around 1,524 m. The best mango orchards in the hilly region are found in the river valleys. The mango tree cannot withstand frost and needs long, cloud free days during the period the fruit is ripening.

Langda, *Bombay* and *Malda* are three well-known varieties of mango grown in the Terai and other parts of Nepal. Mangoes grown in the hills are suitable for pickling.

Banana

It is essentially a tropical and sub-tropical crop; it cannot grow where the air temperature goes below 15°C. The most favourable temperature is between 15°C and 32°C. It needs enough of moisture, an average of 50 mm rain. The principal varieties of banana are: *Malbhog*, *Singapuri*, *Kabuli*, *Harichal*, *Chinia Champa*, and *Vasrai*, in the hilly region; *Rato Kera*, *Rajpuri*, *Sirumali*, *Jhapari*, *Maghe Ghiukera*, etc. in the warmer valleys. In the Teraj — *Pari*, *Kurkutiya* and *Martman* are the principal varieties. Two varieties — *Musa sapientum*, and *Musa paradiasica* (plantain) are widely cultivated in Nepal. The former (*M. sapientum*) is a tall plant and its fruit is eaten green. *Malpuwa* (*M. cavandesi*) is small sized plant; its fruits are small, thin and are of a golden yellow colour when mature. Bananas are picked green and are ripened under rice straw or in grain bins. This practice is employed to ripen mangoes also. Banana, like papaya, is a day-neutral plant, i.e. it shows no response to photoperiod. This accounts for its adaptability to diverse altitudes as well as latitudes.

Persimmon (*Diospyrus virginiana*)

Haluwabed, persimmon (*Diospyrus virginiana*) is a common fruit tree in the Kathmandu Valley. The fruits, when mature, are very delicious but slightly astringent. Persimmon wood is soft

and is suitable for making shuttles, golf clubs, etc.

Jaman (*Eugenia jambolanum*)

Jaman (*Eugenia jambolanum*) is a tree which grows in the rive-rain and warmer parts of the country. Jaman wood is used in the making of agricultural implements. *Jaman* fruits, when ripe, are of a dark blue colour; they are used in the treatment of rheumatism.

Koiralo (*Bauhinia purpurea*)

Koiralo (*Bauhinia purpurea*) is a tree of the temperate parts. Its flowers are used for making curry. The flowers and buds are first boiled and then mixed with lime, pepper and spices. This turns into an excellent *achar* (pickle) or *chutney*. The leaves are used as a vegetable.

Kimu, Mulberry (*Morus alba*)

Kimu, mulberry (*Morus alba*) is a cultivated tree which grows between 1,219 m and 3,048 m. The fruits are succulent spikes which turn black when ripe. Its wood is used to make agricultural implements.

Citrus

Many kinds of citrus fruits are grown in Nepal. Among these are: Lemon (*Citrus limonum, C. limon*), lime (*Citrus limatta*) and citron (*Citrus medica*). Lemon is mostly used fresh, but often the sap is boiled to thick consistency and stored in wooden wares or in *chinda* (dried hollow fruit of *Luffa* sp.) for future use. As locally there is a good demand for this commodity, it provides a small cash income to the farmers.

Tangerine (*Citrus nobilis* var. *deliciosa*), which is a hybrid between sweet orange and a mandarin is grown throughout the hilly regions at altitudes of 609 m to 1,828 m. Large quantities are exported from eastern Nepal, especially from Dharan. The most important centres of orange production are: Dhankuta, Chainpur, Bhojpur, Sallyan, Pokhara, Andhikhola and Baitadi. Oranges grown in the Pokhara valley find a ready market in Butwal and Kathmandu, but most of the orchards are in a state of decline now. The fruits are often infested with scale insects, but this does not seem to lower their market value.

In the Kathmandu Valley, pomelo (*Citrus maxima*) is a com-

mon orchard tree. The fruits which are very thick skinned, have little juice. Those with a pinkish flesh are sweeter than the white ones.

Rough Lemon

Rough lemon, Kathe Jamir (*Citrus jambhiri*) is widely used as stock for grafting better varieties; it is also sold fresh in the market.

Bimro (*Citrus media*) is another thick skinned citrus variety grown locally in the Kathmandu Valley. It contains little juice, but being cheap, has a good market.

Wild Fruits

In the temperate parts of the country, a number of species of wild berries grow; of these the more important ones are: *Ainselu* (*Rubus eillipticus*), *Kalo ainselu* (*Rubus lasiocarpus*) and *Chutro* (*Berberis aristata*). The berries which ripen in early summer are quite sweet. Blackberry jam is made by boiling the fruit juice to a thick consistency.

Kaphal (*Myrica esculenta*) is a medium-sized tree; its fruits which are deep red (drupe) are sold in the market during the months of April and May. The tree grows naturally in oak-rhododendron forest.

SPICES AND PLANTATION CROPS

Ginger

Ginger (*Zingiber officinale*) is a tropical plant. The rhizome, the edible part of the plant, is either used fresh or after drying. *Sutho* is a dried and bleached ginger, a commodity for which there is much demand outside. Ginger is an important cash crop throughout the hilly regions of the country. The plant requires a fertile and well-drained soil and is shade-loving. In the hills, ginger is planted with turmeric. It is propagated by rhizomes. The crop takes 8-10 months to mature.

Cardamom

Cardamom (*Elettaria cardamomum*) belongs to the ginger family (Zingiberaceae). It is a herbaceous perennial plant with rhizome underneath. It is grown in places where the climate is warm and there is no danger of frost. The plant prefers a shady habitat,

which is provided by planting trees such as *utis* (*Alnus nepalensis*). The crop is often planted along the banks of streams, in glens and in small clearings in the forest. The fruits (capsules) are much used as a condiment and have medicinal use. Cardamom grows well upto an altitude of 1,828 m and is an important commercial crop of the western and eastern hilly regions, particularly Illam.

Turmeric

Turmeric, *besar* (*Curcuma aromatica, C. longa*) is obtained by boiling the rhizomes and later drying these in the sun. It is mainly a tropical crop and grows upto about 1,828 m. It is exported to India and overseas countries. The orange yellow powder is widely used in curries and also as a dyestuff.

Chillies

Chillies are grown in the temperate and warmer parts of the country. The long red variety (*Capsicum annuum var. longum*) is exported from the country in large quantities. African varieties are reported to be hottest of all. *Capsicum* has medicinal properties: it is carminative.

Cinnamon

Cinnamon (*Cinnamomum zeylanica*) is obtained from the bark and twigs of cinnamon, an ever-green tree, which grows in abundance in the tropical and temperate parts of the country. Some other trees, such as *Cinnamomum cassia* also yields cinnamon. Cinnamon bark is exported in large quantities.

Tejpat or *dalchini* (*Cinnamomum tamala*) has smooth bark. It grows wild in the central and eastern Terai regions, from where it is exported. The leaves are used as a condiment. The bark is also used to spice food.

BEVERAGES

Tea

Tea (*Camellia sinensis syn. Camellia theifolia*) is propagated vegetatively. The tea plant is of Chinese origin. It is cultivated in the eastern districts of the country — mostly in Jhapa and Illam. The most suitable elevation for the cultivation of this crop is between 914 m to 1,828 m. In the extreme western district of Baitadi,

tea cultivation was introduced about A. D. 1892, but all that remains now are a few tea bushes around Garhi, the headquarters of the district. Tea plants cannot survive intense heat, and hence they are planted at locations which are shady and provide a cool, humid environment to the plants. Tea plants cannot withstand water-logged condition, and hence a gentle, sloping land is preferred. Nepalese tea finds a market both in Tibet and overseas. Brick-tea, which is prepared from coarser twigs, leaves and flour, is very much liked by the Tibetan people. Buttered tea is a favourite drink of the Sherpa community of Nepal

In eastern Nepal, tea gardens are located at Illam (1,249 m), Soktim (517 m) and Karfok (1,676 m). The total acreage in 1964 was 89 ha, with a total production of 351,510 kg of black tea.[1] Additional 218 ha has been brought under further cultivation at Karfok. At present most of these tea gardens are growing only one quality, the small leaf China hybrid and the bushes are 80 to 90 years old. In Soktim, large Manipur tea is also grown.

Leaves and buds of a plant allied to tea, *Chiyapate* (*Camellia drupifera*), are dried, and used as a substitute for tea.

Alcoholic Beverages

Raksi: It is essentially a whisky which is distilled from grains — rice, millet and barley. To bring about fermentation, either yeast (*Saccharomyces sp.*) or a green mould (*Aspergillus oryzae*) are used. Although in recent years some big distilleries have been established in the country which produce hard drinks, mostly from imported high content alcohol or molasses, still, the bulk of the liquor is prepared at home. Local whisky differs from place to place in taste and quality, the one that is prepared from *kodo* (finger millet) is unfailingly of good quality.

Jand is a turbid white liquid. It is low in alcohol content and is equivalent to beer. It is prepared in the following manner: Boiled rice is steeped in water for few hours, at the end of which water is decanted off. The grains are now kept in an earthenware pot which has holes at its bottom. This pot is then placed on top of another pot which is half-filled with water. The water in the lower pot is boiled for few hours, and then the upper pot is removed and placed on top of another earthenware pot. Now a small amount of yeast (*mana, baluma*) is mixed

1. Goultas, W. J. W. 1964. *Report on the Tea Industry of Nepal.* NIDC.

with grains thoroughly. It is left in this condition for about four days. During this period a whitish liquid seeps out through the holes in the upper pot, which holds fermenting rice. The first trickle is of the best quality. It is a very refreshing drink and is a constant companion of local farmers (*Jyapu*) in the field and at home. *Chang* is a kind of beer which is a popular drink of the Sherpas, Thakalis and highland people.

Chapter XVI

Some Wild and Useful Plants

Chutro-Kirmodo (*Berberis aristata*)

This plant belonging to Berberidaceae grows throughout the temperate parts of Nepal. The fruits are edible, and are sold during the early summer months. The bark is used in the treatment of fever and as a tonic.

Ghar Tarul-tauda (*Dioscorea sativa*)

This is a cultivated species of yam. The tubers are often 10 cm to 12.7 cm across and are dug out during winter season.

Ban tarul (*Dioscorea pentaphylla*) is an edible species of yam which grows wild in the temperate parts of Nepal. The plant is medicinally important. The tubers are used to reduce swellings.

Kukur tarul (*Dioscorea bulbifera*) is a wild species which is bitter in taste. It is used to cure biliousness, tumours, etc. The tubers are reported to increase milk yield in cattle. *Bhyakur* (*Dioscorea deltoidea*), is a glabrous climber, which is found in Godavari as well as in other parts of the country. Tubers are used to kill lice and also as a fish poison.[1] The plant yields an alkaloid (*dioscegene*) which is used in the manufacture of contraceptive pills.

Nirmali (*Strychnos nux vomica*)

Strychnos seeds are of the size and shape of coat buttons which are imbedded in the whitish pulp of pale yellow fruits. They yield a highly poisonous alkaloid — strychnine, which is a nervine

1. *Medicinal Plants of Nepal*. Depart. of Medicinal Plants. Ministry of Forests, HMG. 1971.

tonic, aphrodisiac, and appetizer. It stimulates the heart. The fruits are eaten by the birds and beasts without any harmful effect. Human beings are known to build up resistance to the drug (strychnine) over a period of time. The plant, which belongs to the family Loganiaceae, is cultivated in the warmer parts of the country.

Nilobikh (*Delphinium deundatum*)

The plant (Ranunculaceae) is a glabrous or slightly hairy herb. It grows in the Mahabharat region — usually at a height of 2,133 m to 2,438 m. The roots are used for curing disorders of the blood and in the treatment of snake-bite.

Menjitho, Indian Madar (*Rubia cordifolia*)

It is a creeping herb with a very rough surface, which is due to a heavy deposit of silica. It belongs to the family Rubiaceae. Its root is of medicinal value and is used in the treatment of ulcers, swellings, etc. The plant also yields a dye.

Ritha, Soapnut Tree (*Sapindus mukorossi*)

It is a tree which grows to a majestic height. Its leaves, roots and fruits are of medicinal value. The fruit is used as a detergent, and in the treatment of diarrhoea, cholera, as well as for the treatment of snake-bite. The fruit is saponaceous and used as fish poison and as an insecticide.

Pyrethrum (*Chrysanthemum cinrariaefolium*)

Pyrethrum (Compositae) is cultivated for its flowers which yield a safe but effective insecticide, and hence much used against the pests which affect vegetables and fruits. In Nepal, farms for the cultivation of this plant have been established at Daman (along Tribhuvan Rajpath) and Manichur, near Kathmandu at an altitude of 1,828 m to 2,438 m.

Yeklabir (*Lobelia pyramidalis*)

Lobelia yields an alkaloid which is used as an expectorant, antispasmodic and emetic. The plant belongs to the family Lobeliaceae.

Somlata, Bhutukesh (*Ephedra gerardiana*)

It is a small shrubby gymnosperm belonging to the family

Gnetaceae. It grows wild in the dry sub-alpine and alpine regions —between 3,048 m and 4,572m. The plant yields an alkaloid (ephedrine) which is used in the treatment of asthma, cold, hay fever, and as a cardiac stimulant. It provides forage to yak and sheep.

Chitwan (*Alstonia scholaris*)

Chitwan (*Alstonia scholaris*) belongs to Apocyanaceae. The bark of the tree, which contains alkaloids, finds its use as an appetizer, laxative, astringent and general tonic. It is used in cases of fever, dyspepsia, liver troubles, etc. It is also used as a substitute for quinine.

Chiriato (*Swertia angustifolia*)

Chiriato (*Swertia angustifolia*) belongs to Gentianaceae. It is a plant found growing mostly in the temperate regions, between 1,219 m to 3,048 m, especially in the open meadows.

The plant yields a bitter principle which is of much medicinal value. It is used to cure stomach disorders, as a general tonic, as well as in the treatment of respiratory diseases. It is also reportedly efficacious in snake-bite treatment.

Indrayani (*Vitex negundo*)

Indrayani (*Vitex negundo*) belongs to Verbenaceae. It is a plant which grows in the tropical and sub-tropical parts of the country. All parts of the plant have medicinal uses: the leaves are turned into a paste which is used to cure inflammation, insect bites, etc. The roots are used in the treatment of dysentery, piles, worms, boils, etc. The flowers yield an astringent which cures liver and heart troubles.

Gurjo (*Tinospora cordifolia*)

It is a twiner belonging to the family Menispermaceae. Its leaves are heart shaped and have long stalks. The leaf extract is used in cases of fever, cold, indigestion and rheumatism. Roots are used to cure snake-bite.

Rumex Nepalensis

Rumex nepalensis, which belongs to the family Polygonaceae, is a weed in the temperate Himalayas, especially in swampy lands. The tuberous roots are used in the treatment of colic, syphilis, etc.

Thotne (*Polygonum molle*)

This plant, which is erect and robust, belongs to the family Polygonaceae. It is mainly an East Himalayan species. The soft hairy stems available in the market in the spring are used for making curry.

Dhaturo, Devil's Apple (*syn. D. metal, Datura fastuosa, D. allea, D. stramonium*)

A big sized coarse spreading herb — 'the purple leaved variety is supposed to be more useful in medicine'.[1] The leaves and seeds yield the drugs hyoscyamine and atropine. Seeds are used as a narcotic and anodyne. It is also used in the treatment of asthma. The plant is naturally distributed in the N. W. Himalayas and locally, it is cultivated; the fruits are used in the worship of Lord Shiva.

Kurchi, Bitter Oleander (*Holarrhena antidysenterica*)

It is a medium sized tree (Apocynaceae) with a pale brown bark. It is found in the sub-tropical and tropical parts of the country. The bark is used in the treatment of stomach disorders — diarrhoea and dysentery. The seeds are 'carminative, astringent, febrifuge, anthelmintic and lithotric'.[2]

Jatamansi, Nard (*Nardostachys jatamansi*)

It is a herbaceous plant, belonging to the family Valerianaceae. The stem, which is partly a rhizome, is profusely covered with scaly hairs. The plant grows in the Himalayas between 3,048 m and 4,572 m. *Jatamansi* is particularly useful in the treatment of nervous disorders and diseases associated with heart. It is used as a substitute of *valerian*.

Chand Maduwa, Serpentine (*Rauwolfia serpentina*)

It is a small plant belonging to the family Apocynaceae. It grows wild in the foothills of central and eastern Nepal, from where it is exported in considerable quantities. The flowers are pink-tinged with long corolla tubes. The roots contain an alkaloid (reserpine) which is used in the treatment of high blood pressure and diseases associated with nervous disorders. The leaves and

1. Dastur, J. F. *Medicinal Plants of India and Pakistan*. p. 200
2. *Ibid.*

roots have a high reputation as an antidote to bites of reptiles and and stings of insects.[1]

Nagbeli (*Lycopodium clavatum*)

This is a plant which has become economically quite important in recent times. It grows wild — from about 1,524 m to 2,438 m. No effort has thus far been made to cultivate it.

Lycopodium powder is known to be useful in grinding high quality lenses. It is also used in the manufacture of explosives and fire crackers. The plant has medicinal value; it is used in curing disorders of stomach, kidney and lungs. Its decoction is used as a tonic.

Panch Anwle (*Orchis latifolia*)

This is one of the important medicinal plants found growing in Nepal, between 1,828 m and 4,876 m in open grassy meadows. It is used as a tonic, and also as a cure for stomach troubles. It is also reported to be an aphrodisiac.

Bhringraj (*Maharanga emodi*)

The plant (Boraginaceae) is found throughout the temperate parts of the country. Plant decoction is useful as a tonic and in treating the disorders of the stomach. It is also used to dye wool and silk.

Satuwa (*Paris polyphylla*)

A plant (Liliaceae), whose rhizomes possess antihelmitic properties. Large quantities are 'exported' from Jumla.

Padamchal, Rhubarb (*Rheum emodi*)

The plant (Polygonaceae) is found throughout the country between 2,743 m-3,657 m. Besides being used as a dye, stem and petioles are used as an astringent and tonic.

Opium (*Papaver somniferum*)

This is a plant which is known to be cultivated in western hilly parts of Nepal. In Dailekh district alone 15,000 kg of opium was produced in one year. Opium was reportedly introduced in Nepal in the 19th century.

1. Dastur, J. F. *Op. cit.* p. 136.

Okhar, Walnut (*Juglans regia*)

The plant is distributed widely between 1,219 m and 3,048 m. There are both cultivated and wild varieties. The fruit and bark are used as dye and to soften leather. The kernel yields an oil, which is used as a cooking medium. The plant is an astringent and taken as a tonic.

Siltimur (*Lindera neesiana*)

This is a small-sized tree (Lauraceae) which grows between 1,828 m and 2,438 m. The roots yield sassafras which is used in the preparation of confectionaries.

Bikh, Aconitum (*Aconitum napellus*)

It is a perennial herb, belonging to the family Ranunculaceae and grows in all the temperate parts of the country. The tubers yield an alkaloid which is used to relieve pain and fever.

Many other species of *Aconitum* (*A. heterophyllum*, *A. palmatum*, *bishma*, *A. spicatum*, *bikh*) are found in the sub-alpine and alpine regions.

Asuro, Adhatoda-Vasaka (*Adhatoda vasica*)

It is a plant belonging to the family Acanthaceae. It grows in the warmer parts of the country. The plant yields an alkaloid, Vasicine and a volatile oil also. Adhatoda leaves and other parts are used in the treatment of fever, gonorrhoea, cold, cough, asthma, diphtheria, etc. It is also said to lower blood pressure.

Chauri Gandha, Tite Pati (*Artemisia vulgaris*)

It is a common weed, belonging to the family Compositae. It grows in all the temperate parts of Nepal and is valued for its medicinal use in the treatment of stomach trouble and such other diseases as nervous disorders, cough, measles, etc. The leaves yield an essential oil.

Aswagandh (*Withania somnifera*)

Aswagandh (*Withania somnifera*), a plant belonging to the family Solanaceae, yields an alkaloid, particularly from the roots. The reported medicinal use of this plant is in the treatment of rheumatism, dyspepsia, cough, dropsy, as well as an ointment for the treatment of boils, swellings, etc. The seeds are hypnotic.

Lal Ratti (*Abrus precatorius*)

Lal ratti (*Abrus precatorius*) is a plant belonging to the family Leguminosae. Its seeds contain abrin, a toxic proteinaceous matter and abric acid. The seeds act as an aphrodisiac, as a curative for nervous disorders, paralysis, skin diseases, ulcers, inflammations, trachoma, granular eyelids, etc.

Kuth — the Costus (*Saussurea lappa*)

The root, which contains an alkaloid, is used in the treatment of bronchial diseases and as a stomachic. It is also reputed to have tonic, aphrodisiac, antiseptic, aromatic, stimulant, diaphoretic, prophylactic, astringent, sedative and carminative properties.[1]

Rhubarb (*Rheum officinale*)

Rhubarb, *Rheum officinale*, is a native of Tibet. The tuberous roots are used as a tonic and as a laxative.

Sugandhawal, Valerian (*Valeriana wallichii*)

Valerian is a plant that grows mostly at altitudes of 1,524 m and 1,828 m. The roots, which contain an alkaloid, are used in the treatment of hysteria and cough.

Pipla (*Piper longum*)

A small shrub (Piperaceae) found growing in the warm temperate and sub-tropical parts of the country. Its roots are reported to be stimulant and carminative. The roots and fruit are also used as an antidote to snake-bite.

Bish (*Aconitum ferox*)

An extremely poisonous plant which is also known as *singi* (horny) by hill people. Primitive tribes dip their arrow tips in this poison. The plant has wide usage; it is used as a stimulant, in rheumatism and as a neuralgic. It is also reported to cure diabetes.

Bishma (*Aconitum plamatum*)

A herbaceous perennial plant which grows widely between 3,048 m-4,572 m. It is used as an antidote to cholera.

1. Dastur, J. F. *Op. cit.*

Nirbishi (*Delphinium paciflorum*)

It is an annual herbaceous plant (Ranunculaceae) which grows between 1,524 m-3,048 m.

The plant is used as an antidote to poison, and as disinfectant and to stop tooth decay.

Bojho, Sweetflag (*Acorus calamus*)

The plant (Araceae) grows in damp and swampy places at altitudes of 914 m-1,828 m. Its leaves yield an essential oil which was used once as a hairspray in western countries. The rhizomes have medicinal value, being used as a sedative, carminative and purgative. It is also used in the treatment of snake-bite.

The plant is used to flavour liquors — gin, beer, etc.

Khas Khas (*Vetiveria zizanioides syn. Andropogon muricatus*)

This is a grass found throughout the Terai. Its roots are woven into screens which when wetted provide fragrant breeze during summer months. The roots are of medicinal value; their extract is reported to be 'stimulant, stomachic and emmenagogue'.

Bhalayo (*Rhus wallichii*)

It is a small-sized tree belonging to the family Anacardiaceae and is mostly distributed in the N. W. Himalayas. Juice of the leaves is corrosive and causes blisters on the skin.

Bhakamilo (*Rhus semialata*)

It is a moderate-sized tree which grows between 914 m and 2,133 m. Its fruits are edible. The tree also yields a wax.

Bakain, Persian Lilac (*Melia azedarach*)

It is a deciduous tree (Meliaceae) indigenous to the sub-Himalayan tract upto 1,828 m and is commonly seen growing along the edges of the fields. The tree is very useful, its wood which takes an excellent polish is used for museum show-cases. The bark is bitter and anthelmintic. It is also a timber tree.

Boxwood (*Buxus sempervirens*)

It is an evergreen shrub or a small tree and is found growing between 1,219 m and 2,438 m. It is usually found growing along the bank of streams; 'fine specimens are found in the Kali Valley'.

It reproduces freely from cuttings. The wood is used for making containers for butter, honey and for combs.

Birch, Bhojpatra (*Betula utilis*)

Birch belongs to the family Betulaceae. It grows in the temperate and alpine regions, and is a dominant plant between 2,438 m and 3,048 m. The trees yield a very smooth bark, which in the past was used as writing paper.

Apamarg (*Achyranthes aspera*)

It is a small herb belonging to the family Amaranthaceae. It grows throughout the temperate parts of the country in moist situations. Ayurvedic books mention three kinds of *apamarga* — white, red and black. The plant is used by the Hindu women at the time of *teej festival*, when they use the succulent stems as tooth brush. Its ash contains lot of potash. It is astringent, digestive and reported to cure many diseases — pyorrhoea, stomach ulcers, asthma, etc.

Laghupatra, Indian Podophyllum (*Podophyllum hexandrum*)

A glabrous succulent plant belonging to the family Berberidaceae. It grows in the temperate and sub-alpine regions. The rhizomes and roots are hepatic stimulant and purgative.

Sil Timur (*Zanthoxylum oxyphyllum*)

It is a prickly shrub whose green fruits are sold in the market in early summer (March/April). The plant is astringent, and used in the treatment of boils, etc.

Rudraksha (*Elaeaocarpus ganitrus*)

A tall tree which occurs naturally in Bhojpur district, Dingla in east Nepal. The fruits are considered sacred and worn as a necklace or as beads.

Pandanus Furcatus

A plant which grows wild in the ravines and river valleys all along the foothills of the Himalayas. The flowers yield a scent.

Gane (*Houttuynia cordata*)

A herbaceous plant belonging to the famil Sauraceae. It is

used as a vegetable. The plant has medicinal uses.

Kavro (*Ficus lacor*)

A small tree belonging to the family Moraceae. It grows in the sub-tropical parts, in moist habitat. Seeds are a tonic and used in the treatment of stomach disorders.

Ghod Tapre (*Centella asiatica, syn. Hydrocotyl asiatica*)

A creeping herbaceous plant belonging to the family Umbelliferae. It is known to have many uses as a tonic, to cure diseases of the skin, leprosy, as a nervine tonic, etc. Leaves are known to cure skin diseases, syphilis and rheumatism.

Kutki (*Picrorhiza kurroa*)

Kutki (*Picrorhiza kurroa*), a plant belonging to the family Scrophulariaceae, grows at higher altitudes, between 2,438 m and 3,657 m. The root is prescribed for snake-bite, as a brain tonic and laxative, and for the treatment of ring-worm. It is also known to possesss aphrodisiac properties.

Uneu (*Dryopteris cochleata*)

Male plants of *Uneu, liundo,* (*Dryopteris cochleata*) are collected by the villagers and sold in the market during the summer and rainy seasons. It is cooked as a vegetable or as curry.

Besides *Dryopteris cochleata,* some other species of this fern are used as vegetables.

Jark, Jarrag (*Phytolacca acinosa*)

Jark, Jarrag (*Phytolacca acinosa*), which belongs to the family Phytolacaceae, is a medicinal plant. It is called 'sweet belladonna'. It is used as a curry, and for preparing *pakodas.*

Bhewul (*Grewia oppositifolia*)

This is a medium-sized tree, which grows upto an altitude of 1,828 m. It belongs to the family Tiliaceae. The whitish bark is used to make rope. The fruits, which are edible, are olive green at first, becoming black when mature.

Willow (*Salix babylonica*)

Willow is a common tree in Kathmandu along the banks of

the rivers, streams and roads. Because of its drooping branches, it is also called as 'Weeping willow'. Its wood is suitable for making bats, boats, crates and boxes. The wood also provides good charcoal, while the branches can be used to make wicker baskets and furniture. Another species of willow (*Salix tetrasperma*) is found in the Godavari forest.

Wattle (*Acacia delbata, A. decurrens, A. pycantha*)

This is a fast growing species which, along with eucalyptus, has been extensively used in reforesting programme. Wattle is also a good shade or avenue tree. Its bark has a high tannin content (upto 50 per cent) and is used in leather tanneries.

Khari (*Celtis australis*)

This, a plant belonging to the family Urticaceae, is a common tree between 1,219 m to 2,133 m. It provides green fodder — particularly during the lean winter months. It is lopped severely but regenerates quickly and is an extremely useful fodder tree. *Celtis* wood is suitable for making boxes, woodware and furniture, but as yet it is put to none of these usages in Nepal.

Barro (*Terminalia belerica*)

This, along with *harro* (*Terminalia chebula*), are the chief associates of *sal* (*Shorea robusta*). They occur in mixed forests and are the main constituents of *triphala* or the three myrobalans. The fruits are used to cure cough. Its use for timber is rather limited. The bark yields a tannin.

Khair (*Acacia catechu*)

Khair (*Acacia catechu*) is a riverine species — along with *sheesham* or *sisso* (*Dalbergia sissoo*). It is a tree of major economic importance. Its wood is very durable and strong and yields on boiling tannin — *khair* or *katha*, which is spread over betel leaves before they are chewed.

Masla, Eucalyptus

Eucalyptus rostrata (the red gum) and *E. globulus* (the blue gum), the latter identifiable by its falcate leaves, are the common avenue trees in Kathmandu. The plant which belongs to Myrtaceae, is widely used for reforestation. It is a fast growing valuable

species and is useful as timber, pulp and firewood. The timber of *E. rostrata* is very durable. Besides, it is also a beautiful ornamental tree.

Eucalyptus is a native of Australia, but is now world-wide in distribution. Eucalyptus oil is obtained from the dried leaves and used to cure common cold, malaria and some other types of fever.

Champ (*michelia*)

At one time there were extensive forests in east and central parts of the country — part of the *Michelia-Laurel* forest, but these have mostly been destroyed.

Dhai (*Woodfordia fructicosa*)

Dhai (*Woodfordia fructicosa*) is a plant belonging to the family Lythraceae, which is easily identifiable by its pretty pinkish flowers. Its flowers as well as leaves are of medicinal use.

Bael (*Aegle marmelos*)

Bael, a plant belonging to Rutaceae, grows wild in the warmer parts of the country. The leaves are offered to Lord Shiva and the fruits yield a sweet pulpy mass which is supposed to be a 'cure all' for stomach disorders. During the hot summer months *bael* fruits provide a cool refreshing drink.

Bans (*Dendrocalamus strictus*)

Bans or bamboo clumps are found throughout the sub-tropical and tropical parts of the country. The silicious matter found near the joints is used as a tonic. Bamboo shoots are fermented, which then turn into *tamba*. Both dried and fresh *tamba* is sold in the market.

Essential Oils

Champaca oil is obtained from *Michelia champaca*, a tree found in the eastern part of the country. *Cymbopogon citratus*, *Juniperus indica*, *Mentha piperata*, and *Eucalyptus citridora* are some other plants which yield essential oils but in Nepal no effort has so far been made to produce these on a commercial scale.

Camphor (*Cinnamomum camphora*)

The tree is indigenous to Formosa, China and Japan. Camphor

is obtained from *Cinnamomum camphora*, a common tree between 1,524 m and 2,438 m in the Kathmandu Valley and its environs. The plant belongs to the family Lauraceae. Camphor oil is obtained through destructive distillation of wood and leaves. Camphor is used for medicinal purposes, manufacture of celluloid, smokeless powder and disinfectant. Camphor is used to induce abortion.

Lemon-grass (*Cymbopogon citratus*)

Lemon-grass is known in the cultivated state only. It yields a sweet smelling essential oil after distillation.

Edible Mushrooms and Morels

Around the Kathmandu Valley many kinds of mushrooms grow wild, a number of which are collected by the villagers during the rainy season and sold in the market. The mushrooms are packed in bamboo packets and are considered a delicacy. Mushroom poisoning cases are rarely reported.

Fleshy mushrooms of the Kathmandu Valley are[1]: *Agaricus campestris, Agaricus bisporus, Morchella conica* (common in Nagarjun), *Favolus canadensis, Polyporus melanopus, Boletus edulis, Russula vesca, Pleurotus ostreatus, P. nepalensis, Clavaria corniculata, Lepiota procera, Armillarea mellea, Marasmius oreades*, and species of *Cantharellus, Lactarius, Hydnum, Clitocybe, Coprinus, Lycoperdon, Auricularia* and *Polyporus* (*P. auricularius, P. berkeleyi* and *P. sulphureus*, the chicken fungus). In the forest of Sukla Phanta, *P. shorae* is the common fungus. Of the poisonous species Caesar's Toadstool (*Amanita caesarea* and the Fly Agaric (*A. muscaria*) have been collected from the woods around the Kathmandu Valley. Normally, mushrooms which grow on wood, such as *Pleurotus ostreatus*, are not poisonous.

1. Pandey, Bunu Devi (Miss). 'Survey, Collection, Preservation and Identification of the Mushrooms in Nepal.' *Nepalese Journal of Agriculture*. Vols. 6-11. February 1971-76. pp. 115-29.

Chapter XVII

Nepal-Tibet Trade

As early as the seventh century cultural, commercial, and political contacts were established between Tibet and Nepal by the overland routes. However, 'regular trade relations between Nepal and Tibet were established from the 17th century onwards only.[1] Nepalese merchants were mostly interested in the Tibetan gold, silver, wool, salt and herbs. About 1650 a commercial treaty was signed at Lhasa, 'by virtue of which the properties of the Nepalese deceased in Lhasa were to be returned to the Government of Nepal and the town of Kuti was placed under its jurisdiction.[2] During this period, Nepalese coins were the only coinage current in Tibet'. Nepal-Tibet trade was basically an entrepot trade.

All along the Nepal-Tibet border a number of trading posts flourished: of these Kuti and Kerung (Kyirong), located at heights of 4,267 m and 2,438 m respectively, in the central part of the country were of great importance. The Kuti route once provided the shortest route to Lhasa, the capital of Tibet, from Kathmandu, although it remains snow-bound during winter months and is inaccessible to pack animals.

The high Himalayas provide deep gorges in a number of places, which lead into the Tibetan territory. Some of the more important passes on the Nepal-Tibet border are: Tip-Tala (5,819 m), Poptia (7,022 m), Bangwa (5,819 m), Phalak Lamtang (5,213 m), Mustang (3,108 m) and Byas (Tinker). Except for Rasuwa and

1. Historicus. 1953. 'Nepal-China Relations through the Centuries.' *Nepal Guardian*, p. 53.

2. *Ibid.* p. 53.

Kodari (both around 1,828) all the other routes are difficult and remain snow-bound for six months or more.

The 104-km long Kathmandu-Kodari (*Ariniko*) Highway has, to some extent, revived the centuries old cultural and commercial contacts between Tibet and Nepal. Some amount of rice, jute and sugar is exported to Tibet through Kodari.

All along the border, trade is mostly in the form of barter: sheep, goats, wool, honey, salt, *suhaga* (saltpetre), herbs and drugs are exchanged for foodgrains, kerosene, sugar, cloth and spices. Although there has been some setback in the Nepal-Tibet trade due to general scarcity of foodgrains in the border districts and restrictions on free trade across the border, it has never totally ceased. The economy of these parts is interdependent.

Nepal's monopoly in trade with Tibet received a severe setback in 1923 when the Gangtok (Sikkim) route connected Lhasa with India. Over a long period, Nepalese commercial houses continued to do business in Tibet, though they gradually lost the special privileges which they had enjoyed for long. It is said that a number of commercial houses in Lhasa (45) and in Digarcha (4) are still in existence. Trade is carried out through such border trading posts as Tinker (Baitadi), Docham-Lapchula (Humla), Tukucha (Manang), Rasuwa (Bagmati zone) and Wallung-chung (Taplejung), the latter being the easternmost pass on the Nepal-Tibet border. Saipal, in west Nepal, bustles with trade during the summer months. Rice, flour, pulses, and baskets are exchanged for salt and wool from Tibet; salt is hauled by long trains of sheep and yaks.

The state owned National Trading Limited imported approximately 544 tonnes of raw wool from Tibet in 1970. This was valued at £136,540, a small portion of which was exported to Soviet Russia; the rest was used locally. Every year, during *dasain*, thousands of goats and sheep are imported from Tibet in exchange for rice and sugar. In 1971/72 a small quantity of rice (327 tonnes) was exported through Jumla, Mugu, Humla, Sindu Palanchok, Dolakha and Taplejung.

APPENDIX A

Trees of Nepal

(Those marked with asterisk are important timber trees)

S. No.	Species	Local Name	Family	Distribution	Use
1.	*Abies spectabilis* *(Syn: *A. webbiana*)	*sallo*	Pinaceae	Temperate 9,000 ft and above	Packing case, pulp.
2.	*Acacia arabica*	*kikar, babul*	Leguminosae	Tropical and sub-tropical mostly in *bhabhar*	Strong and durable wood; good for agricultural implements; cart wheel, etc. fuel.
3.	*Acacia catechu*	*khair*	,,	,, very good stands in Kanchanpur	Cutch or katha, bed posts; logs, keels of boats, sugar-cane crushers, etc.
4.	**Adina cordifolia*	*haldu, karma*	Rubiaceae	Throughout Terai; good stands in Bardiya	Wood yellow, good for bobbin; panelling; toys, roof boards, timber, etc.
5.	**Albizzia lebbek*	*siris*	Leguminosae	temperate, as well as sub-tropical parts	Wood good for wood panelling; furniture, etc.
6.	**A. procera*	*safed siris*	,,	,,	,,
7.	**A. odoratissima*	*kalo siris*	,,	Tropical, sub-tropical	,,
8.	**Alnus nepalensis*	*utis*	Betulaceae	Temperate — a riverain species; very common in east	Timber; firewood, etc.
9.	*Anogeissus latifolia* var. *tomentosa*	*bakali, dhawadan*	Combretaceae	Tropical — mostly in the eastern parts	Bark and twig used in tanning; good for tool handle; furniture; timber.
10.	*Anthocephalus cadamba*	*kadam*	Rubiaceae	,,	Packing case, ceiling.
11.	*Betula alnoides*	*bhojpatra*	Betulaceae	Temperate	Plywood making; bark used as writing paper.

(Contd.)

Appendix A (*Contd.*)

S. No.	Species	Local Name	Family	Distribution	Use
12.	**Bischofia javanica*	*andhikrimii; kanjal*	Euphorbiaceae	Tropical — Terai foothills	Timber; good for railway sleepers.
13.	*Boswellia serrata*	*salai*	Burseraceae	Tropical, sub-tropical	Good for box and cheap furniture.
14.	**Bridelia retusa*	*kaja*	Euphorbiaceae	Tropical and sub-tropical; mostly in eastern parts	Timber; house posts; rafters; floor boards, etc.
15.	**Cedrela toona*	*tooni*	Meliaceae	Temperate, sub-Himalayan tracts	Timber, also good for furniture and cigar boxes.
16.	**Cedrus deodara*	*debdar, dar*	Pinaceae	Temperate, confined to west Nepal in the Karnali basin	Timber, mostly used as railway sleepers.
17.	*Cinnamomum camphora*	*kapur*	Lauraceae	Temperate; mostly eastern	Camphor
18.	*Cochlospermum religiosa* (Syn: *Cochlospermum gossypium*) 'Yellow silk cotton'	*kumbhi*	Cochlospermaceae	Tropical, mostly in eastern parts	Timber; stuffi g mattresses and pillows.
19.	*Cupressus torulosa*	*dhubi, surai* (Hindi)	Cupressaceae	Temperate	Timber; furniture; incense also
20.	*Buchanania latifolia*	*char, achar*	Anacardiaceae	Tropical — not so common	Timber.
21.	*Calamus tenius*	*bet*	Palmae	,,	Furniture; often used as timber.
22.	**Careya arborea* (Syn: *C. pentagyna*)	*kumti, kumbhi*	Lecythidiaceae	,,	Thin reedy stems, used in basket and chair making much as timber.
23.	*Castanopsis indica*	*dhalne katush*	Fagaceae	Temperate	Timber, fodder, firewood.
24.	*Daphne cannabina* (Syn: *D. bholua*)	*baruwa; pat*	Thymeliaceae	Temperate	Paper made from bark.

25.	**Dalbergia latifolia*	*satisal, satisal* (rose wood)	Leguminosae	Tropical and sub-tropical, mostly in the Western and Central parts	Timber; excellent for cabinet and furniture.
26.	**D. sisoo*	*sisso, sisham*	,,	,,	,,
27.	**Dendrocalamus strictus*	*bans*	Gramineae	Tropical, sub-tropical and temperate 5,000 ft.	Timber, poles, mats, baskets, etc. shoots (*tama*) used as food; also used for making lances.
28.	**Dillenia pentagyna*	*aggai, tatari*	Dilleniaceae	Tropical and sub-tropical, throughout Terai	Timber, furniture.
29.	*Diospyrus melanoxylon* (Syn : *D. dubiya*)	*abnush*	Ebenaceae	Tropical, and sub-tropical, mostly eastern species	'Valuable wood', leaves used for wrapping *bidi*, post for rafters; sticks, umbrella handles, etc.
30.	*Eucalyptus citridora* 'white gum'	*masla*	Myrtaceae	Exotic	White shaftlike trunk, mostly for firewood; yields oil of eucalyptus.
31.	*E. globulus* 'blue gum'	,,	,,	,,	Fibrous bark; mostly for firewood, also ornamental.
32.	*E. robusta* 'red gum'	,,	,,	,,	Timber very durable; leaves lanceolate falcate, yields eucalyptus oil.
33.	*Erythrina suberosa*	*buru marer; mander*	Leguminosae	Tropical and sub-tropical	Only limited use as timber; ornamental tree.
34.	*Eugenia suberosa* 'rose apple'	*jaman*	Myrtaceae	Terai, inner Terai, as well as warm river valleys of 'midland'	Timber; fruits edible.
35.	*Fraxinus floribunda*	*lakuri, ash*	Oleaceae	Temperate; planted as well as wild eastern	Firewood; ornamental.
36.	*Holopetala integrifolia*	*papri*	Ulmaceae	Tropical and sub-tropical	Wood used for making cheap furniture.

(*Contd.*)

Appendix A (*Contd.*)

S. No	Species	Local Name	Family	Distribution	Use
37.	*Hollarrhena antidysenterica*	*kewat, madishe khiro*	Apocyanaceae	Tropical and sub-tropical	Timber; seeds of medicinal value.
38.	*Hymenodictyon excelsum*	*lati karma, bhudkul*	Rubiaceae	Tropical and sub-tropical—mostly eastern species	Matchwood, toys; bark medicinal.
39.	*Mallotus philippinensis*	*sindur*	Euphorbiaceae	,,	Timber; fruits yield a redish dye.
40.	**Michelia champaca*	*champa*	Magnoliaceae	Mostly inner Terai, Chitwan and Southeastern hilly parts; an eastern species	Timber; excellent for cabinet making, boat building, panelling, etc.
41.	*Myrsine semiserrata*	*kalikath*	Myrsinaceae	Temperate	Little use as timber; firewood.
42.	*Ougenia dalbergioides*	*sandan, sandhan*	Leguminosae	Tropical — mostly eastern species	Timber.
43.	**Oroxylon indicum*	*sanna*	Bignoniaceae	,,	Wood used for making yoke, and containers for milk, *ghee*, curd, etc.
44.	**Juglans regia*	*okhar*	Juglandaceae	Temperate; mostly in Jumla, Humla; Baitadi, Doti districts	Edible fruits; furniture, agricultural implements; butt of guns, rifles, etc.
45.	**Juniperus recurva*	*dhoopi*	Pinaceae	Temperate; central and eastern parts	Used to burn as incense; timber.
46.	*Legerstroemia flosreginae*	*ashare phul*	Lythraceae	Temperate	Ornamental; floor boards, house building, etc.
47.	**L. parviflora*	*bot dhamgero*	,,	Tropical and sub-tropical, mostly in central and western parts	Timber; construction of bridge, etc.
48.	*Lannea grandis*	*Jhingada*	Anacardiaceae	,,	Furniture and house construction.

49.	*Magnolia grandiflora*	*Rukh kamal*	Magnoliaceae	Temperate ; mostly eastern parts	Ornamental
50.	*Mangifera indica*	*amp*	Anacardiaceae	Tropical, Sub-tropical and temperate	Edible fruit; timber.
51.	*Mesua ferrea*	*nageswarey*	Guttiferae	Temperate and sub-tropical	Railway sleepers.
52.	**Pinus roxburghii* (Syn: *P. longifolia*)	*khote sallo, rani sallo, sallo*	Pinaceae	Sub-tropical and temperate	Timber; resin, drawing board; plane tables, etc.
53.	**P. wallichiana* (Syn: *P. excelsa*)	*gobre sallo*	,,	Temperate — 6,000 to 12,000 ft.	,,
54.	**Pterocarpus marsupium*	*Bijaya sal* 'Red sandal wood'	Leguminosae	Tropical and sub-tropical—mostly in western parts	'Highly valued wood' Timber; reputed for medicinal value.
55.	**Quercus glauca*	*banjh, banj*	Fagaceae	Temperate — 5,000 to 8,000 ft.	Timber; fodder.
56.	**Quercus semecarpifolia*	*kharsu*	,,	Temperate — 5,000 to 10,000 ft.	,,
57.	**Salmalia malabarica* (Syn: *Bombax malabaricum*)	*semal*	Bombacaceae	Sub-tropical; a riverain species	Dug-out canoe, packing case; plywood; match sticks; match box; stuffing of pillows, etc.
58.	**Schima wallichii*	*chilaune*	Theaceae	Temperate, mostly eastern species, between 2,500 to 5,000 ft.	Timber; agricultural implements.
59.	**Schleichera trijuga*	*kusum*	Sapindaceae	Tropical and sub-tropical — mostly in eastern parts	For making hubs of wheel and agricultural implements; timber; oil from seeds.
60.	**Shorea robusta*	*agrakh, sal*	Dipterocarpaceae	Tropical, sub-tropical; in temperate regions in river valleys	Railway sleepers; construction; furniture.
61.	*Tamarindus indica*	*imli*	Leguminosae	Tropical and sub-tropical	Edible fruits; timber; shade tree.

(*Contd.*)

Appendix A (*Contd.*)

S. No.	*Species*	*Local Name*	*Family*	*Distribution*	*Use*
62.	**Terminalia arjuna*	*arjun*	Combretaceae	Tropical and sub-tropical	Agricultural implements; tannin from bark; used as tonic.
63.	*T. belerica*	*barro*	,,	,,	Timber, medicinal.
64.	*T. chebula*	*dudal harro*	,,	,,	
65.	*T. myriocarpa*	*pani saj*	,,	,, eastern sp.	For making carriages; construction (timber).
66.	*Trewia nudiflora*	*gutel*	Euphorbiaceae	,,	Timber; packing case and book-shelf; plywood.

APPENDIX B

Fishes of Nepal*

S. No.	Genus	Family	Local Name	Locality	Remarks
1.	*Barbus conchonius*	Cyprinidae	—	Phewa Tal (Pokhara)	Kosi 5″ max.
2.	*B. chagunio*	,,	*reba, chaguni*	Pokhara, Central & Western Nepal	
3.	*B. chola*	,,	—	Biratnagar, also in Central and Western Nepal	5″ max; bitter in taste.
4.	*B. hexagonoleis*	,,	*katla*	Pokhara, Kosi & other Himalayan rivers	
5.	*B. puttitora*	,,	*mahseer*	Pokhara, Karnali, Mahakali, Kathmandu, etc.	Common in the Himalayan rivers.
6.	*B. sarana*	,,	*karne*	Pokhara, Janakpur	Common in Terai.
7.	*B. sophore*	,,	—	Patan	May be introduced.
8.	*B. stigma*	,,	—	,,	,,
9.	*B. ticto*	,,	*bhile*	Pokhara, Karnali, Mahakali	
10.	*Barilius burna*	,,	*buhari*	,,	5″ or more
11.	*B. bendelisis*	,,	—	Trisuli & tributaries	
12.	*Chela bacaila*	,,	—	Biratnagar, Chatra (Morang)	
13.	*C. gora*	,,	—	,,	
14.	*Catla catla*	,,	*katla*	,,	Common in Terai
15.	*Cirrhina reba*	,,	*rewa*	Throughout Terai	

* only a partial list.
—not known or recorded.

(Contd.)

Appendix B (*Contd.*)

S. No.	Genus	Family	Local Name	Locality	Remarks
16.	*C. mrigala*	Cyprinidae	*mrigala*	Kosi and other rivers in East	
17.	*Cyprinus bacaila*	,,	—	,,	
18.	*Esomus danrica*	,,	—	East Nepal	
19.	*Garra annandalei*	,,	—	,,	
20.	*G. lamta*	,,	—	Trisuli, Kathmandu	
21.	*Labeo bata*	,,	*rohu*	Biratnagar, Kathmandu (probably introduced)	
22.	*L. boga*	,,	,,	,,	
23.	*L. dero*	,,	,,	Biratnagar, Janakpur and rest of Nepal	
24.	*L. doycheilus*	,,	,,	Biratnagar, Janakpur and rest of Nepal	
25.	*L. gonius*	,,	,,	Biratnagar, probably rest of Terai	
26.	*L. rohita*	,,	,,	Throughout Terai, Kathmandu introduced	
27.	*Lepidocephalus guntea* (Syn: *Cobitus guntea*)	,,	—	Kosi	
28.	*Nemacheilus rupecola*	,,		Bhaktapur hilly streams	Himalayas, and in Tibet at very high altitudes.
29.	*Oreinus richardsonii*	,,	*asla*	Godavari, Pokhara, Dolalghat, Jhulaghat, etc.	Common in the Himalayan streams and rivers.
30.	*Saccobranchus Sp.*	,,	*singi*	Biratnagar, Taudah	Common throughout Terai.
31.	*Schizothorax* (Syn: *Diptychus annandalei*)	,, ,,	*asla* ,,	Trisuli, Kosi	Probably in other rivers also.
32.	*S. hodgsonii*	Bagridae		Pokhara (Begnas and Roopa Tal)	

33.	*Mystus tor*	,,		,,	
34.	*M. cavasius*	,,	*tengra*	,,	
35.	*M. tengara*	,,	*tengri*	Throughout Terai	
36.	*M. vittatus* (Syn: *Silurus vittatus*)	,,	*tengra*	,,	
37.	*Nandus nanchus*	Nandidae		Biratnagar	Probably in rest of Terai.
38.	*N. nandus*	,,	,,	,,	Small size max 3".
39.	*Notopterus notopterus*	Notopteridae		Throughout Terai	
40.	*Clupisoma montana*	Schilbeidae		Trisuli	
41.	*Pseuduetripisu antheriniodes*	,,		Biratnagar	
42.	*Wallago attu*	,,	,,	,,	
43.	*Ompok bimaculatus*	,,		,,	
44.	*Coliosa fasciata*	Anabantidae		Biratnagar	
45.	*Ambassis ranga* (Syn: *A. range*)	Ambassidae		,,	Nearly transparent body; not common.
46.	*Amphipnous cuchia*	Amphipuoidae		Harshidhi (Kathmandu)	
47.	*Xenentodon caneila*	Belonidae		Pokhara (Phewa Tal)	
48.	*Channa orientalis* (Syn: *Ophiocephalus punctatus*)	Channidae	*hile*	Harsiddhi (Kathmandu), also in Terai	
49.	*C. punctatus*	Channidae	*Garrie*	Harsiddhi (Kathmandu), also in Terai	
50.	*Clarius betrachus*	Claridae	—	Throughout Terai.	
51.	*Gudusia chapra*	Clupeidae	—	Janakpur	
52.	*Glossobius giuris*	Gobidae	—	Kosi	Max length 1".
53.	*Heteropneustes fossilis*	Saccobranchidae	—	Trisuli	'eel type'.

(*Contd.*)

Appendix B (*Contd.*)

S. No.	Genus	Family	Local Name	Locality	Remarks
54.	*Macrognathus aculeatus*	Mastacembelidae	*Bame* *Bam*	Biratnagar, throughout terai	,,
55.	*Macrognathus armatus*		—	,,	'sand and spine eel'.
56.	*Mugul nepalensis*	Mugulidae	—	not recorded	
57.	*Pseudocheinis suleatus*	Sisoridae	*Kabre*	Bhote kosi, etc.	Suckers on the ventral surface, body adapted to hilly streams.

APPENDIX C

LIST OF VEGETABLES AND FRUITS AVAILABLE IN THE KATHMANDU MARKET

Vegetables

S. No.	English Name	Local Name	Scientific Name	Family	Season Summer (April-Sept.) Winter (Oct.-March)
1.	Bitter gourd	*Karela*	*Momordica charantia* L.	Cucurbitaceae	Summer
2.	Pumpkin	*Pharsi*	*Cucurbita maxima* Dueh	,,	,,
3.	Ridge gourd	*Pate ghirola*	*Luffa acutangula* Roxb	,,	,,
4.	Bottle gourd	*Loki, Lankor*	*Lagenaria leucartha* Rusby	,,	,,
5.	Smooth gourd	*Ghiu toriya, Gheraula*	*Luffa aegyptica* Mill	,,	,,
6.	Snake gourd	*Chichindo*	*Trichosanthes anguina* L.	,,	,,
7.	,,	*Ban chichindo*	,, *cucumerina*	,,	,,
8.	,,	*Parwal*	,, *dioica* Roxb	,,	,,
9.		*Kakro*	*Cucumis sativus* L.	,,	,,
10.		*Tinda*	*Citrullus vulgaris* var. *fistulosus*	,,	,,
11.		*Skool*	*Sechium edule*	,,	,,
12.	Soyabean	*Bhatmas*	*Glycine max*	Leguminosae	,,
13.	Cowpea	*Bodi*	*Vigna catjang* Walp.	,,	,,
14.	Horse gram	*Gahat*	*Dolichos biflorus* Roxb	,,	,,
15.	French bean	*Semi*	*Phaseolus vulgaris* L.	,,	,,
16.	Broad bean	*Bakula*	*Vicia faba* L.	,,	,,
17.	Pea	*matar*	*Pisum sativum* L.	,,	Winter
18.	Pea	*Kerau*	*P. sativum* var. *arvense* L.	,,	,,

(Contd.)

Appendix C (*Contd.*)

S. No.	English Name	Local Name	Scientific Name	Family	Season Summer (April-Sept.) Winter (Oct.-March)
19.	Lentil	*Musur*	*Lens esculenta* Moench	Leguminosae	Winter
20.	Fenugreek	*Methi*	*Trigonella foenum graceum* L.	,,	,,
21.	Cress	*Chansur*	*Lepidium sativum* L.	Cruciferae	,,
22.	Gram (Bengal Gram)	*Chana*	*Cicer arietinum* L.	Leguminosae	,,
23.	Onion	*Pyaj*	*Allium cepa* L.	Liliaceae	,,
24.	Garlic	*Lashun*	*A. sativum* L.		,,
25.	Coriander	*Dhaniya*	*Coriandrum sativum* L.	Umbelliferae	,,
26.	Carrot	*Gajar*	*Daucus carota* L.	,,	,,
27.	Celery	—	*Apium graveolens*	,,	,,
28.	Cabbage	*Band gobi*	*Brassica oleracea* var. *capitata* L.	Cruciferae	,,
29.	Cauliflower	*Couli*	*B. oleracea* var. *botrytis* L.	,,	,,
30.	Radish	*Mula*	*Raphanus sativus* L.	,,	,,
31.	Turnip	*Salagam*	*Brassica rapa* L.	,,	,,
32.	Mustard	*Rayo*	*B. juncea* Coss	,,	,,
33.	,,	,,	*B.* ,, var. *foliosa*	,,	,,
34.	Indian rape	*Tori*	*B. campestris* Duthie	,,	,,
35.	Knol knol	*Ganth gobi*	*Brassica oleracea* var. *caulocarpa*	,,	,,
36.	Tomato	*Gol bhenda*	*Lycopersicum esculentum* Muill	Solanaceae	,,
37.	Egg plant	*Bhenta*	*Solanum melongena* L.	,,	,,
38.	Buckwheat	*Phaphar*	*Fagopyrum esculentum*	Polygonaceae	,,
39.	Spinach	*Palungo*	*Spinacea oleracea* L.	Chenopodiaceae	,,
40.	Beet	*Chakandar*	*Beta vulgaris* L.	Chenopodiaceae	,,
41.	Colocasia	*Karkalo*	*Colocasia esculenta*	Araceae	Summer
42.	Alocasia	*Pindalu*	*Alocasia indicum*	,,	,,

43.	Asparagus	*Kurilo*	*Asparagus officinalis*	Liliaceae	,,
44.	Sweet potato	*Sakharkhanda*	*Ipomoea batatas* Lam	Convolvulaceae	Winter
45.	Potato	*Alu*	*Solanum tuberosum* L.	Solanaceae	Summer-Winter
46.	Ginger	*Aduwa*	*Zingiber officinale* Rosc.	Zingiberaceae	Winter
47.	Turmeric	*Haledo*	*Curcuma longa*	,,	,,
48.	Bamboo shoots	*Tama*	*Dendrocalamus Sp.*	Graminae	Summer-Winter
49.	Lady's finger (okra)	*Ramtoriya*	*Hibiscus esculentus*	Malvaceae	Summer
50.	Bell pepper	*Bhdae khursani*	*Capsicum frutescens* var. *grossum*	Solanaceae	,,(?)
51.	Chilli	*Khursani*	*Capsicum frutescens* var. *longum*		,,
52.	Mushroom	*Chyau*	*Agaricus campestris*		,,
53.	Yam	*Tarul*	*Dioscorea alata*	Dioscoreaceae	Summer-Winter
54.	Bauhinia	*Koiralo*	*Bauhinia purpurea*	Leguminosae	Summer

Fruits

S. No.	English Name	Local Name	Scientific Name	Family	Season
1.	Peach	*Aru*	*Prunus persica* Batch	Rosaceae	Summer
2.	Pear	*Naspati*	*Pyrus communis* L.	,,	,,
3.	Apple	*Syau*	*Malus sylvestris*	,,	,,
4.	Plum	*Alu Bukhara*	*Prunus domestica* L.	,,	,,
5.	Apricot	*Khurpani*	*Prunus armeniaca* L.	,,	,,
6.	Quince	—	*Cydonia vulgaris*	,,	,,
7.	Strawberry	*Bhuiainsalu*	*Fragaria vesca* L.	,,	,,
8.	—	*Kaphal*	*Myrica nagi*	Myricaceae	,,
9.	—	*Aiinselu*	*Rubus ellipticus*	Rosaceae	,,
10.	Papaya	*Mewa*	*Carica papaya*	Caricaceae	,,
11.	Jack fruit	*Rookh kathar*	*Artocarpus intergifolia*	Moraceae	,,
12.	Pine apple	*Bhui Kathar*	*Ananas comosus*	Bromeliaceae	,,
13.	Custard apple	*Sharefa*	*Anona squamosa*	Annonaceae	,,
14.	Persimmon	*Haluwabed*	*Diospyros virginiana*	Ebenaceae	,,
15.	Pomegranate	*Anar*	*Punica granatum*	Punicaceae	,,
16.	Guava	*Amba*	*Psidium guajava*	Myrtaceae	,,
17.	Rose apple	*Jaman*	*Eugenia jambolana*	,,	,,
18.	Mango	*Aamp*	*Mangifera indica*	Anacardiaceae	,,
19.	Wood apple	*Bael*	*Aegle marmelos*	Rutaceae	,,
20.	Jujube (Chinese date)	*Bair*	*Zizyphus jujuba*	Rhamnaceae	Winter
21.	Grape	*Dakh*	*Vitis vinifera*	Vitaceae	Summer
22.	Lime	*Kagati*	*Citrus aurantifolia* Single	Rutaceae	Summer-Winter
23.	Pomelo (shaddock)	*Bhogate*	*Citrus maxima*	,,	Winter
24.	Tangerine/mandarin	*Suntola*	*Citrus reticulata* Balncs	,,	,,

25.	Orange (tight skin orange)	*Suntola*	*Citrus chrysocarpa*	,,	,,
				,,	,,
26.	Sweet lime	*Chaksi*	*C. limetioides*	,,	,,
27.	Citron	*Bimaro*	*C. edica*	,,	,,
28.	Rough lemon	*Kathe jamir*	*C. jambhiri*	,,	,,
29.	Sweet orange(malta)	*Mosambi*	*C. sinensis*	,,	,,
30.	Banana plantain	*Kera* (malbhog, *Jhapri*, etc.)	*Musa sapientum*	Musaceae	Summer-winter
31.	Banana	*Kera*	*M. paradisiaca*	,,	,,
32.	Barberry	*Chutro*	*Berberis aristata*	Berberidaceae	Summer
33.	Melon	*Tarbuj*	*Citrullus vulgaris*	Cucurbitaceae	,,
34.	Loquat	*Loquat*	*Eriobotrya japonica*	Rosaceae	,,
35.	Bassia	*Cheuri*	*Bassia butyracea*	Sapotaceae	,,
36.	—	*Lapsi*	*Spondias axillaris*	,,	Summer-winter
37.	Tamarind	*Imli*	*Tamarindus indica*	Leguminosae	,,
38.	Chestnut	*Katus*	*Castanopsis hystrix*	Fagaceae	Winter
39.	,,	*Musre katus*	*C. tribuloides*	,,	,,
40.	Walnut	*Okhar*	*Juglans regia*	Juglandaceae	,,
41.	Peanut (ground nut)	*Badam*	*Arachis hypogea*	Leguminosae	,,
42.	—	*Amla*	*Phyllanthus emblica*	Euphorbiaceae	,,

APPENDIX D

List of Medicinal Plants*

MONOCOTYLEDON

Palmae
Phoenix Sp.; thakil

Araceae
Acorus calamus; bojho
Arisaema speciosum; bish jharne
A. torulosum; birbanka

Liliaceae
Asparagus racemosus; satawari
Aloe vera; ghirtkumari
Asparagus racemosus; satawari
Lilium wallichianum; findora
Fritillaria cirrhosa
Smilax macrophylla; kukurdiano

Araliaceae
Panax pseudogensing Beth.

Amaryllidaceae
Curculigo orchioides; muslikand

Commelinaceae
Aneilema scapiflorum; siyamuli
Commelina subfruticosa; kataspriya

Dioscoreaceae
Dioscorea sativa; githo
D. deltoidea; vyakur
D. oppositifolia; kukur tarul

Iridaceae
Iris nepalensis; padampuskar

Zingiberaceae
Zingiber officinale; aduwa

Orchidaceae
Orchis Sp.; panchangule
Dendrobium fimbriatum

DICOTYLEDON

Piperaceae
Piper longum; pipla

Oleaceae
Fraxinus floribunda; lankuri

Gentianaceae
Swertia chirata; chirata

Apocynaceae
Alstonia scholaris; chatiwan
Rauwolfia serpentina; chandmaruwa
Vinca rosea; nayantara

Asclepiadaceae
Calotropis procera; ak

Verbenaceae
Vitex negundo; indrani

Labiatae
Origanum marjorana; surava
O. vulgare; sathra
Mentha piperita; padam, babri

Solanaceae
Atropa belladona, beladona
Datura stramonium; dhaturo
Hyoscyamus niger; kurchi; ajwain
Solanum xanthocarpum; kantakari

Scrophulariaceae
Digitalis purpurea; digitalis
Picrorrhiza kurroa; kutki

Acanthaceae
Adhatoda vasica; Ak. ashuro

Rubiaceae
Hedyotis scandens
Rubia cordifolia; menjitho

Valerianaceae
Nardostachys jatamansi; jatamanshi
Valeriana wallichii; sugandhwal

Amaranthaceae
Achyranthes aspera; apamarg

*A partial list only.

Moraceae
Cannabis sativa; charas

Polygonaceae
Rheum emodi; padam chal
Rumex acetosa; amillo papergo

Ranunculaceae
Aconitum Balfourii; gobari
A. Chaomanthum; bish
A. ferox; atisingiya bish
A. heterophyllum; ativash
A. luridum; bish
A. napellus; madhubish
A. palmatum; bishma; non-poisonous
Anemone obtusiloba; ratanjot
Delphinium denudatum; nirbishi

Papavaraceae
Corydalis govaniana; bhutukesh

Berberidaceae
Berberis aristata; chutro
B. nepalensis; daruhaldi
Podophyllum emodi; laghupatra

Menispermaceae
Tinospora cordifolia; gurjo

Lauraceae
Cinnamomum tamala; dalchini

Saxifragaceae
Saxifraga ligulata; pashanved
Dichroa febrifuga

Rosaceae
Potentilla fulgens; bajradanti

Leguminosae
Acacia catechu; khair
Alhagi maurorum; durlabh
Bauhinia purpurea; koiralo
Cassia fistula; rajbriksha
Desmodium tiliafolium; sarkinu
Erythrina indica; phaledo
Mucuna momosperma; baldhengra

Geraniaceae
Geranium wallichianum

Anacardiaceae
Semicarpus anacardium; bhalayo

Euphorbiaceae
Phyllanthus emblica; amla
Ricinus communis; andi

Sapindaceae
Spondias axillaris; lapsi
Sapindus trifoliatum; ritha

Rhamnaceae
Berchemia lineata; angeri

Sterculiaceae
Abroma angusta; sanu kappasi

Myrtaceae
Eugenia operculata; kyamun
E. jambolana; Jaman

Combretaceae
Anogeissus latifolia; daru
Terminalia belerica; harro
T. chebula; barro

Punicaceae
Punica granatum; anar

Aristolochiaceae
Aristolochia indica; ishwari

Umbelliferae
Hydrocotyl asiatica; ghodtapre

Ericaceae
Rhododendron anthopogon; gurash
R. barbatum; ,,
R. campanulatum; nilo chimal
R. cinnabaricum; wulu

Ebenaceae
Diospyros embryopteris; gab

Campanulaceae
Lobelia pyramidalis; eklebir

Compositae
Ageratum conyzoides; ajaganda
Artimesia vulgaris; titepati
Chrysanthemum cinerariaefolium
Saussurea lappa; kuth
Taraxacum officinale; dudhal waran
Xanthium strumarium; gokhru

GYMNOSPERMS

Pinaceae

Abies webbiana; talispatra; gobir sallo
Cedrus deodara; deodaru
Juniperus recurva; dhupi

Gnetaceae

Ephedra wallichiana; bhutukesh
E. equisetifolia; ,,

PTERIDOPHYTES

Lycopodiaceae

Lycopodium clavatum; nagbeli

Osmundaceae

Lygodium japonicum

Polypodiaceae

Adiantum lunulatum; hansraj
Dryopteris cochleata; uneu
D. odontoloma
D. filix-mas

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