CHAPTER I

GENERAL

Udupi district, which stands as a symbol for temple and cultural tradition, is a small district comprising three taluks. On the west it is bounded by the roaring sea and to its east reclines the dense green Sahyadri mountain ranges. The district is blessed with a fairly 100 km long beautiful coastline. Malpe forms the only big natural port which, of late, is developing into a large fishing port. It has the distinction of being the biggest port that supplies the sea products to the State as well as other States of the Country. Dotted with tall coconut trees, the St. Mary's Island (locally known as Thonse Paru) and the neighbouring island Bahaddurgadh are the tourist attractions located about 10 km from Malpe beach. Kapu which is 11 km from Udupi is yet another attraction with gorgeous beach and a light house built during the British period. Maravanthe, is another tourist spot, where the national highway passes quietly. The river Sauparnika flows glutted with water towards the right, while, the sea roaring on the left looks as though kissing the beach. The turtle rearing centre on the beach of *Maravanthe* attracts the tourists, nature lovers and those who are interested in exploring biodiversity. The bird sanctuary located in the Sitanadi between Hebri and Someshwara is an enticing place for bird lovers. Jomlu thirtha, a nearby rocky place has always lured the people who have fascination for trekking. If one climbs Agumbe ghats, after crossing Hebri-Someshwara, the sunset scene offers an awesome experience. It is no exaggeration that Udupi district is the home for Yakshagana - a folk art famed both in the Country and abroad. Kakanda Srinivasa Udupa and Shridhara Hande are credited for leading Saligrama children's Yakshaqana troupe to the foreign countries, for the first time from Udupi and it is considered as the pride of the district.

Udupi district, which is amidst the vast greenery is often the place preferred by nature lovers. It is equally true that this district is a unique spiritual centre for devotees and optimists alike. Udupi district acclaimed for its captivating temples, holy places is also lauded by tourists and nature lovers for its bountiful places for rejoicing. The district abounds in Temples, Churches, Masjids, Jain monuments, the charming beaches, historical places, cultural and educational centres, along with diversified human lives, protected forests and water falls.

Origin of Name

Opinion differs as to the derivation of the name Dakshina Kannada including Udupi district, which is situated on the southern end of the western coast of Karnataka. Before the two districts namely South and North Kanara were separated out in 1860, the entire coastal belt was known either as *Kanara* or *Canara*. Later, they were called South Kanara and North Kanara. It appears that the Portuguese when they arrived here and came in contact with the local people found that the common linguistic medium of the people to be Kannada and coined the name *Kanara*, 'd' being not much in use in Portuguese. Since then, the name *Kanara* came into being. People who spoke Kannada were called *Kanarese/Canarese*. But it was in 1860, that the *Kanara* district was divided geographically into South Kanara and North Kanara and each got a separate identity. When Karnataka was unified in 1956, both the districts were merged in Karnataka. In 1997, Udupi district was separated from Dakshina Kannada district.

From the earlier times the coastal part that included the present Dakshina kannada and Udupi districts was called variously as Parashurama Kshetra, Shanthika Kshetra, Nagayinda, Shurpanka Kshetra, Aparanthaka Desha with mythological stigma attached to each of these. But, historical connotation was different - where the land was identified with the rulers, it was called Alvakheda – 6000, Alvanadu of Saptha Konkana region, Tulunadu in the reign of Alupas. But, with the entry of Portuguese, the region came to be known as Kanara. Mythology has it, that, when Parashurama (parashu for axe) threw the axe, the sea got retreated and the land exposed stretching in north-south direction This was identified as Parashurama Kshetra. It has a scientific version too. During Megalithic period (Iron Age), perhaps man used axe to cut down the forest for his settlement and Parashurama may symbolize this cultural transposition, according to Dr. K.V. Ramesh.

Regionally, South Kanara district is alluded to as *Tulunadu* in *Agananooru*, a Tamil Sangam anthology of circa 1500. There is a reference to Tulu *Vishaya* in the *Barakuru* inscription of the period of Bankideva –I of the Alupa dynasty and Nayasena who lived in 1115 A.D. in his work '*Dharmamrutha*' makes a mention of *Tulunadu*. Lithic records of the Vijayanagar rules mention the region as *Tulu Rajya* and *Tulu Desha* and parts of it as Mangalore *Rajya* and Barakuru *Rajya*.

Though Kannada has been in general use in this region both as the official language and popularly cultivated link language, since a long time, the native tongue of a large number of people in a major portion of the district is Tulu of the Dravidian family of languages. The word 'Tuluva' refers to either people who speak this language or to the region. There is no single opinion as to how the word Tulu has been derived. Legend has it, that, Ramabhoja, an early ruler of this region was known for his gifts like tuludhana, tulapurusha etc. and his dynasty was called *Tholar* and the region under his control as Tulu. But this version is refuted by scholars like B.A. Salethore as untenable. He argues that the word 'Tuluve' has its roots in Tulu which means mild and meek; which evidently denotes the peaceful demeanour of the people. Yet in another instance, Salethore opines that, the word 'Tuluva' is derived from the Kannada word which literally means 'to attack'. It could well reflect the intrepidity of the Tuluvas in the ancient times and hence the name. A totally different version is provided by another scholar Dr. K.V.Ramesh who points out that in the Tulu language, as spoken today, when this word qualified certain fruits, it signifies the softness of the fruits. He opines that in the ancient days also, the region must have been famous for its variety of soft fruits and might have, therefore, came to be called as Tulunadu.

M.Govinda Pai, however, argues that there would be some meaning in the derivation of the word from softness, if softness is taken as an attribute not of the people but the soil of the region. Dr. Gururaja Bhat traces the roots of the word Tulu to cattle and that the Tuluvas in ancient times were cattle breeders and in that context probably Turuvars were called Tuluvas. Sediyapu Krishna Bhat however, derives a different meaning for Tulu. He suggests that the word Tulu denotes water and therefore the name *Tulunadu* has something to do with the region which abounds in water. K.M. Raghava Nambiar believes, that, in its true sense, *Tulunadu* refers

to the area over flown by water and agrees with the view of Sediyapu Krishna Bhat. Moreover, Alupas, the rulers of the region were known by the name Aluva, denoting rich natural background. Hence, it is possible that the word Alupa might have had roots in Anupa, since the word Anupa refers to the region with dense vegetation and cascades. With this background the words *Tulunadu* and *Anupadesha* look as though one is the translation of the other denoting the same meaning. Whatever could be the argument, the fact remains, that, this part of the country is in the foothills of the Western Ghats, rich in valleys with copious water supply and is appropriate that the region is called *Tulunadu*.

Similarly, there are many versions about the roots of the name 'Udupi'. Legend has it, that, Chandra (the moon) who was cursed by Daksha Brahma, in order to get rid of this curse, he did penance in this part and could succeed since Lord Shiva was benevolent to him. The word Udupa refers to the lord of stars in Sanskrit language. Since Chandra (Udupa) the lord of stars did penance in this part, the place was called 'Udupi' and is entrenched in the local legend. Udupi also means Cobra, the serpent. It is no wonder that Udupi is known for snake worshipping and the name 'Udupi' could have roots in this legend as opined by Sri Gururaja Bhat. Udupi being in the fore front of Sapthakshetra of Tulunadu, has been aptly refer to as the seat of Roopia (silver) in Sapthakshetra Smarana Shloka. Yet, in another legend, there is an interesting anecdote; when the ground was being tilled for performing yagna, it appears that a snake was hurt while picking it from the tip of the plough which invited curse from the snake. In order to rid of the curse, the king Rama Bhoja prepared a silver seat which was accepted by Parashurama in which he got himself installed and for that very reason, the place was called `Udupi'. In ancient epigraphs too, there are references to Udupi, Narayana Pandit, in his Madhva Vijaya (circa, 14th century) calls this silver seat odipu in colloquial language and there are documents to this effect. Odipu, from which the word `Udupi' has derived, refers to breaking, as the word just as the word odapu denotes in Kannada. Hence it is necessary to carefully examine the relationship between the local name odipu and O (va) Odambadeshwara as opined by Bannaje Govindacharya. This view is endorsed by Kemturu Raghupathi Bhat, who further discussed

the derivation of the word Udupi. (For further details refer the work of K. Anantharamu of *Dakshina Sirinadu*, 1997). As it is true with many districts of Karnataka, Udupi being the centre of the district is aptly named Udupi district.

Location and Boundaries

Geographically the Udupi district is separated from the rest of the South Indian Peninsula by the Western Ghats. It spreads from the Western Ghats towards the sea to the west. The undivided Dakshina Kannada almost had a straight coastal line running for 76 nautical miles (141 km). The newly formed Udupi district has a coastal line which extends for about 100 km and is broken at numerous points by rivers, rivulets, creeks and bays. The district lies between 13° 05' and 13° 55' North latitude and 74° 40' and 75° 07' East longitude.

The district is bounded by Uttara Kannada district on the north, Shimoga and Chikmagalur districts on the east, Dakshina Kannada on the south and Arabian Sea on the west.

Area and Population

Udupi district, according to the Census of 2001, has a geographical area of 3,880 sq.km. Of the total population of 11.12 lakhs, there are 5.33 lakhs males and 5.90 lakhs females. It is interesting to note that there are more females than the males in the district. Udupi has the highest population compared to other taluks of the district (5.29 lakhs). Karkala has the least population among the taluks (2.05 lakhs); Kundapur taluk has a population of 3.77 lakhs. The district represents 2.10 per cent of the total population of the State. The density of the population (population for every sq.km) of the district is 311, which is more than that of the State (276). If we consider the population density talukwise, Udupi taluk has the highest density (572/sq.km) while Karkala represent the least (188/sq.km) density. Kundapur has 242 people for every sq.km. According to the census of 2001, the male and female ratio is 1130:1000 and in the State the figure is 964:1000. There is an increase of population of 6.88 per cent in the district between the period 1991 and 2001 (for details see Chapter 3-People).

S1. No.	Details	Kundapur	Karkala	Udupi	Total
1.	No. of Hoblies	3	2	4	9
2.	No. of Grama panchayats	56	29	61	146
3.	As per Census 2001 nur	nber of			
	 Inhabited villages 	99	50	99	148
	• Town/City Agglomeration	4	1	4	9
	• City/ Municipality/ Corporation	1	1	2	4
4.	Area in Sq. km.	1,560	1,072	929	3,880*
5.	Total population (2001))			
	• Male	1,74,455	96,755	2,51,021	5,22,231
	• Female	2,02,965	1,08,843	2,78,204	5,90,012
	• Total	3,77,420	2,05,598	5,29,225	11,12,243
6.	Urban Population				
	• Male	13,919	12,686	74,570	1,01,175
	• Female	14,672	12,686	74,570	1,05,178
	• Total	28,591	25,116	1,52,646	2,06,353
7.	Population density per sq. km	242	188	572	311
8.	Sex ratio per 1000				
	Male	1,163	1,125	1,108	1,130
9.	Growth ratio (%)				
	1981-1991	12.57	8.75	7.66	9.42
	1991-2001	7.32	7.83	6.75	7.14

Table 1.1: General Information of Udupi district

* The total area of taluks does not match with the total area of the district. The statistics of the total area of taluk represents the land use. The area of the district represents the apparent geographical area.

Source : Directorate of Census, Bangalore; Statistics of Udupi District, District Statistical Officer, Udupi District, Udupi

Regional changes

The Alupas ruled the present Dakshina Kannada district which included Udupi district, from the early period of 2nd Century A.D. to 12th Century A.D. During their rule, the kingdom was divided into divisions called *Nadu* and the region around *Baindoor* was known as Byndoorunadu, while the region around the Mangalore was known as Moogoorunadu. For a short period, it was under the suzerainty of the Hoysalas. From about the middle of the 14th century to the end of 16th century, the district formed a part of the Vijayanagar Empire. It was during this period that the Barakooru Rajya with its headquarters at Barakoor of Udupi taluk and Mangalore Rajya with its headquarters at Mangalore came into being. Both the States had governors as overseers and sometime there used to be a single governor for both the Rajyas. The region was further subdivided into smaller administrative units known as Nadus. There are references in the Inscriptions of the Kings of Vijayanagar to Paduvakonanadu, Byndoorunadu, Udayangalanadu, Thilugadhiyanadu, Kadabanadu, Nalavattanadu, Harunadu, Munginadu, Mandalakeyanadu, Kantaradhanadu, Kabbunadu, Kandenadu, Bandampallinadu etc.

The administration of the district was transferred to the Keladi rulers by the emperor of Vijayanagar around 1554 A.D. It was under the rule of Keladi Nayaks for about two centuries. With the capture of Bidanur by Hyder Ali in 1763 A.D., the district also was passed on into his hands and subsequently to the possession of Tipu Sultan. It was annexed by Britishers in 1799 after the death of Tipu Sultan. The fourth Mysore War of 1799 made a significant change in the history of the Mysore State. After Tipu, his kingdom was shared among Britishers, Marathas, Nizam of Hyderabad, Royal clan of Mysore Wadeyars. Thomas Munro, took charge of Kanara districts as Collector in 1799 and Kanara and Sonda divisions which were under Madras Presidency in 1800 included the present Dakshina Kannada, Udupi and Uttara Kannada districts, Kasargod (it was transferred to Kerala after 1956) and Amindivi Islands (the latter was under the central administration in 1956).

In the early period the present Dakshina Kannada, Udupi, Kasargod and Uttara Kannada districts formed a single district and the unified district was called Kanara/Canara. It was in 1860 that the Kanara/Canara district was divided into South Kanara and North Kanara. The South Kanara division in those period included Barakur, Bekala, Bantvala and Mangalore taluks. It was bounded by Arabian

Sea on the west, Western Ghats on the east, and Kavayi river on the south and Koteshwara on the north which defined the boundaries. Udupi taluk came into being in 1835. When Kanara region was further divided into two districts in 1862, the taluks included in the newly formed South Kanara district were Mangalore, Bekala(kasargod), Bantwala, Puttur, Udupi and Barakur. In 1862, North Kanara (excluding the Kundapur taluk which was transferred to South Kanara) was transferred to Bombay Presidency, while, retaining South Kanara in the Madras Presidency. With the reorganization of the State in 1956, the South Kanara district was integrated with the New Mysore State (excluding Kasaragod which was transferred to Kerala State). Udupi district was carved from the Dakshina Kannada district in 1997.

Administrative Divisions

In 1895, the area of South Kanara district which included the present Udupi district was 3,902 sq. miles and it also included a small group of islands in the Indian Ocean known as the Amindivi Islands. In 1896, the taluks which included under South Karana district are Mangalore, Kundapur, Udupi, Kasargod and Uppinangady. A new taluk, with Moodabidri as the headquarters and called after that place, was formed in 1910. However, for administrative reasons, the Moodabidri taluk was abolished two years later and a new taluk called the Karkala taluk was formed with effect from 1st July, 1912. In 1927. Uppinangady taluk was renamed as Puttur and its headquarters was also located there. For purposes of revenue administration, the district was divided into three divisions namely Kundapur, Mangalore and Puttur. The Kundapur division comprised the three northern taluks of Kundapur, Udupi and Karkala and was headed by an Indian Civil Service Officer designated as Head Assistant Collector, while the Puttur taluk comprising the taluks of Puttur and Kasargod was under the charge of a Deputy Collector. The Mangalore taluk which constituted a division by itself was under the charge of a Deputy Collector.

In 1954, another new taluk, namely, Belthangady, was constituted for administrative convenience. But, on 1st November 1956, the taluk of Kasaragod, which was all along an integral part of the Dakshina Kannada district, was transferred to Kerala State as a consequence of re-organisation of the State. The jurisdiction of the revenue divisions of the district was again revised in 1959 and the old Mangalore division, which had been abolished earlier, and the Buntwal taluk, which was at one time an independent taluk and had been merged with Mangalore in 1858, was revived with effect from

1st October, 1959. Again, in April, 1966, another new taluk, namely, Sulya, was carved out of Puttur taluk. In 1972 the district of Dakshina Kannada had eight taluks and three revenue sub divisions. Kundapur sub division included Kundapur, Udupi and Karkala taluks, similarly, Puttur division included Puttur, Sulya and Belthangady taluks and under Mangalore sub division were included Mangalore and Bantawala taluks. The eight taluks were divided into revenue circles or Hoblies (in the district they were called Pirkas). The details of talukwise Hoblies and villages(total) as existed in 1973 is given here.

S1. No.	Taluk	Total number of Villages	Name of Hobli
1.	Kundapura	101	1. Kundapura 2. Bynduru 3. Vandse
2.	Udupi	115	1. Udupi 2. Kaapu 3. Kota 4. Brahmavara
3.	Karkala	79	1. Karkala 2. Moodabidri 3. Ajekar
4.	Puttur	68	1.Puttur 2. Uppinangadi 3. Kadaba
5.	Sulya	41	1. Sulya 2. Panja
6.	Beltangadi	81	1. Beltangadi 2. Venooru 3. Kokkada
7.	Mangalore	118	1. Mangalore – A 2. Mangalore – B 3. Gurupura 4. Suratkal 5. Mulki
8.	Bantvala	84	1. Bantvala 2. Pane Mangalore 3. Vitla
	Total	687	26

Table 1.2: Talukwise Details of Hoblies - 1973

Apart from the transfer of Kasaragod taluk to the Kerala State in 1956, the Amindivi group of Islands, which formed a part of the district, were also transferred to the newly formed Union Territory of Laccadive(Lakshadweep), Minicov and Amindivi Islands. Within the district itself, consequent to the formation of the Belthangady taluk in 1954, 25 villages each of Belthangady and Kokkada hoblies and two villages (Barya and Tekkar) of Uppinangady hobli from the then Puttur taluk, and 29 villages of Venoor hobli from Karkala taluk were transferred to form the new taluk. Similarly, when the new taluk of Buntwala was formed in 1959, 31 villages of Buntwala hobli and 30 villages of Panemangalore hobli of the then Mangalore taluk and 24 villages of Vittla hobli from the Puttur taluk were transferred to form this new taluk. Further, for purposes of administrative convenience, the village Halady was transferred from Udupi taluk to Kundapura taluk, so also the village Hejmady from Mangalore taluk to Udupi taluk and the villages Inne, Mulladka and Mundkur from Mangalore taluk to the Karkal taluk, during that year.

Again, during 1966, consequent to the formation of the new taluk of Sulya, 19 villages of the Panja hobli and 22 villages of Sulya hobli from the then Puttur taluk were transferred to form the new taluk. Udupi district came into being by taking out Udupi, Kundapur and Karkala taluk from Dakshina Kannada district in 1997. Moodabidare hobli of Karkala taluk of Udupi district was transferred to Mangalore taluk of Dakshina Kannada on 25.3.1998. At present, Udupi district has a revenue sub division under which are included Udupi, Kundapura and Karkala taluks with Kundapura as its headquarters. There are nine hoblies in the district and talukwise details are given here:

Sl.No.	Taluk	East Longitude (Degree and Minutes)		North Latitude (Degree and Minutes)	
		From	То	From	То
1.	Udupi	74-42	74-56	13-05	13-33
2.	Kundapura	74-35	75-05	13-29	13-57
3.	Karkala	74-40	75-13	12-59	13-31
	District	74-35	75-13	12-59	13-57

Table 1.3: Talukwise particulars of Udupi district

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S1.No.	Taluk	Area(sq.km.)	Population sq.km (Population Density)	Number Of villages	Number of cities/towns
1	Kundapura	1,559.72	242	99	5
2	Udupi	929.24	570	99	6
3	Karkala	1,072.37	188	50	2
Di	strict Total	3,880.00	310	248	13

Source : Census of India 2001, Directorate of Census, Bangalore

GEOLOGY

On its east Udupi district is bounded by higher ranges of Western Ghats. The width of the districts gets narrower as one proceeds from south to north. Geologically, the district represents mainly the Dharwar Group of rocks, intrusives and rocks belonging to the Recent period. The Dharwar Group is composed of metamorphic rocks belonging to the earliest time in the history of the earth. High grade rocks belonging to Sargur Group represented by *talc tremolite actinolite schist, hornblende schist* and isolated bands of *ferruginous quartzite* occur as enclaves here and there. Laterite is found mostly in the interior part of the coastal plain. *Alluvium, clay* and layers of *limestone* are grouped under Recent Formation.

Western Ghats with dense forest having canopy are to be seen all along the eastern boundary of the district. The towering peaks intersected by valleys offer grandeur to the landscape. The Agumbe Ghat lying in the midst of Sahyadri mountain ranges connects the coastal part with the plains. The highway which passes through Karkala and touching Dakshina Kannada bifurcates into two, one leading to Sringeri and another to Kudremukh, is yet another important connecting road in this region. Kodachadri which lies to the north of Agumbe is the highest peak (1,341 m) of the district. Below the ghat section, the plains get opened up as one proceeds towards west. There are high hills on the slope which is not very steep. In the cultivated land are to be seen the paddy fields, coconut plantation, arecanut and cashewnut plantation. There are barren lands with red soil, here and there and there appears to be less representation of the flat ground. The coastal part of the district assumes importance from the point of view of resources. Here, there is more density of population and equally a bee hive of economic activities. The coast line is generally straight and the backwater areas

are ideal for fisheries and boating. Towns like Baindur, Gangolli, Kundapura, Malpe, Padubidare etc. have developed into fishing and trade centres. St. Mary group of islands are located near Malpe.

Water Resources

The district has rich water resources due to its unique geographical position and climate. The south west monsoon brings a lot of rains both to the coast and the ghat sections. During monsoon period, i.e. June to September, as there is heavy down pour the rivers and streams of western ghats flow westward though the length of the rivers are short but carry a huge volume of water. River Gangolli near Kundapura joins with five tributaries and subsequently flows into Arabian Sea and hence is called *Panchagangavalli*. Here the estuary is large and there is also a harbour.

Swarna, Seetha, Haladi, Chakra and Kollur are the important rivers of the district. The river Seetha joins with Swarna near Barakoor before flowing into the sea. The backwaters of most of the streams are ideal for boating. But the sad part is that though the district abounds in water resources most of the streams are not tamed for cultivation and instead are allowed to simply join the sea. The Bhandaji water fall in Karkala taluk has a vertical fall of 700 m. The low lying coastal part stretching from west of Western Ghats to the sea was called Parashuramakshetra or Parashuramananadu in legends. The story goes that Parashurama after defeating all the kings of kshatriyas, while proceeding towards western Ghats to herald his victory, encountered the sea and was enraged and threw his axe (parashu for axe) towards the sea and ordered the sea to withdraw from the point where the axe fell. The king of sea sincerely obliged his order. Whatever could be the legend there is ample scope to think that the present coastal part was once, under the sea in the geological past and the land got exposed when the sea got retreated.

Mineral Resources

Udupi district has been systematically mapped which aids to understand its geological formations and the associated mineral deposits.

Laterite: Laterite (brick stone) occurs all along the coastal part and is restricted to the upper part of the rock formation and is one of the important building stones of the district. Right from the Vishnu

temple of Angakarvat (Anandavati) of Combodia, laterite is being used throughout Dakshina Kannada, Uttara Kannada and Udupi districts since a long time. But, it was named laterite only when Buchanan visited Malabar in 1807. Laterite could be cut into desired size just as a log can be cleaved and made into piece. In Malayalam, it was called vettukallu and ittikakallu, but, Buchanan called it laterite. Laterite in Greek, literally means brick. The rock is called Jambittige in other parts of the State. The use of laterite could be traced to Mahalingeshwara temple of 8th Century A.D. located on Shambhugadde near Udyavara. In Jain Basadis (temples) it is generally seen that either mud or laterite walls are erected between the pillars. Laterite is being used for construction of small granary, pond, well, diggings since a very long time. In rural areas, it is but a common practice that most of the materials were shifted as head loads, which is tiresome and the persons needed rests on their way. In order to relax for a brief period, there was a practice of fixing single laterite piece of about two metres length by the side of roads. They were called resting stones and could be seen even today in many parts of the district.

The origin of laterite has been scientifically explained. The country rocks – granite, gneiss and basalt - for instance, are subjected to the process of weathering. In due course silica, calcium and alkalies are leached out as solution while alumina, iron and a small amount of titanium are left out in the parent rock giving rise to laterite, a product of alteration. The formation of laterite is believed to be in the *Cenozoic era* (*Pleistocene epoch*) as postulated by geologists. The rock, more or less appears to be perforated and such structure is referred to as vesicular texture. The colour of laterite may vary from brownish red to blackish brown and yellow depending on the mineralogical constitution. There are laterite quarries at *Parkala* in Udupi taluk, *Mudurangadi* in Karkala taluk.

The peculiar nature of laterite is that it is soft when freshly cut, but becomes hard on exposure to air and could be used as stones. It has the bearing strength of 20 to 80 tons per sq.m and density being 2.5. But, it is not as hard as granite and gneiss. However, as time passes the rock becomes harder. Laterite finds use in many constructions; for instance, houses for lower income groups, village roads, tanks, platforms and wells, small bridges supporting material and for dig outs. Laterite is used along with soil, lime or cement as binding materials.

Granite: Though both granite and gneiss share common mineralogy, they differ in the mode of origin. While, granite represents a typical igneous rock, gneiss is a metamorphosed form of granite formed under specific temperature and pressure within the earth's crust. However, they exhibit similar physical features. Both are hard rocks and generally occur below the lateritic cover in Udupi district. These rocks are abundant around Karkala taluk and near Udyavara of Udupi. The surface generally appears dark since it is exposed to rains and sun. It is opined, that, the name Karkal is derived from Kariyakal which literally means black stone. However, if chipped, the inner part appears to be white in colour. Since granite is a hard rock and normally free from fractures, it is easy to cut into bigger slabs of desired size. It is to the credit of Ranjala Gopala Shenai of Karkala, who sculptured two imposing statues of *Bahubali* using granite. The statue of Gommateshwara at Venoor and Karkala are carved out of granite. The threshold pillar (garudagamba), the thousand pillar basadi of Jains at Mudabidri is yet another master piece sculpted in granite. Granite finds its use in a variety of structures which include enclosures of temples, *qarudaqamba*, buildings, bridges and even as foundation stone.

Basalt: Basalt represents a typical dark, hard rock of volcanic origin. Though it is found in some parts of Udupi district, it is almost in weathered condition giving rise to dark soil rich in magnesium and encourages the growth of coconut trees.

Acid Volcanics: St. Mary's Islands about three kilometre west of Malpe, expose spectacular columnar rocks as though chiselled by human hands and exhibit polygonal outline. This rock was earlier identified as basalt but now a detailed study has indicated that these are silicic volcanic and sub volcanic rocks of rhyolite and granophyric dacite composition, formed about 88 to 90 million years ago when greater India and Madagaskar got separated. These unique structures are preserved by Geological Survey of India as National Geological Monument and are one of the main tourist attractions of the coastal part of Karnataka.

Iron Ore: Leteritic iron ore generally contains about 45% of iron. If iron exceeds 50 - 55%, then it qualifies to be classified under iron ore. By and large, the gangue in the form of quartz and other impurities reduces the quality of the ore and such ores have little use for the extraction of metal. Laterite occurs on a large scale in the coastal part.

Bauxite: Bauxite is the chief ore of aluminium. Deposits of bauxite containing more than 45-50% Al_2O_3 are reported from *Muddalpare* and *Guppipare* and *Paduvalpare* of Baindur. Though the ore is rich in aluminium content, it has quartz as impurity. If this could be removed, the enriched ore can be used as ore for extraction of aluminium.

Fire Clay/Black Clay: Fire clay is pitch black in colour, but, on mixing with water, it turns into pale red colour. Quartz occurs as impurity in minor amount. Deposits of fire clay occur in many wet lands as well as in places with stagnated water. After necessary purification, fire clay is used in the manufacture of tiles, bricks and for pottery in cottage industry. Pale red clay when burnt turns into bright brown colour. Extensive deposits of fire clay are reported from Udupi and Kundapur taluk.

White Sand: The coastal part of the Udupi district has rich deposits of white sand in the shore. But, the deposits have plenty of salt content in them which disqualifies for use in the manufacture of cement. White, smooth sand resembling the grains of sugar is reported from *Tenkagrama*, *Badagrama*, *Udyavara*, *Bykampadi*, *Hejmadi*, *Kapu*, *Uliyaragoli* and *Mulur*. The deposits contain 96% Silica, rendering them suitable for the manufacture of transparent glass or bottles.

River Sand: West flowing rivers joining the sea, generally carry sand grains of bigger dimensions in their load. Since river sand is generally free from salt content, is preferred for mixing up with cement used for constructions. River sand is being quarried from the beds of *Mulki*, *Seetha*, *Gangolli* and other rivers and supplied to other parts of the district.

Shells: The shells of marine organism get accumulated in the beach after the death of the organisms. Chemically these shells are completely made up of calcium carbonate, which is generally burnt to recover lime. Lime is used for white washing the buildings and for *pan beeda*. It is also used in poultry farm and in the manufacture of insecticides. The foam associated with the shells is used for cleaning and polishing the glass.

FLORA (NATURAL VEGETATION)

People still recall the days when the entire State of Karnataka was full of greenery. Nobody denied the fact, that, the State is blessed with a variety of land which is fertile and the congenial climate prevailing here encourages natural vegetation, as though meant for the benefit of both man and animals; this has led to the overall development of the environment. But, the impression is short lived as there is a thorough change in the form of vegetation in recent years. No doubt, the green belt has survived but only here and there. It is disheartening to note that the mining has caused irreparable damage to the land. It is feared that it may reflect the sorrowful State to which we have stooped. In order not to encounter such eventualities it is necessary to enumerate what type of vegetation flourished earlier and its status today. It is not all that; equally important is the fact that we need to know the type of pressure the vegetation is facing and the method to overcome such onslaughts. It is needless to say that the vegetation cover of any area, to a greater extent, depends on the amount of rainfall the area receives. If we correlate the amount of rainfall with the type of soil and the altitude of the land from the sea level, it is fairly easy to imagine the type of vegetation that the land will be supporting. It is now very clear that the forest area is mainly limited to the Western Ghats and some hilly areas of the Deccan plateau. This can very well be understood by considering the type of land use or in other words land use pattern that is practiced in Karnataka. Forest area is very scarce in other parts and whatever little exists today is man made.

It is the scarp edge of the Western Ghats that faces the impact of southwest monsoon. It rains heavily since the moisture laden clouds strike against the ghats. The coastal Mangalore enjoys an average of 3,000 mm of rains annually. On approaching the ghat, the intensity of rains increases and the peaks enjoy the highest rainfall. About 7,000 mm of rainfall is recorded in Kudremukh, while Agumbe, because of peculiar alignment of mountain peaks, receives much higher rains, averaging 7,460 mm. annually. As monsoon approaches the ghats and advances towards east, there is a considerable decline in the amount of rainfall. It is obvious that Sakaleshpura which is located just 10 km from the peaks of Western Ghats receives an average of 2,210 mm of rains while Hassan about 32 km. east gets about 875 mm of rains. The change of climate of this part of Karnataka and its ecology has already been made known. The wide variation in the vegetation

can also be related to the undulating topography of the land which is 1800 m above the sea level. The type of forest in the Udupi district, Western Ghats of Dakshina kannada and the coastal parts are discussed here.

1. Tropical Evergreen Forest: The valleys and the slopes of Western Ghats offer the best example of the evergreen vegetation. Such covers are referred to as the Coastal Tropical Forest. Since the area enjoys heavy rainfall there is characteristic climax vegetation due to canopy coverage. There is no dearth of trees growing to a height of 30 m with wide spread canopy at the top, where they have interwoven with the neighbouring vegetation. These canopy, in fact acts as a barrier to both the windblown during June to December and the drizzle. But during rest of the season, the canopy is exposed to the sunlight and filters only a small part of it for the vegetation at the ground level. The different levels achieved by the vegetation are the result of specific humidity and the availability of desired amount of sunlight. The first one being the level of the vegetation which is dependent on the ground. The second level is defined by the trees which are comparatively at higher level. The last level is the one achieved by the cloud scrapers. Each level of trees, thus have obliged the theory of evolution and carrying successfully the process of photosynthesis as part of their biological activity in such environment. There is a great diversity even among canopy trees. The change in the species can well be noted as one proceeds from north to south and this change is brought about by the quality of the soil, relative altitude and slope has also played a significant role.

About 600 m above the sea level, one can encounter the oiliferous trees such as *Dipterocarpus –Kingiodendron –Vataria* and *Canarium strictum, Dipterocarpus – Mesuva – Palaquium.* There is a conspicuous change in the species at an altitude between 600m and 1200 m. Trees have lush growth at the lower levels as demonstrated by the species such as *Scleropyrum pentandrum, Syzygium laetum, Harpudliia arborea* etc. single seeded trees like *Caryota urens* and multi seeded trees like *Arenga wightii* are commonly encountered in addition to palm group of trees such *Pinanga dicksonil.* Yet, at other levels are to be seen the thorny shrubs; the forest also abounds in a variety of vegetation, creepers with their thick trunks twist around huge trees and spread over canopy to get the required sunlight. It is a common scene that the epiphytes have successfully survived on the trees without coming in contact with either the groundwater or soil below.

Orchids which are essentially epiphytes, have a special arrangement in their morphology to absorb moisture from the atmosphere and retain it for a longer period for their use. The flowers with attractive colours help in dispersal of seeds which are airborne and settle on some trees, where, with the help fungi are, able to get necessary nutrition for their development.

The microorganisms in deciduous forests – where the withered leaves and the dry sticks fall on the ground help in disintegration and decay of these materials, which ultimately, over years get accumulated and become the best manure available *insitu*. The soil of the Western Ghats, in fact, is not very thick. It appears that even the water seeping through the rock is poor in nutrition and as such manure formed due to the decay of withered leaves and the dry sticks is the main natural source for the growth of the forests. It also helps to retain the rain water. Rapid flow is effectively checked in such an environment and the water slowly gets into ground which serves as perennial flow in the form of streams throughout the year.

It is obvious that the vegetation cover in the Western Ghats has a strong hold on the web of life. The diverse *flora* here absorb sunlight effectively and successfully carryout photosynthesis – a complex process in which water and nutrients are absorbed through soil and the carbon dioxide through the air, to synthesise carbohydrates. The carbon dioxide which is detrimental to the animal world is absorbed by the plants, at the same time giving away oxygen to the atmosphere - the essence of life for living organisms.

It is true, that, the dense forests with characteristic levels are not free from danger. There will be a severe competition among minor trees to occupy the space, in case the canopy is damaged and in the process, the canopy may completely be covered up by this secondary vegetation. There is another situation too – in case the canopy is wide in area, instead of recovering from damage, the very levels may be disturbed. This evidently leads to other problems namely disappearance of wide variety of plants. When once canopy gets damaged, the consequences are serious. Firstly, the heavy rain falls with no obstruction from the canopy may increase the rate of soil erosion which ultimately cut into the layers of soil leading to the formation of gullies. It has effects on rocks also, as they get hardened. like the lateritic soil. Such a situation prevents water from seeping into the earth and instead finds entry into the forest which could

ultimately destroy the entire forest. The manure of withered leaves accumulated over years will be easily washed out. Flash floods resulting in abrupt rainfall will also bring enough silt from both the sides of the eroded river banks. It is a common scene in the deforested area, that, there is meagre scope for percolation of water which, obviously depletes the ground water reservoir and hence the disappearance of springs. Streams get dried up during summer. If there is no continuous flow of rivers, it may, even result in the encroachment of salt water into the coastal areas, thus, rendering the fresh water source unsuitable for use.

2. Humid Deciduous Forest in the upper reaches of Ghats: As one proceeds towards plain from *Malnad* area, the change in the vegetation with tall trees – the humid deciduous forests are encountered. Here, the canopy will be very dense when the trees are full of leaves. But, during winter the trees shed their leaves as a mechanism for conservation of moistures for a brief time. It is strange that they start flowering in the absence of leaves. Before it rains, and particularly during the period between March and April, when the trees sprouts, they start shedding the flowers followed by the appearance of young nut in the process of development. Such deciduous forests could be seen extending from Belgaum up to Kodagu on the south, where species of *Tectona Dillenia-Lagerstroemia-Terminala* are commonly encountered.

In the moisture laden deciduous forests, the withered leaves form a bed which is sufficiently thick and serves as a protective layer. In such environment, there are plenty of plants including epiphytes and their protection is assured during rainy season, while, they are exposed to hot sun during summer seasons. They start flowering between April and May, soon after the rainfall. There will be plenty of activities at the ground level of vegetation due to pre monsoon showers. The aromatic medicinal plants which are hidden in the ground start surfacing with multiple colours and diverse patterns of flowers.

All along the edge of the Western Ghats, the bamboo bushes were once spread over a wide area. Especially, *Bambusa arundinacea* and *Dendrocalamus strictus* were aplenty in the forest. Every cluster of bamboo sends the shoots (the new bamboo culms) when once the rainy season commences and growth is very rapid. Bamboo starts flowering once in 40 to 60 years and flowers wither away in Toto.

The bamboo seeds accumulated in the ground start germinating and the new generation comes to being. Bamboo, earlier could meet the demand of paper manufacturing industry, even after its full scale utility for artefacts by the tribal people. Of late, the industry is facing acute shortage of bamboo.

3. South Tropical Montane Forest: The South Tropical Montane Forests are essentially made up of scrubby green plants and green patches of short breeds of plants. Characteristically the evergreen tropical forests undergo visible change according to the altitude. The green plains primarily have innumerable minor medicinal plants which quickly complete their life cycles. The medicinal herbs and climbers are burnt every summer, only to sprout during April and May when it rains. The blades of grass, perennial as they are, will even decorate the burnt out hills with attractive greenery. The slopes full of grass start flowering as soon as the monsoon commences and gives an impression as though a colourful carpet is spread over the land. The floral assembly encompasses a wide variety of plants, including orchid gentian and violet flowers, insectivorous like bladder-wort and sundew flowers.

More or less, the dense forests with patchy appearance are often called *Shola* forests. Such *Sholas* are to be seen in the lower part of the mountains essentially along depressions and follow undulation of the terrain; as a result, there are considerable variations in their heights. Parasites like algae; lichens etc. get attached to these short breeds for their survivals. *Shola* forests are generally rich in species like *Gordonia-Schefflera-Meliosma*. The rain water infiltrated through the beds of withered leaves gets purified and finds entry into the stream rich with vegetation on either side of the banks. *Vernonia arboria* of composite family is yet another species abundant in the *Shola* forests of South India. This in brief is the general description of diverse vegetation of the Western Ghats.

There were times, when, forests were considered as means for easy money making and trees are nothing but timbers. It was only in recent time that we have realized that, forest plays a very important role in maintaining the ecological balance of web of life. Now, we know the importance of vegetation in purifying air, water and soil and their abundance. When once this fact was realized, the phrase 'Forest for Commerce', was replaced with the popular myth 'Forest for Conservation'. Slowly, but gradually the role played by the Western Ghats has been made known, especially, in the context of conservation of ecology.

Coastal Vegetation: It looks as though the vegetation in the coastal area evolved in a different environment than the one in the interior land. This could be classified under three groups: 1. Sand dune vegetation 2. Mangrove and 3. Sea algae or sea weeds. Of this, the sea algae is always found submerged in the water, while, the mangroves are partially submerged and their growth is influenced by the tides. The sand dune vegetation is generally found on the sand dune located in a fairly higher altitude so that they are not affected by high tides.

Sand Dune Vegetation: This type of vegetation is linear, narrow and crescent shaped occurring as isolated patches (mainly between the borders of low and high tide marks). Sand dune vegetation is characterized by bands or dunes of sand, sand with heap or of linear depression in undisturbed coastal part or continental shelf having no tides or littoral zones or areas where laterite is in contact with the sea. Sand dunes are formed when wind blows and picks up and transport sand particles from intermediate as well as narrow zones.

There are three types of sand dunes namely; Frontal dunes, Inter dunes and Rear dunes. Of these Frontal dunes have to face high velocity winds and are characterized by spinifex grass, creepers and marshy vegetation. Inter dunes encourage vegetation which can grow to a considerable height and deep rooted shrubs. The rare dunes are characterized by the presence of trees. Since, assorted vegetation give rise to natural slopes, obviously, it acts as a barrier against the wind and thus reducing erosion of dunes to a considerable extent. In the frontal dunes are to be seen the vegetation consisting of *Ipomoea pes* - caprae, Asparaqus dumosus, Spinifex littoreus, Leucas Aspera and Eclipta Alda. In some parts, either Ipomoea pes – capra or Spinifex littoreus have thick growth. In the rear dunes, species like Vitex negundo, Pandanus Sp, Duranta repens, Anacardium Occidentale, Cocos nucifera etc. are found generally. Large scale plantation of Casuarina equisetifolia has been taken up on these dunes in some coastal areas. Plants growing on the dunes have matted hair like roots which can hold the plants firmly on the dunes, while, the trunk and the branches successfully acts as barriers for the migration of sand. In other words, roots of these plants not only take part in the biological process but also provide the necessary mechanical support. When once the growth of vegetation on the dune is encouraged, it helps in preventing further advance of sand grains, thus reducing the degree of erosion. It is strange that it is the same plants which successfully adapt to the semi-arid region where there is dearth of water.

It is true that if there is heavy down pour, soil erosion is imminent which could be dangerous for the very survival of plants. Wind plays a vital role in the formation and movement of dunes. If the wind is strong, the barren dunes may be destroyed as well. One could see the erosion of dunes in many parts of coastal area. One of the reasons for erosion is believed to be sand quarrying in the restricted areas. Over quarrying and cutting the vegetation is believed to contribute for further erosion of dunes. In order to conserve the vegetation and the dunes associated with it, it is necessary that stringent rules are to be framed and implemented which alone can save such eco system.

Mangrove: Mangrove includes plants, trees, creepers that grow all along the tidal zone of tropical coastal areas. Mangrove grows along the margins of estuaries or in shallow lagoons which are separated from the sea by low lying dunes. The coral reefs also encourage the growth of mangrove in water circumscribing the reef. The Mangrove wet lands are home for a variety of biota in the coastal part of tropical areas which have higher proportion of life supporting system. Sandy soil is the main source for the food chain. Mangroves adapt themselves to this environment by changing the morphological characters in accordance with the changing tides. Mangrove are able to exploit their habitat (inter tidal zone) by developing physiological adaptations to overcome the problem of anoxia, high salinity and frequent tidal inundation. Modification includes developing aerobic roots to thrive in the environment lacking oxygen, supporting roots and mother roots for firmly fixing to the bottom and for absorbing nutrients. Another important modification is the development of nodules, when still intact with the plants, which, on attaining a particular stage will detach themselves and fall on the grounds and start sprouting *insitu*. Mangroves have a major role in stabilizing the coast acting as walls and preventing the land from coastal erosion. The web formed by supporting roots, the branching roots and the mother roots not only strengthen the plant but help in preventing the loss of fine soil beneath, from being removed by water currents. Mangroves also help in connecting rich nutrient soil of the estuaries. More importantly, mangrove as a part of biosphere supports habitat of a variety of fishes which have commercial value. The roots, barks and other intricate space provided by the mangroves are the breeding places for many marine animals, which successfully exploit the available mud, waste material and the nutrients available. In mangrove eco system the plants that flourish are the main productive resources, of which only

a small part is available for herbivorous animals. The rest becomes deciduous and get accumulated in the bottom. The accumulated biomass get decayed which becomes the main resource to the microorganisms. This in turn acts as a source of food for bivalve Mollusca, which either float in water or dwell in the bottom. The water dwelling creatures normally rush to the place where food and shelter is assured. Fishery and collection of prawn is an important activity wherever mangrove flourishes. These two are directly related to each other and hence shows the importance of mangroves from the point of fisheries. Since mangrove forests have higher productivity and the means of transportation is fairly easy, they happen to be ideal places for developing aquaculture.

In Udupi district, mangroves are flourished in the ponds of back water, islands and other protected areas. Luxuriant growths of mangroves are seen in the outer rim of the water bodies, specially, in the intertidal zones. Whether mangroves are thick or scarce depend on the area of inter tidal zones, nature of tides, soil and the salinity of water. Again, salinity and the substrata underneath decide the density of the mangroves.

Estuary and River Systems

1.Mulki and Pavanje Estuary System: The mangrove occurring on either side of the river is greatly damaged since there is heavy cutting for fuel wood. However, thick mangrove has managed to survive on the banks of Pavanje river near Kolunayalu. The important species found are Rhizophara mucronata, Avicennia alba, Excoecaria agallocha, Avicennia officinalis, Bruquiera gymnorrhiza, Sonnerata caseoloris and Aegiceras corriculatum. The low lying land mass is surrounded by Acanthus ilicifolius giving an impression of an island. These get submerged when there are high tides and are unravelled by low tides. Avicennia Alba being the important species near Chitrapu reaches up to a height of six meters. While, banks are proliferated by Acanthus *Ilicifolius. Rhizophara mucronata* is the main species found in Sasihitlu, Haleyangadi and Pavanje areas. Mangroves suffer heavily due to uncontrolled clearance for fuel wood. In such areas a fern like Acrostichum aureum becomes the second important species growing in salty water.

2. Udyavara River: Mangroves have flourished on the banks of Udyavara, particularly at *Katapadi*, *Yenagadde*, *Udyavara*, *Jarakodaru*, *Mattu*, *Pitrodi*, *Kadekar* and *Kidiyur* areas. The important species found

here are *Rhizophora mucronata*, *Avicennia officinalis*, *Excoecaria agallocha*, *Avicennia alba*, *Bruguiera gymnorrhiza*, *Kandelia Candes*, *Asegiceras corniculatum*, *Sonneratia alba*, *Acanthus ilicifolius* and *Clerodendrum ineme*. *Acanthus ilicifolia* has proliferated along the river line and surrounding the small islands. Banks of Udyavara river near *Mattu* is suitable for regeneration of mangrove. Here one could see maximum growth of mangrove to a height of 5.5 m. The important species found here are *Rhizophora mucronata*, *Kandelia Candal*, *Aegieenas corniculatum*, *Bruguiera gymnorrhiza*, *Avicennia alba*. The rare species like *Excoecaria agallocha* near *Pitrodi* have attained a height of seven metres and is considered as an ideal place for regeneration of mangrove.

3. Swarna, Seetha and Khodi Estuary System: Today, the rare mangrove coverage along the banks of Swarna is facing severe problems due to the construction of permanent embankment, establishment of many jute factories and unabated cutting of trees. The mangrove coverage is very scarce along the banks of Seetha river. Important species found around Bokkapatna and Haradi are Rhizophora mucranata, Avicennia alba, Aegiceras corniculatum and Sonneratia alba and the species from Hangarakatte, Irodi, Parampalli and Kotatattu on the banks of Kodihole are Rhizophora mucranata, Avicennia alba, Sonneratia caseolaris, Aegiceras corridulatum and rare species include Avicennia officinalis, Bruquiera cylindrical. Species like Acanthus ilicifolius are found on the banks of estuaries or small islands and can thrive well provided proper measures are taken for their conservation. Mangroves are flourishing well in lagoons and around coral reefs, where diversity of mangrove coverage could be noticed. At many places, mangroves are cleared from the edges of the estuaries for cultivation.

4. Chakra, Haladi and Kollur Estuary System: Before Chakra, Kollur and Haladi rivers join the sea, there is a dense vegetation Of mangroves near Kundapur. The estuary system spreading over 30,000 sq. km. has encouraged mangrove forest. The important species found here are *Rhizophora conjugate* and *Acanthus ilicifolius*. The measurements have shown that in the intertidal zone about 20 cm. thick mud and in the lowest strata of the low tidal zone about 20 cm. thick mud is deposited. The main constituents of the mud are made up of deciduous leaves and barks of *Rhizophora* and *Avicennia*. The farmers near the coast use this mud as manure for their land. No big mangrove cover of *Rhizophora mucronata* are seen in the estuary margin of Sira and Koppala. But, the eco system of Kodi has supported

Rhizophora mucronata, which grows parallel to the banks. Here, trees growing up to a height of 10 m. have been reported. Dense mangrove cover is observed for about 20 to 25 m. distance from the river banks. Near Hoderahobli, Koni and Angali, which enjoy the back water environment species like *Acanthus ilidifolius, Rhizophora mucronata, Kandelia candel* and *avicennia alba* have been reported. Species like *Lumintzera racemosa* are found in the small islands of the river. There are plenty of *Lumintzera racemosa* in a small island called Kamastara kaduru. Mangroves have been cleared in many places for firewood. Species like *Rhizophora mucronata* are grown for protecting the inland areas.

5. Baindur River: Dense mangrove forests have flourished near Paduvari which is well within the Baindur river environment. The important species recorded here are *Rhizophora mucranata and Sonneratia caseolaris, Bruguiera gymnorrhiza, Rhizophora mucronata, Aegikceras orriculatium, Excoecaria agallocha* and *Avicennia alba* are represented on a small scale. On the margin of the river bank *Acanthus ilicifolius* shows profuse development. Similarly, dense growth of Rhizophora mucronata is found near Uppunda.

6. Shirur River: The ecology around Shirur river has encouraged species like *Rhizophora mucronata, Bruguiera gymnorrhiza, Sonneratia alba* and *Avicennia alba*. Of the rare species of the mangroves, the important ones are *Luminitzera racemosa, Ceriops decandra, Bruguiera cylindrica* and *Avicennia marina*. On the margin of the river bank *Acanthus ilicifolius* is found on a large scale. Intense fishery has destroyed the mangrove cover to a great extent. Mangrove has a variety of use – as food, fodder, timber, firewood and for the manufacture of the paper, pulp, tannin as well as alcohol. Species such as *Rhizophora mucranata, Bruguiera gymnorrhiza* are considered to be suited for the construction of boats, since the timber from these species are believed to have long life. The barks of the species *Bruguiera, Rhezophora* and Sonneratia have commercial use and these fall prey when other kinds of fuel wood are not available. Almost all the mangrove vegetation is used for the manufacture of charcoal, paper and pulp.

Marine algae: Marine algae generally thrive attaching themselves with the rock beneath tidal zone or on the lower part of the water. These algae are considered to be highly productive and have a vital role to play in the marine eco system. They find a variety of use which include food, fodder, manure, chemical used in medicine.

Marine algae are classified under four heads viz., Chlorophyta, Fayophyta, Rhodophyta and Microphyta.

In all, 18 species of marine algae have been reported from Malpe and adjoining islands of Udupi district. Marine algae which are common along the coast include *Enteromorpha*. Ulva, Padina, Dictyoota, Sorgassum, Gracilaria and gratiloupia. The species that found in Malpe and adjoining islands are 1.Enteromorpha felxuosa, 2) Ulva fasciata, 3) Chaetamorpha media, 4) Bryopsis plumose 5) Caulerpa pettata, 6) Caulerpa sertulariodes, 7)Dictyota bartayrasiana 8)Padina tetrastromatica, 9) Steoechospermus marginatuam 10) Colpomimia siruosa and 11) Sargassum tenerrimum. Marine algae are known for their rapid photosynthesis and are efficient agents for the removal of decayed organic matter in the coastal part.

The organic remains of these algae, particularly in back water areas have served as food and shelter for many marine organism and many of these prefer to lay eggs and care their juveniles with algal mat as shelters in the deeper parts. Algae are the only source of the chemicals which include agar, alginates, carogen and mannitols and many halogenated compounds. Though these algae are aplenty in the coastal part, are not exploited for commercial use on a large scale.

Important Timber Trees: In the earlier times excepting timber trees like *tectona grandis, delbergia latifolia, pterocarpus marsupium*, other trees were used as fuel wood. Similarly bamboo was extensively used for the manufacture of paper, and for plantation no other trees were preferred other than *tectona grandis*. And today, the concept has radically changed. In addition to *tectona grandis*, there are a number of other trees which are being used in plantation. With the plantation work in waste land and social forestry, there is rejuvenation of rural and district forestry. The earlier practice of clearing the forest, to give way to the social forestry has been dispensed with and instead, gap planting of some useful species is being adapted and has contributed in large measures to the development of forests.

Timber trees are to be found in both evergreen and deciduous forests of the district. Of these *Elaeocarpus tuberculatus*, *Poeciloneuron indicum*, *Hopea parviflora*, *Calophylum polyanthum*, *artocarpus*, grow on the slopes of the Western Ghats. The important timber trees of the district are listed.

S1.No.	Scientific Name of the Plant	Local Name	Family
1.	Acacia chundra	Baddejali, Kempujali	Fabaceae
	(Roxb ex Rottler) Willd.		
2.	Acacia sinuata	Seege	Fabaceae
	(Lour.)Merr.		
З.	Hadina cordifolia	Heddi, Yathyaga	Rubiaceae
	(Roxb). Ridsd	Haladhu	
		Arishinathega	
4.	Aegle marmelos	Bilwapathre	Rutaceae
	(L.) Correa		
5.	Ailanthus tryphysa	Gagguladhupa	Simaroubaceae
	(Dennst.) Alston		
6.	Alangium salvifolium	Anasorali, Ankole	Alangiaceae
	(L.f.) Wangerin	Nikochaka	
7.	Albizzia lebbeck	Bage, Hombage, Shirish	Fabaceae
	(L.) Benth.		
8.	Albizzia odoratissima	Bilwara, Bettasujjalu	Fabaceae
	(L.f.) Bentgh		
9.	Anacardium	Geru poppu, Godambi,	Anacardiaceae
	occidentale L.	Kaju, Jidi	
10.	Arenga wightii	Dadasal	Arecaceae
	Giriffith		
11.	Artocarpus	Hebbalasu, Kabbalasu,	Moraceae
	hirsutus Lam	Hessva, Kanduhalasu	
12.	Artocarpus	Halasu, Fanasa	Moraceae
	heterophyllus Lam		
13.	Artocarpus gomezia-	Vantimara, Vatemara	Moraceae
	nus Wall ex Trecul.		
	Spp zeylanicus Jarreth		
14.	Azadirachta indica	Bevu, Ollebevu	Meliaceae
	A Juss		
15.	Bambusa	Hebbidiru, Dowga,	Poaceae
	arundinacea	Mallubidiru, Andebidiru	
	(Retz.) Roxb		
16.	Madhuca longifolia	Mahuva, Madhuka,	
	(L) Maebride var	Kaduhippie, Hippe	Sapotaceae
	latifolia (Roxb.) chev		

Table 1.4: Details of Timber Plants - Udupi District

S1.No.	Scientific Name of the Plant	Local Name	Family
17.	Bauhinia malabarica	Basavanapada, Mandara	Fabaceae
	Roxb	Huliachalu	
18.	Bischofia javanica	Neeli, Neerulli,	Euphorbiace
	Bl.	Gobbaranerale	
19.	Bombax ceiba L.		Booruga
	Bombacaceae		
20.	Bridelia retusa	Gurige, Gowrige, Asana	Euphorbiaceae
	(L.) Spreng.	Gowje, Bikumbe	
21.	Buchanania	Murkali, Maradi, Morave	Anacardiaceae
	lanzan Spreng	Charoli, Bhanushchata	
22.	Butea monosperma	Muthuga or Palasha	Fabaceae
	(Lam.) Taub		
23.	Calophyllum Polyanthum	Shrihonne, Holenonne	Clusiaceae
	Wall ex. Choisy. Puna	Koove, Bobbi	
24.	Calophyllum	Holehonne	Clusiaceae
	apetalum Willd		
25.	Caloptropis	Yekkemara	Asclepiadaceae
	gigantea (L.) R.Br.		_
26.	Canarium	Kaayidhoopa, Karidoopa	Burseraceae
	strictum Roxb	Raladoopa	
27.	Canthium	Kare, Gandukakorla	Rubiaceae
	parviflorum Lam		
28.	Carallia brachiata	Andinar or Andipunar	Rhizophoraceae
	(Lour.)Merr	_	
29	Careya arborea	Daddal, Kaval, Kavalu	Lecythidaceae
	Roxb	Gopwjalu mara	-
30	Caryota urens L.	Bainemara, Paine,	Arecaceae
	-	Bagani	
31	Cassia fistula L.	Kakke, Bava	Fabaceae
		Swarnapushpa	
32	Casuarina	Saruvemara, Casuarina	Casuarinaceae
	equisetifolia L.	Galimara, Saruve	
33	Toona ciliata	Gandhagarige, Noge	Meliaceae
	Roemer	Nandhuri, Nandivruksha	
		Toonmara	
34	Celtis tetrandra Roxb.	Karki	Ulmaceae
35	Chloroxylon	Kaligarige, Dalmara	Rutaceae
	swietenia DC.	Gavuda, Madhaqiribevu	

S1.No.	Scientific Name of the Plant	Local Name	Family
36	Chukrasia tabularis A Juss	Kallugarike	Meliaceae
37	Cinnamomum	Dalchinni,	
	verum J.S. Presl.	Lavangapathre	Lauraceae
38	Cordia myxa	Challe, Solle, Bhotte	Boraginaceae
	wight	Chadlu, Mannadake	
		Kendal	
39	Dalbergia	Beete, Karevyadi	Fabaceae
	<i>latifolia</i> Roxb.	Ibadi, Thodeghatta	
40	Delonix regia	Kathikayimara,	Fabaceae
	(Boj.ex Hook.) Raj	Goldmohar, Gulmohar	
41	Dendrocalamus	Bandubidru, Kirubidiru	Poaceae
	strictus (Roxb.) Nees	Medhari, seebu	
42	Dillenia pentagyna		
	Roxb	Machuka	Apocyanaceae
43	Dillenia pentagyna	Kadu Kanigalu	Dillenaiaceae
	Madathega, Karambala	Kolthega	
44	Diospyros malabarica	Holethumra, Hrotutta	Ebenaceae
	(Jusr) Kastel	Thinduka	
45	Diospyros montana Roxb	Jagalaganti, Bilkunika	Ebenaceae
		Kalnandi	
46	Dipterocarpus	Kalpain, Challane	Depterocar
	indicus Bedd	Dhooma	paceae
47	Elaeocarpus	Analthari	Elaeocarpaceae
	oblongus Wight & Arn.		
48	Elaeocarpus	Sattagadhamara	Tiliaceae
	tuberculatus	Kungemara	
	Roxb	Rudrakshimara	
		Dhandlamara	
49	Phyllanthus	Nelli, Bettanelli	Euphorbiaceae
	emblica L.,	Amla, Analaka	
50	Erinocarpus	Chera, Chowra	Tiliaceae
	nimmonii	Bharangi,	
	Graham	Adavibendi	
51	Erythrina	Aluvana	Fabaceae
	variegata L		
52	Syzygium cumini	Nerale	Myrtaceae
	L Speels	Jambunerale	
	1		

S1.No.	Scientific Name of the Plant	Local Name	Family
53	Zanthophyllum		Rutaceae
	retusa (Roxb.) DC		
54	Ficus	Ala, Vada	Moracerae
	benghalensis L.	Vatavruksha	
55	Ficus racemosa L	Atti, Gulara, Rumadi,	Moraceae
		Oudhumbara	
56	Ficus virens Aiton	Basari	Moraceae
57	Ficus religiosa L	Arali, Ashwatha	Moraceae
58	Garcinia indica	Mugal, Murugal,	
	(Thouars) Choisy	Kokammara, Bheerunda	Clusiaceae
59	Garuga pinnata	Goddanamara	Burseraceae
	Roxb.	Holabalige, Bolamate	
60	Grewia tiliifolia	Thadsal, Dhaman,	Tiliaceae
	vahl	Kendalasu, Thadasalu	
61	Hardwickia binata Roxb	Yennemara, Penai	Fabaceae
		Chowpaini	
62	Helicteres isora L.	Kowri, Yadamuri	Sterculiaceae
	Kavargi, Murugikayi		
63	Hemidesmus	Halberu, Sogadeberu	Asclepiadaceae
	indicus(L) R. Br.	Sugandaberu, Nama-	
		daberu Mannariberu	
64	Hibiscus	Pudike	Malvaceae
	cannabinus L.		
65	Halarrhena	Hirekodsa	Apocynaceae
	<i>pubescen</i> s (Buch.Ham.		
	Wall ex GDon	Maddarasa	
66	Holigarna	Chara	Anacardiaceae
	<i>arnottiana</i> Hook. F		
67	Holigarna	Bettaholegara,	Anacardiaceae
	<i>beddomei</i> Hook. F	Doddeleholegara	
68	Hopea	Kiralbhogi, Karmara	Dipterocar
	parviflora Bedd	Kallane, Kodachaga	paceae
		Kodamuruka	
69	Hopea ponga	Haiga, Doddekebogi	Dipterocar
	(Dennst.)Mabberly		paceae
70	Hydnocarpus	Sooratii	Flacourtiaceae
	alpina Wight		

S1.No.	Scientific Name of the Plant	Local Name	Family
71	<i>Ixora pavetta</i> Andr.	Goruvi, Kansara, Heddarani, Kansuragi Gorije	Rubiaceae
72	Jasminum arborescens Roxb	Mallige	Oleaceae
73	<i>Garcinia xanthochymus</i> Hook, gex T And	Jarigemara	
74	<i>Kydia calycina</i> Roxb	Bende, Bellaka, Belagu	Malvaceae
75	Lagerstroemia speciosa (L.) Pers	Holenandi	Lythraceae
76	Litsea wightiana (Nus) Hook.J.	Massi or Mashe	Lauraceae
77	Lagerstroemia microcarpa Wight	Nandi, Beimatti Bolandaru, Nans	Lythraceae
78	Lophopetalum wightianum Arn.	Balipale	Celastraceae
79	<i>Macaranga peltata</i> (Roxb.) MuellArg	Uppalige, Kanchupranthi Chandrakala, Batla- chandrike	Euphorbiaceae
80	Persea macrantha (Nees)	<i>Gulumavu, Chittundi</i> Chandrahittu, Katerm	Lauraceae
81	<i>Mallotus philippinensis</i> (Lam.) Muell-Arg	Kumkumadamara, Kapilarangu Hulibendu Urabatti	Euphorbiaceae
82	Mangifera indica L	Mavu	Anacardiaceae
83	Melia dubia Cav	Kadubevu, Bettadabevu Hebbevu	Meliacea
84	Memecylon edule Roxb.	Nemar	Meliaceae
85	Mesua ferrea L.	Nagasampige Nagakesari	Clusiaceae
86	Mimusops elengi L	Ranja, Pagademara Kesara, Malasuri, Yalangi	Sapotaceae
87	Knema attenuata	<i>Ramapathri</i> Hook.J & Thoms) Warb	Myristicaceae
88	<i>Myristica fatua</i> Houtt	Ramapathre	Myristicaceae

S1.No.	Scientific Name of the Plant	Local Name	Family
89	Myristica malabarica	Ramapathre	Myristicaceae
90	Dimocarpus longana Lour	Chakote	
91	Ochlandra travancorica	Vate	Gramineae
	Benth. Ex. Gamble		
92	Lannea	Godda, Udimara.	Anacardiaceae
	coromandelica (Houth)	Oodimara,	
		Simtimara, Gogal	
		Hemmugodda	
93	Olea dioica	Madle, Hekkarakalu	Oleaceae
94	Palaquium	Pali, Hadasale,	Sapotaceae
	ellipticum (Dalz)	Panchotimara,	
	Baill	Hadasaale ,Halusalle	
95	Pongamia pinnata	Honge, Karanja,	Fabaceae
	(L.) Pierre	Huligili	
96	Pterocarpus	Honne,	Fabaceae
	marsupium	Hane	
	Roxb.	Bijasal	
97	Rauwolfia	Chandrike, Nanjaregida	Apocynaceae
	serpentina	Sarpakshi,	
	(L.) Benth/ ex Kurz	Sarpagandha	
98	Rhizophora	Kandla	Rhizophoraceae
	mucronata	Kandala	
	Poir		
99	Bombax ceiba L	Bhuruga	
		Kempuburuga	Bombacaceae
100	Santalum album L	Shrighandha	Santalaceae
101	Sapindus emarginatus	Antuvala, Norekayi	Sapindaceae
	vahl	Kugatemara	
102	Schleichera oleosa (Lour)	Kendala, Kusum	Sapindaceae
		Sagade, Kusambi	
103	Soymida febrifuga (Roxb)	Somemara, Swamimara	Meliaceae
	A Juss	Kemmara, Navilumettu	
		Rohini	
104	Spondias pinnata (L.f) Kurr	Amate, Pundi	Anacardiaceae
105	Mitragyna paraviflora	Kadivala, Kadagadha	Rubiaceae
	(Roxb.) Korth	Kapari, Kongu	
106	Sterculia guttata	Hulitharadu	Sterculiaceae
	Roxb		

S1.No.	Scientific Name of the Plant	Local Name	Family
107	Stereospermum suaveolens	Billmara, Belipadri	Bignoniaceae
	(Roxb). DC	Uppalave, Billa	
108	Strychnos nux-vomica L	Kasaraka, Nanjinakoradu	Loganniaceae
		Katharike	
109	Swietenia	Mahagani	Meliaceae
	mahagoni (L.) Jack		
110	Symplocos laurina	Changa, Chunga	Symplocaceae
	(Retz.)Wall	Lodhra	
111	Syzygium cumini	Kadunerale	Myrtaceae
	(L.) Speels		
112	Syzegium gardneri	Bilichiravu	Myrtaceae
	ThW		
113	Tectona grandis L.f.	Saguvani, Tega	Verbenaceae
114	Terminalia arjuna	Holemathi, Belimatti	Combertaceae
	(Roxb.ex.DC)		
	Wight & Aru	Thorematti	
115	Terminalia bellirica	Shanthimara	Combertaceae
	(Gaertn) Roxb	Gotingadamara Thare	
116	Terminalia alata	Matti	Combertaceae
	Heyne ex Roth		
117	Tetrameles nudiflora R Br	Cheeni	Datiscaceae
118	Thespesia	Bugarimara	Malvaceae
	populnea (L.)	Hoovarasi	
	Sol. ex Corr	Johiherale, Kandarola	
119	Vepris bilocularis	Doddatoppe	Rutaceae
	(Wight & Aru) Engl.		
120	Trewia	Kadugunbala	Euphorbiaceae
	nudiflora L.	Katakamba, Hilaga	
121	Vitex altissima L.f	Myrole or Thornukki	Verbemaceae
122	Vitex negundo L.	Nekki, Lakkigida, Lakkili	Verbenaceae
123	Xylia xylocarpa	Jambe	Fabaceae
	(Roxb.) Taub		
124	Ziziphus oenoplia	Soorimullu	Rhamnaceae
	(L.) Mill		

Sacred Groves

Our ancients, with great devotion worshipped, in the name of God and Goddesses, small forests called Sacred groves. Such forest patches which were conserved traditionally are now considered as the biodiversity hot spots. The concept of sacred groves in our cultural tradition incorporates in that the forests and the plants and animals therein symbolize the God and needs to be conserved. Our ancient people equated many plants and animals with god and hence they are sacred to us. Trees like Peepal. Banyan and Ficus are termed as key stone species in the biodiversity jargon. It is justified too, since such species provide food and shelter to many birds and animals throughout the year. The tigers today represent the flagship species. Tigers and Panthers live mainly and deer, antelope, wild sheep and hence play an important role in keeping the ecology in balance. Under Project Tiger, the herbivorous preys such as deer, antelope, gaur and their habitat is being protected along with tigers. In our cultural tradition along with other mammals animals like monkey, hanuman langooor, macaque are considered as sacred animals and every god or goddess is assigned an animal or a bird as vehicle. It is interesting to note that in *Tulunadu*, the tradition of snake worship, and spirit worship are closely associated with the conservation of ecology. It is sad that the emotional stigma attached to sacred groves by our ancient is fast disappearing and is replaced by greed for commercial benefits. In the scientific era, when culture, spirituality, religion, society, faith and devotion are loosing their sanctity. The faith on nagarakallu (erecting stone carved with the image of snake) need not be used as a weapon for exploitation. As the desire of people towards astrology is gaining more importance, serpents seems to play a villain. It is poignant that more than the living snakes, the unseen and hidden snakes are troublesome - which is believed to pass on from one generation to the other. Naming streets and creating enclosures in honour of naga has pushed the society to backwards. Losing money, health and peace is yet another impediment for the progress of the society. 'Devotional and redressel programmes to get rid of the so called curse have led to business.' - observes Dr. Amrutha Someshwara, a renowned folklore expert and this is a warning, no doubt.

There was a renovation programme of *nagabrahmasthana* at Miyar village of Karkala taluk on 12th December, 2004. Here is an excerpt: The legend is related to the sanctity of the place. It appears that in the distant past the *nagabrahmasthana* was full of aromatic plants and

creepers of medicinal value. One of the branches of river Swarna circumscribes flowing in clockwise direction and in the centre was established the figurate of naga. Nagabrahmasthana was once flourished with huge trees symbolizing god. But, as the days changed the greedy people started cutting the trees which invited curse from naga - the legend goes. Today, people relate this legend to the wild fire, health hazards, poor crops, epilepsy and so on. The efforts made by the environmentalist and priests have resulted in regeneration of the forest and nagabrahmasthana. Now, that people have learnt from the past experience that it is necessary to renovate the place and hunting should be strictly prohibited and no axe should fall on any vegetation. Indeed such impositions in the name of god helped in conserving the ecology of the sacred groves. Interestingly such conclusions are drawn in the sessions where the devotees, with fear ask some questions called astamangala prashna which are answered by god indirectly. Whatever may be the faith, the fact remains that it is perhaps one of the best strategies to help conservation.

Diversity of Sacred Groves

Udupi district which got separated from the Dakshina Kannada district in 1997, is still a part of Dakshina Kannada both culturally and emotionally. This is supported by the fact that here too there is a practice of snake worship, spirit worship, annual fair and celebrations, *talamaddale, yakshagana bayalata, kambala,* cock fights, which are very much alive as folk art similar to the one in Dakshina Kannada. There are thousands of *nagarakallu* and sacred groves in addition to some pristine cultural practices, as reflected in the concept of *Kadyanamane*. But some of the *nagabanas* have been converted into concrete forests, while, sacred groves are still intact in few places. Western Ghats within the jurisdictions of Udupi taluk boasts sanctuaries like Kolluru *Mookambika* and *Someshwara* and a part of Kudremukh National park. The forests of Udupi district have supported tiger, panther, gaur, deer and endangered species like lion tailed dark macaque. The mangroves have flourished in the estuaries.

The district has an area of 3,880 sq.km with a population numbering 11,12,243. Of the six selected villages, in all 482 sacred groves have been recorded whose area is 23.32 acres. Of this, 12.44 acres have been devoted to *nagarabana* numbering 254 and 10.88 acres have been devoted to *bhoothastana* numbering 228.

FAUNA

The wild life of Udupi district is both abundant and varied. It is the home of a variety of *fauna* which are both small and big, including vertebrates. It is apparent that the *fauna* and more particularly the percentage of larger mammals essentially reflect the abundance of flora in the area. It is no strange that animals depend on vegetation as food chain and where there is great diversity of flora, one can expect the diversity of animals too. Tree dwelling animals like monkeys generally abound in ever green forests, if the availability of food is taken as one of the criteria. Similarly, the deciduous forests have proved more functional for herbivorous giant mammals like bison, elephants and deers etc. Out of six forest types which have supported wild life in Karnataka, two are to be found in the coastal part and mountain ranges bordering the district.

The evergreen forests are no doubt, very dense except at some places where some indent has been made due to the persistent human activity. Such areas generally are covered by withered leaves and as could be expected, the growth of grass is very limited in such cases. This ecological set up has encouraged the tree dwelling monkeys and minor mammals like squirrels, instead of grazing ungulates and elephants. Animals like black bear, wild boar, which show duality in their food habits could be seen in the area. These animals can survive with limited food. Since vegetation like bamboo and plants with leaf at the lowers reach are generally scarce, these forests are not suited for herbivorous animals. On the other hand, there is abundant moisture and ecological support system that has encouraged insects, amphibians, and reptiles to thrive well in these areas. Rarely does it happen that when forests with profuse canopy trees are invaded by alien plant that turn out to be a good grazing ground for animals. The deciduous forests and their environment are highly suited for mammals. Though, the evergreen forests and deciduous forests suffer heavily, nevertheless, they encourage grass and bushes which in turn support large sized wild animals. The unlimited disintegration of forests has encouraged the rapid growth of weeds like *lantana* and *eupatorium* which have suppressed the growth of the local species. It may look beneficial, apparently that some animals live on wild fruits and flowers (berries). But, in the long run, it turns out to be futile due to other harmful effects that the destruction brings. The lush forests in the coastal parts were once the home for a variety of wild life. Sadly, today they no longer have

the same environment to support these creatures. Heavy cutting of trees and disintegration of forests have proved detrimental to the wild life. The sea dwelling animals of coastal area include whales, sea turtles and sea snakes, balaeloptera, a-genus of whales live in the sea and sea cows, dugong are found in Bays and lagoons in the coastal areas. Endangered and would be extinct animals of the district are listed here.

Species	Туре	Zone			
Avicennia officinalis	Mangove	Coastal saline			
Avicennia marina	Mangrove	Coastal saline			
Kandelia kandel	Mangrove	Coastal saline			
Rhizophora mucronata	Mangrove	Coastal saline			
Sonneratia alba	Mangrove	Coastal saline			
Aegiceras corniculatum	Mangrove	Upstream			
Excoecaria agallocha	Mangrove	Upstream			
Rhizophora conjugata	Mangrove	Upstream			
Sonneratia caseolaris	Mangrove	Upstream			
Salvadora persica	Salvadora persica Shrub				
Ierodendrm inerme	irm inerme Shrub U _I				
Acanthus ilicifolius	Shrub	Upstream			
Entreromorpha intestinalis	Alga	Backwaters			
Cheatomaorpha lineum	Alga	Backwaters			
Gracilaia verrucosa	Alga	Backwater			
Ipomoea perscaprae	Shrub	Coastal dune			
Asparagus dumosus	Shrub	Coastal dune			
Spenifex littoreus	Shrub	Coastal dune			
Cyperus aristatus	Shrub	Coastal dune			
Sporoborus tremulus	Shrub	Coastal dune			
Leucas aspera	Shrub	Coastal dune			
Thespsia populnea	Tree	Coastal dune			
Casuarina equisetifolia	Tree	Coastal dune			
Vitex negundo	shrub	Back shore			
Pandanus Sp.	Shrub	Back shore			
Durana repens	Shrub	Back shore			
Anacardium occidentale	Tree	Back shore			
Cocos nucifera	Tree	Back shore			

Table 1.5: Details of Endangered Animal Species

Species	Туре	Zone	Status	
Periophthalmus Sp.	Mud Shipper	Intertidal	uncommon	
Fishing Cat	Mammal	Lagoon	Rare*	
Otter	Mammal	Lagoon	Rare*	
Osprey	Bird	Lagoon	Endangered	
Green Turtle	Reptile	Sea	Rare*	
Olive Ridley	Reptile	Sea	Rare*	
Water Monitor				
Varanus Salvator	Reptile	Lagoon	Threatened*	
Common monitor				
Varanus benghalensis	Reptile	Lagoon	Threatened*	
Estuarine Crocodile				
Crocodilus Porosus	Reptile Lagoon		V.rare*	
Cryptocoryne congnatoides	Marsh Plant	Coast	rare**	
Hubbarda heptaneuron	Grass	River	Extinct (?)**	
Nelumbo mucifera	Plant	Ponds	Heavily used	
Hydrobryopsis sessilis	Plant	Stream	rare	
Aponogeton appendiculatus	Plant	Coast	Threatened	

Table 1.6: Rare and Endangered Fauna

Birds

There is no dearth of diversity of birds in Udupi district. Different habitats – right from evergreen forests to islands near the shore, have proved to be congenial habitat for the birds. These include wild birds, aquatic birds, sea birds and those living in the coast. While, the evergreen forests of the Western Ghats are home for wild birds, the water birds are comfortable with back water, reservoirs, tanks and rivers. The coastal part of the sea is a special habitat and aptly has encouraged rare birds in these zones.

Hornbills, nicknamed as rain nightingales are the endemic species of the Western Ghats. pied hornbills are becoming rare and the impact of deforestation is visible to a larger extent. White bellied sea gull is yet another bird listed as endangered species in the district. This rare bird is protected under the wild life (conservation) Act. The other important birds of interest are Ceylon frog mouth, black kestrel, imperial green pigeon, nightjar, laughing thrush, emerald dove. The wading birds and water dwelling birds are aplenty. Among the abundant water birds, mention may be made of heron, grey heron, purple heron, darter, little grebe(dabchick), water hens and a wide variety of ducks, heron (Krouncha), coot, kingfishers. In addition, the other scavengers like shikra, kestrel, black kite and crows flourish in large numbers. Birds from the northern hemisphere migrate to many parts of the coastal areas from March to April, every year. A total of 35 varieties of migratory birds have been listed as on now. Their details are given in the following table:

Name of the Birds	Scientific Name	Migratory Places			
Common Teal	Anas crecca	Europe – Siberia			
Garganey	A querquedula	Europe – Siberia			
Northern pintail	A. acuta	North Europe			
Blue-tailed Bee-eater	Merops Philippinus	Himayala, Pakistan			
Short-eared Owl	Asio flammeus	North Kashmir, Himalaya			
Common Snipe	Gallinago gallinago	North Europe			
Jack Snipe	Lymnocryptes minimus	North Europe, Siberia			
Black-yailed Godwit	Limosa limosa	Central Europe			
Whimbrel	WhimbrelNumenius PhaeopusCentral Eu				
Eurasian Curlew	N. arquata	North Central Europe			
Common Redshank	Tringa totanus	Central Europe, Tibet			
Common Greenshank	T. nebularia	Central Europe, North Asia			
Marsh Sandpiper	T. stagnatilis	Central Europe			
Wood Sandpiper	T. glarola	Central Europe, Siberia			
Common Sandpiper	Actitis hypoleucos	Himalaya			
Terek Sandpiper	Xenus cinreus	North Europe, Siberia			
Little Stint	Calidris minuta	Siberia			
Temminck's Stint	Calidris temminckii	North Europe			
Dunlin	Calidris alpina	North Europe, North Asia			
Pacific Golden Plover	Pluvialis fulva	North Europe, North Asia			
Grey Plover	Pluvialis squatarola	Siberia			
Lesser Sand Plover	Charadrius mongolus	Europe			
Kentish Plover	Charadrius alexandrinus	Europe			
Slender-billed Gull	Larus genei				
Brown-headed Gull	Larus brunnicephalus	Ladakh, Tibet			
Gull-billed Tern	Gelochelidon nilotica				
Lesser crested tern	Sterna bengalensis	Pakistan			

Table 1.7: Migratory Birds during Winter Season

UDUPI DISTRICT

Name of the Birds	Scientific Name	Migratory Places		
Whiskered Tern	chlidonias hybridus	North India (Kashmir)		
Osprey	Pandion haliaetus	Europe (Himalaya)		
Western Marsh-Harrier	Circus aeruagenosis	West Himalaya		
Pallid harrier	Circus macrourus			
Common swallow	Hirundo rustica	Europe		
White Wagtail	Motacilla alba	Pakistan, Kashmir		
Yellow Wagtail	Motacilla flava	Himalaya		
Grey Wagtail	Motacilla cinerea	Himalaya		
Rosy Starling	Sturnus roseus	Pakistan		

Birds migrating from a long distance generally fly in groups and belong to two or three different species. The coast, nearby islands, paddy fields, back water areas, soil mounds, amidst rivers are the favorite places of the migratory birds. It is only after the close examination, one could notice their wide varieties which are not generally revealed at the first instance.

Depending on the local conditions, many birds change their habitat accordingly. When the tanks and minor water bodies get dried up in summer, the aquatic birds are quick to leave the place in search of suitable habitat. The birds which are scattered in the winter season go in search of tanks and ponds in the coastal regions concurrently. It is also observed that the local migratory birds do not prefer to migrate to the same place every year. On their flight, if they come across suitable place, the birds prefer to stay there for a brief stint. Cormorant, darter, ibis, purple heron and grey heron are among the birds which change their local habitat.

Some sea birds when faced with bellowing rainy season and roaring wind, prefer to take shelter in the coastal areas; it is not their destination, however. But, they would have missed their way during migration. In some cases, during their long journey, the birds would have faced fatigue and would rest wherever they could. The strange birds which have noticed in the recent time are listed in table No.1.8.

Common name	Scientific Name	Possible places of Migration		
Masked Booby	Sula dactylatra	Laccadive's Islands		
Roseae Tern (Laccadive)	Sterna dougalli	Islands of Arabian Sea		
Bridled Tern	Sterna anaethetus	Islands of Arabian		
Sea(Laccadive)				
Great Frigatebird	Frigate minor	Pacific Ocean		
Magnificent Frigate	Frigate. magnificens*	Pacific Ocean		
Whiskered Tern	Chlidonias hybrida	North India		
Grey-backed Tropicbird	Phaethon acthomic	Islands of Archion Coo		
(Laccadive)	1 naemon aemerus	Isianus of Alabian Sea		
South Polar Skua	Catheract skua	South Pole (Antarctica)		
Spot-billed Pelican	Pelecanus phillippensis	Local migratary bird		

Table 1.8: Details of Strange Birds - Dakshina Kannada District

The birds of Udupi and Dakshina Kannada too face serious environmental problems. King vultures were reported from coastal part, about 40 years ago, and today they are not found anywhere in these districts. Way back in 1990, national level scientific studies were conducted about the status of King Vulture. It is disheartening to note that there is not a single bird of this genus or its nest reported from Dakshina Kannada district of that time. Vultures, which are on the tip of pyramid of food chain, are subjected to a variety of pressure and the problems are multi-dimensional. The pesticides have definitely made an impact on their reproduction. Clearing bigger trees have adversely affected on the building of nests. The non-availability of dead animals is yet another serious problem, and the overall result is the decline of predatory birds. King Vultures have completely vanished in the coastal part and the situation is not different for white-backed Vultures also.

Coastal erosion is a serious problem in this region. Erecting wall to check the invasion of water is considered to be a workable solution. But, such erections have direct bearing on the birds which live in the coast. Particularly, species like Dunlin, Sanderling and ringed Plover etc. practically suffer from the loss of habitat.

FORESTS

In the revised forest survey by H.G. Champion and S.K. Sethi, the different types of forests found in Mangalore Forest Division are also to be seen in Udupi district. However, no area represents a particular type of forest and transition from one forest to the other is very conspicuous. It can be generalized that, out of total area of forest, evergreen forests constitute 0.5%, semi evergreen forest 54%, and humid deciduous forest 42% and the other types make up 3.5%. But, between them it is not possible to demarcate the boundaries.

Lateritic Shrub: Lateritic shrub is found in dry areas of the coastal district, where the lateritic soil is developed at a much shallower part. Though the environment is highly favourable for the growth of evergreen or semi evergreen forest, the land is more or less denuded and is exposed to the natural agents like wind, rain and heat from the sun. Only scrubs are successful in such environment. The stunted growth of trees – mainly deciduous, belongs to the open type scrub forest. The vegetation is almost scarce and only few species of evergreen forest which have adapted to tropical conditions seem to survive in such conditions. **The important Plant species are** :*Terminalia chebula, Careya arborea, Strychnos nux-vomica, Anacardium accidentale; Randia species, lxora* etc.,

Southern Secondary Moist Mixed Deciduous Forest: This type of forests are to be seen in the western part of Mangalore Forest Division, where the environment, though suited for the development of tropical or semi tropical forest, the soil is more favourable for moist mixed deciduous forests. *Kumri* cultivation, over exploitation of forests products, grazing of cattle, fire, have all contributed in their own way for degeneration of forests. Inevitably, only forests of this type thrive in such environment. Like the luxuriant moist mixed evergreen forest, here also the trees are tall, soft and grow in a short time. Whatever the trees left out in the primary forest are to be seen mainly in wet land and moisture laden areas. No doubt, the control of wild fire and simultaneously the growth of evergreen forest have come in the way of the development of moisture mixed deciduous forests. The ground is covered by shrubs and trees with withering leaves and grass, wherever wild fire occurs frequently. In addition, the thickness of soil

is very limited and mostly made up of rocky debris and as such is prone to erosion. But, the development of lateritic soil is characteristic of such environment.

The important Plant species are: Terminalia paniculate, Bombax ceiba, Mangifera indica, Dalbergia latifolia, Adina cordifolia, Dillenia pentagyna, Schleichera oleosa, Alstonia scholaris, Xylia xylocarpa, Lagerstroemia lanceolata, Olea dioca, Careya arborea, Emblica officinalis, strychnos max-vomica, Clerodendron infortunatum, Helecteris isora. In damp areas evergreen under growth includes Actinodaphne, Psychotria, Webera, Lxora and Strobilanthes. No bamboos but canes are confined to wet pockets. Claimers of the species of Calycopteris floribunda, Acacia species are common.

Lateritic Semi Evergreen Forest: The forest of this category is to be seen in the areas where there is abundant lateritic soil and plants like *Xylia xylocarpa* are characteristic of this type of forests. The environment, though, resembles that of semi evergreen forests, and the soil is lateritic in nature, is shallow and dry for its most part.

The important Plant species are Xylia xylocarpa, Pterocarpus marsupium, Grewia tiliaefolia, Terminalia species, Careya arborea, Bridelia retusa, Calycopteris floribunda, Strychnos nux-vomica, Lea indica. Generally sparse Adhatoda vasica, Holarrhena antidysenterica.

West Coast Secondary Evergreen Dipterocarpus Forest: The plains below the Western Ghats have encouraged this type of forests. The characteristic of these forests are the uniformity and luxuriant growth and are covered by evergreen shrubs. The species *Hopea parviflora* is aplenty in Evergreen *Dipterocarpus* Forest.

The important Plant species are; Hopea parviflora, Hopea wightiana, Vateria indica, Diospyros microphylla, Eugenia gardneri, Aporasa lindleyana, Olea dioica, Syzygium Species, Ixora and Calycopteris floribunda bushes.

West Coast Semi Evergreen Forest: This forms the intermediate type between the evergreen forest and the moist mixed deciduous forest. It is not surprising if both the above types are

represented in this category. Tall trees with luxuriant growth are aplenty in this type of forest. Another interesting feature is the abundance of evergreen vegetation at lower levels. The ground level is made up of bushy shrubs. The bamboo vegetation is represented by *Bambusa bambos* and *Terminalia paniculata* is a common species in West Coast Semi Evergreen Forest.

The important Plant species are: *Terminalia paniculata, Diospyros spp, Lagerstroema lanceolata, Lophopetalum wightianum, Machilus macarantha, Cinnamomum spp, Hopea parviflora, Mangifera indica, Artocarpus hirsute, Holigarna arnotiana, Elaeocarpus serratus, Mallotus philippensis, Diospyros spp, Lxora spp, Strobilanthus, Lxora.* Climbers and canes are abundant.

West Coast Tropical Evergreen Forest: This forms a part of dense evergreen forests of Mangalore Forest Division. Generally, these are abundant in the areas where there is rainfall of more 3,000 mm. and are located on the slopes of Western Ghats - 120 to 250 m. above the sea level. The moisture and nature of soil are highly favorable for the development of tropical evergreen forest. Here not only the diversity of the trees but also the cloud scrapers could be seen.

The important Plant species are Dipterocarpus indicus, Hopea wightiana, Vateria indica, Calophyllum wightianum, Hardwickia pinnata, Artocarpus hirsuie, Machilus macaranta, Magnifera indica, Lophopetalum wightianum, Olea dioca etc., Aporosa lindleyana, Myristica spp, Garcinia spp, Caryota urens, Elaeocarpus serratus, Strobilanthus spp, Psychotria spp, Lea sambucina. Climbers are seen often and are mainly of Entada scandens, Dioscorea spp. Regeneration of inferior spp is more abundant than that of merchantable ones. Epiphytes are numerous, mosses and ferns occur almost everywhere.

Southern Wet Bamboo Brakes: Generally, the banks of streams and areas where there is less desiccation of water, the bamboo bushes are seen as brakes and are referred to as the Southern Wet Bamboo Brakes.

Cane Brakes: Cane Brakes are commonly found in evergreen and semi evergreen forests where there is less desiccation of water. Many species of Calamas have been reported from such areas. Udupi district

boasts a wide variety of plants with 99,439 hectares of forest area. The forest of the district is endowed with valuable trees such as Santalum album, Tectona grandis, Lagerstroemia microcarpa, Terminalia alata, Dalbergia latifolia, Calophyllum apetalum, Artocarpus heterophyllus. In addition, trees such as Fycus bengalensis, Fycus racemosa, Michalia champaca, Mangifera indica, Pongamia pinnata. proliferate in this district. In some places species like Bamboo, Dendrocalamus strictum, Ochlandra

S1. No.	Scientific names	Local name	Useful part of the tree		
1	Acacia sinuate	Seegekai	Fruit		
2	Artocarpus gomezianus	Vatehuli	Fruit		
3	Cinnamomum verum	Dalchinni	leaf, flower, bud and bark		
4	Garcinia gummigutta	Upagimara	Fruit		
5	Garcinia indica	Punarpuli	Fruit		
6	Garcinia xanthchymus	Jarige	Fruit		
7	Myristica malabarica	Ramapatre	Flower, Seeds		
8	Emblica officinalis	Nellikayi	Fruit		
9	Sapindus laurifolia	Norekayi	Fruit		
10	Strychnos nuxvomica	Kasarka	Seed and bark		
11	Tamarindus indica	Hunise	Fruit		
12	Terminalia bellirica	Shanthi	Fruit		
13	Terminalia chebula	Alalekayi	Fruit		
14	Zanthoxylum rhetsa	Gamatamara	Fruit		

Table 1.9: Details of Forest Products

travancorica, Pandanus fascicularis, Phoenix sylvestris, Caryota urenus are found in larger numbers. In addition, forests products from cardamom pipernigram, Anarcardium occidentale and Cinnamomum zeylaniclum, Acacia sinuate are produced in plenty. Non timber plants found in the district are listed below. These trees are used as a source of food, medicine, manure as well as in the cosmetic industry.

Almost all the animals of South India are represented in Udupi taluk. They include wild animals like tiger, leopard, elephant, gaur, sambar, wild bore, rabbit, brown squirrel, macaque and other animals. The district is also known for rich reptiles and birds.

CLIMATE

The climate of the State is determined by parameters such as the distance from the sea, monsoon winds and physical features. The Western Ghats act as the weather divide between the West coast mountainous area having highest rainfall and eastern part with little rainfall and draught prone areas. Western Ghats play a significant role as an important physical feature in determining the climate of the State. It also serves as catchment area giving birth to the rivers and streams which flow both towards east and west. The ghats extend in north south direction and are responsible for the heavy downpour all along the coast and *Malnad* area. They act as barrier to the north western monsoon winds. Since the catchment area is the main source of water, this could amply be termed as the backbone of the State.

The district is known for highest annual rainfall, humidity and dynamic weather patterns. The year can be divided into four parts from the point of view of climate. It is summer between March and April months; south western monsoon extends from June to September The pre monsoon period commences from October and ends in November. Similarly, the period from December to February marks the regime of north-eastern monsoon. It rains in December, generally, due to north-eastern monsoon and the other two months are free from rains.

Of the total four important climatic zones, Udupi and South Kanara district encompasses two zones.

1) Coastal part: This part lies between the Arabian Sea and Western Ghats and includes Dakshina Kannada district, Udupi district and south-west part of Uttara kannada district. It enjoys more than 3000 mm of annual rainfall and

2) Western Ghats and Malnad areas: This forms part of mountain and forest areas lying to the east of western margin of Western Ghats.

Rainfall

South-West Monsoon: (June to September): The imaginary lines that divide the year into two equal parts run parallel to the Western Ghats and the coast. The Asian land mass surrounded by cold oceanic water gets heated up during summer and the pressure created in the

atmosphere moves the south-western monsoon. The part of Asian continent spread over a large area right from Sudan of East Africa to Rajasthan and West Bengal is subjected to a very high pressure during winter seasons, while, in summer (April to May) the pressure substantially gets lowered. The south-east winds at the end of May move from south to north of the equator as south-west moisture laden winds advance toward the Arabian Sea and Bay of Bengal. This is known as South-Western Monsoon. The south-west winds absorb a great amount of moisture over a considerable height in the atmosphere before reaching the coastal part. It is the moisture laden monsoon currents when strike against the ghats leads to heavy downpour along the western coast and the neighboring areas of Western Ghats. The impact is so profound that the moisture laden clouds will undergo intense cooling which ultimately leads to the formation of rain clouds followed by solidification of moisture and consequent heavy rains. Even in areas enjoying heavy rainfall the rains are not continuous during monsoon period. The rainy days are in pulses. It is also a common experience that after heavy rains there follows a period of quiescence for about few days or week. Such intervals are noticed in the months of August or September, while, it rarely occurs in the month of July. Both the coast and the Western Ghats enjoy heavy rainfall. It is about 3,200 mm. in the coastal parts. This season, in fact, represents the maximum rains to the tune of 82 to 90% total rainfall in the area for the year. The coastal and Western Ghats being the areas receiving heavy rainfall, the numbers of rain days (if it rains 2.5 mm. in 24 hours, it is considered as one rain day) are of the order of 95 to 105 for this track.

North-east Monsoon (October to December): While north-east monsoon commences from October, at the same time withdrawal of south-west monsoon is noticed. There will be change in the air pressure over the Asian continent including India. When the northern states experience high pressure, it is reverse the case in the southern part of the subcontinent. The low pressure starts developing over Bay of Bengal. This leads to changes in the wind and the north-east wind blows over India and its neighbouring parts. In their early stage, winds

which originate on the land are generally drier and on their way absorb the moisture from the Bay of Bengal. When they strike the eastern coast of South India the north-east monsoon brings rains. The coastal part of the State receives as much as 200 to 300 mm. of rains, but this forms just 10% of the annual rainfall in coastal and the ghat sections. Half the amount of rain of this season falls in October itself. Dakshina Kannada district and Udupi district receive 150 to 200 mm. of rainfalls and it rains less in November compared to the month of October. Further decrease in rainfall occurs during the month of December.

Winter (January to February): Generally winter is almost a dry season in the State with very little rainfall. The summer (March to May) for its most part is characterized by dry weather with scanty rainfall. But greater changes are to be seen in the month of April. It rains nearly 150 mm. at the southern tips of Dakshina Kannada and Udupi district. Half the amount of rainfall of this season is received in the month of May itself.

Depression and Storms: Storms are more frequent in the Bay of Bengal than Arabian Sea. On an average, at least two major storms strike the eastern coast of South India or almost nearby parts. Strangely on an average not even two storms strike the western coast annually. Only few storms strike the coast where upon they become weak and cross the Peninsula, while passing the Arabian Sea may turn to storms again. It is this condition that renders into stormy rains in the coastal area of Karnataka. Such rare phenomenon might happen in the month of May, October and November. Again, such disasters might visit once in three to five years. Storms of this type are recorded on 2nd May, 1872, May 4th 1874, in the last phase of November, 1880, November 17th 1885, May 3rd 1909, October 16th and 23rd 1916. During these periods the storms crossed the Bay of Bengal and there was heavy downpour in the State following this event. In the later part of May, before monsoon commences in the coastal Kerala, the storms that originate in the south-west part of Arabian sea, sometimes, as it happens rarely, may move towards north and may result in heavy rains in the west coast of Karnataka.

Rain

There is an excellent network of rain gauge in the district and data on rainfall is available for the last 90 to 120 years. The detail of rainfall for the period 1901 to 1950 is appended in the table 1.10.

Raingauge stations Statistics for the available years		Udupi	Byndoor	Karkala	Kundapura		
		50	50	50	50		
January	a	3.6	1.3	7.6	1.5		
	b	0.3	0.1	0.4	0.1		
February	a	3.3	0.8	1.8	2.5		
	b	0.1	0.1	0.1	0.1		
March	a	3.3	0.2	2.3	0.2		
	b	12.2	0.8	3.8	0.1		
April	a	29.7	23.9	48.5	25.7		
	b	2.0	1.2	3.5	1.3		
Мау	a	141.5	121.4	160.5	126.5		
	b	5.8	4.8	6.9	5.1		
June	a	995.9	1,123.9	1,108.5	1,037.8		
	b	25.1	24.8	25.5	24.5		
July	a	1,197.6	1,361.7	1,532.1	1,211.3		
	b	28.2	29.2	29.5	28.2		
August	a	721.6	823.2	976.4	698.3		
	b	26.0	27.1	27.6	25.8		
September	a	351.5	395.2	412.2	349.8		
	b	17.4	18.0	18.8	16.8		
October	a	187.2	201.2	298.7	156.2		
	b	9.0	9.6	13.8	7.9		
November	a	68.8	73.4	111.8	66.0		
	b	3.8	3.9	6.2	3.3		
December	a	14.7	9.1	24.1	13.5		
	b	1.0	0.8	1.5	0.8		

Table 1.10: Normal rainfall and actual rainfall in mm. for Udupi district 1901-1950

The period between June to September is the peak rainy season and on an average it rains 3,930 mm. annually. It is observed that the rainfall increases as one proceeds from coast towards the ghats. The south-west monsoon brings about the highest rainfall during the month of July, as it happens generally.

Pressure and Wind: Generally wind blows from west to southwest during south-west monsoon season and from northeast to east during north-east monsoon season in the State. While pressure increases in North India during winter, it declines in the South. The pressure is on the lower side during winter season, and wind blows from northeast or east direction. There is decrease in the pressure beginning from March but by April the situation is reversed, where North India experiences low pressure while it is high in South India. The pressure further weakens during March and April in the State, and light wind blows towards west in the evenings.

As summer continues South India experiences moderate pressure in accordance with the season. Further decrease in the moderate weather is witnessed in the State during July. The isobars (lines connecting points of equal pressure) move from north-west to southeast during this period. Wind blows with more intensity over the coastal parts in the evenings from west or southwest The wind and pressure system are more or less same from August to September. But, low pressure gets reversed in the month of October. During this period the North India again experiences high pressure while it is low in the south. There is a small variation in the low pressure on land during the month of October. But, during the north-east monsoon, wind blows from northeast to east and there is slight decrease in the pressure system.

Temperature

Temperature will be very low in the early part of January and gradually increases in the subsequent months. By mid February or early March, there will be sufficient increase in temperature. The coastal part records the highest temperature during the month of May and the average day temperature in the coast will be $31^{\circ} - 32^{\circ}$ C in January. While in Ghats section and Malnad areas it will be $28^{\circ}-32^{\circ}$ C. Generally, most part of the State will have higher temperature during the month of May, when it reaches 35° to 36° C in the coastal part and the temperature gradually decreases after May.

At the same time, in the coastal parts the temperature reaches as much as 28° C. The ghats and Malnad areas will record 22° -24° C. An interesting feature is that in the Malnad area which extends from the coast up to Hassan, the maximum temperature reached during July is less than what it enjoys during the month of January. The sky is cloudy and intermittent rains are common during July. But the sky will be clear with intense sunlight after January. The temperature reaches maximum in the coastal parts and Malnad areas by October, though the temperature in both day and night increases during April and May, the highest day temperature is recorded during the month of December.

While the average day temperature in the coastal part during January touches 20° C., it will come down to $13^{\circ} - 14^{\circ}$ C. in the ghats and Malnad parts. The lowest temperature recorded so far in the coast is $16^{\circ} - 18^{\circ}$ C. It is interesting to note that the average temperature (i.e. the difference between the average highest day temperature and the lowest day temperature) is lowest in the coastal part (about 6° C.). The average annual temperature (average 12 months temperature) of ghats and Malnad areas is $18^{\circ}-28^{\circ}$ C. and that of coast is 27° C. The details of temperature are given in the table 1.11.

Month	A	Dailw		Recorde		Relative	humidity		
Month	Average	Dally	Max.	Date	Min	Date	8.30 am	5.30 pm	
January	31.6	21.5	36.1	21.01.1957	16.7	13.01.2011	69	63	
February	31.2	22.6	37.8	28-02-1920	16.7	08-02-1911	74	67	
March	32.0	24.4	37.3	07-03-1958	18.3	04-03-1911	75	68	
April	32.8	25.9	35.6	28-04-1921	20.0	23-04-1954	72	69	
May	32.6	26.1	36.7	02-05-1921	18.9	06-05-1911	75	72	
June	29.2	23.8	34.4	05-06-1923	20.0	16-06-1920	88	57	
July	28.6	23.5	31.7	25-07-1954	20.6	25-07-1931	90	89	
August	28.7	23.5	32.2	26-08-1932	20.6	12-08-1911	91	88	
September	28.9	23.5	31.7	23-09-1955	21.1	09-09-1950	88	85	
October	30.0	23.7	34.4	31-10-1941	20.0	23-10-1933	84	79	
November	31.1	23.2	35.6	03-11-1941	18.3	30-11-1950	76	72	
December	31.7	21.8	35.0	01-12-1953	16.7	10-12-1950	68	63	
Annual	30.7	23.6					79	75	

 Table 1.11: Monthly average Temperature, Minimum and Maximum temperature, and Relative Humdity of Mangalore

January	7.9	May	9.0	September	6.4
February	8.2	June	8.7	October	6.6
March	7.9	July	9.0	November	6.6
April	8.2	August	7.4	December	7.0
				Annual	7.8

Table 1.12: Month-wise Average Wind speed in Mangalore (km/hour)

Relative Humidity: The relative humidity in the State is highest during the months of July and August and is very low during the months of March to April. Humidity depends not only on water vapour but also the temperature in the atmosphere. Generally coastal and ghats are more humid during the months of March and April, compared to the plains, 30-40% of humidity is recorded in the coast and Malnad parts during the months of March and April. Likewise during the months of July and August more than 90% relative humidity prevails in this part. This marks the highest humidity and thereafter there is a gradual decrease till November and further decrease is noticed in the subsequent months.

Cloudiness: Cloudiness is measured in units called Octa (okta). One octa refers to 1/8 part of the sky covered by clouds. If the whole sky is overcast, it is referred to as 8 octa. If the cloud coverage is half the sky, then, it is 4 octa. The south-west monsoon witnesses heavy cloudiness of the sky and it gets reduced in the months of January to March when the sky is almost clear. But, one can see the floating of bigger or medium sized clouds in the sky here and there. Sky is overcast in the coastal ghats and Malnad areas and the clouds will be at lower levels during the months of July and August. It rains more than 20 days in a month during this period and the sun is covered for days together.

Other Phenomena of Climate: Phenomena such as thunderbolt, storm, hail storm, rains, typhoons, cyclones and mist are included among the phenomena associated with climate. Storms associated with thunderbolts are common features in the summer season (April to May) and also during the months of September to October, but, are very rare during the months of November to March. Sometimes it is not uncommon during the months of June and August. But, this

happens very rarely. Likewise, rain associated with hailstorm is also a rare phenomenon. But during the months of April to May, sometimes during September and October, there could be hailstorm associated with thunderbolt followed by heavy rains. The Western Ghats and Malnad areas may experience hailstorm associated with thunderbolt or cyclones. When cyclone attains a speed of more than 50 km per every hour in a span of 3 to 5 minutes and operates for about 10 minutes, then it is called squall. Tables 1.13 shows the details of phenomena associated with the climate.

Prevailing Days	Jan	Feb	Mar	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
Lightning	0.0	0.3	0.5	4.1	5.8	3.7	1.0	0.4	0.9	6.9	5.3	1.2	30.1
Storms													
Hail stone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Typhoon	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.4
Cyclone	0.2	0.0	0.0	0.5	0.9	2.9	1.9	0.3	0.1	0.3	0.4	0.1	7.6
Mist	0.5	0.1	0.7	0.2	0.0	0.0	0.2	0.1	0.5	0.5	0.2	0.2	3.6

 Table 1.13: Other phenomena of climate – Mangalore

If it exceeds more than two days, it is rounded off to the nearest number Source : Indian Meteorological Department, Government of India, 1984

The State of Environment in the District

The survival of life on the earth depends on the availability of natural resources. The exploitation of natural resources undoubtedly has a greater impact on the environment. For instance, when we use water we also pollute it. By over exploitation of the resources such as coal, oil and mineral wealth, they get depleted. The soil becomes either saline or alkaline, when there is no sufficient slope for infiltration of water and especially in the areas where large scale cultivation is practiced. Burning more wood also brings about increase in the emission of carbon dioxide which ultimately leads to global warming. Both exploration and depleting the natural resources have adverse effect on the environment.

The loss of vegetation on a large scale in the plains is due to the agricultural activities extending into these areas. In fact, the

shrubby forests which form a unique vegetation in the plains have almost disappeared. Even the wild life has been driven out excepting few places. Similarly, disintegration of natural vegetation in the Western Ghats has reached a dangerous level and has badly affected the rate of destruction of *flora*. The wild life in many parts of the State has already been wiped out. The loss of habitat, continual separation and unlawful killing are some of the prime causes that have dwindled the population of wild life. At the same time, the forest areas of Western Ghats are converted into cardamom, coco, coffee and tea plantations. Similarly, the lush tropical forests are fast replacing the timber and woody forests. No doubt, the plantations are commercially viable but it is at the cost of wild life, bio-diversity and the habitat of both *fauna* and *flora*. West flowing rivers of the Western Ghats are tamed for the generation of electricity and it has led to the submergence of vast areas of forest. This has another ugly face too; such developmental activities demand rehabilitation of refugees which leads to further reduction in the forest area. Exploitation of both renewable and non renewable resources undoubtedly affects the environment. The impact of mining activities depends on the place, the type of mining and the amount of work carried out. Even the area around mining will be under great pressure due to the mining activities as well as the miners activities. In order to extend the long life to the resources and the conservation of environment, it is imperative that both the extention of mining and methods followed need to be standardized.

When the foreign objects (undesired) mix up with the resources and reduce their utility, then the resources are said to be polluted. When the waste water is mixed up with the natural water or fresh water, the water gets polluted. Both industries and the human activity can pollute water. Especially, the industrial effluents containing organic, chemical and hazardous waste can lead to pollution. In order to control this type of pollution, evaluation has been made with respect to each industrial source. The Parliament has passed the Water Act (Prevention and Control) on 23rd March, 1974. The urban agglomeration is responsible for higher rate of water pollution. Before the sewage water is discharged, it is the duty of the agency responsible for processing to see that the job is carried out.

Air Pollution: The noise pollution is classified under three categories. 1) Industrial noise 2) Traffic congestion 3) cultural activities. This is also covered under Air Pollution Act (Pollution and

Control) 1981. Similar to water pollution, the noise pollution is also increasing at a rapid pace. That, our ears get used to higher level noise is a misconcept. As person gets aged, the ears gradually but silently slow down their functions. In order to achieve the conservation of environment and promote development, the Centre has framed Environmental (Conservation) Act, which is in force since 23rd May, 1986. The Department of Ecology and Environment was established by the State Government in March, 1981 in order to protect and conserve the environment, forest and other natural resources, keeping in view the overall development in these fields. The Act concerning the Environment (Conservation) came into being in November, 1986. Under this Act, public can question the officers engaged in pollution control, in the court. It is also the responsibility of the Department of Ecology and Environment to manage the hazardous chemicals and oil pollution in the sea. In addition, much attention has also been paid for the management of ports in the coastal areas (shore). The Karnataka State Pollution Control Board came into being in 1974. This Board is responsible for the implementation of some Acts connected with Water, Air and Environment. The Regional office of Karnataka State Pollution Control Board was established in Dakshina Kannada in 1991.

The laws enacted in the district:

- · Water (Prevention and Control of Pollution) Act, 1974
- · Water (Prevention and Control of Polluition) Cess Act, 1977
- · Air (Prevention and Control of Pollution), Act, 1981
- · Environment Protection Act, 1986, amended 1991
- · The Hazardous Waster (Management and Handling) Rules, 1989
- The Municipal solid waste (Management and Handling), Rules, 2000
- · The Batteries (Management and Handling) Rules, 2001
- The Recycled Plastics Manufacture and Usage Rules, 1999, amended , 2003,

Under these Rules and Acts, the industries, hospitals and the local bodies have to function so as to control Air, Water and Land pollution in the district and the enforcing authority are permitted to take suitable measures to achieve this goal.

There were no reliable records till 1960 about the mineral deposits of Udupi and Dakshina kannada districts. Geological studies carried out later have brought to light the iron ore occurrences in Keradi and silica sand in Kapu, Moolur, Hejmadi and bauxite deposits in Madalpare of Byndur. But, these deposits have no economic significance. Laterite and granite are used on a large scale throughout the districts. Fire clay is used for the manufacture of tiles in many parts of the district since it is one of the important industries here. The importance of the industry is reflected in the fact that Udupi and Dakshina Kannada districts account for one third of the production of tiles of the country. Collections of sea shells as a source of lime is yet another commercial activity and the streams of Kundapur, till recently were the main source of sea shells. The industry flourished for the past 20 to 25 years but now it is gradually declining and has caused much anxiety among those who are dependent on this as a source of income. Udupi district shares a small part of Western Ghats which is considered as one of the 25 biodiversity hot spots. However, there is no dearth for biodiversity in this part. A total of 1600 flowering plants species have been recorded by Dr. Gopalakrishna Bhat in Udupi district. Paracatlia bhalli, a species of ginger is considered as a rare one in the world, its habitat is restricted but thriving in Udupi district.

Species which are rare on the global scale but are restricted to the Western Ghat namely *Lion tailed macaque, barking deer, loris,* have proliferated in Udupi district and it is a matter of pride. They are protected in two wild life sanctuaries and in one of the parts of National Park. Ornithalogists have recorded the migratory birds visiting this district. Of these, some are believed to be migrating from the northern Europe, Syberia and Himalaya. Of the migratory birds coming from a long distance *golden plover* is found in some parts of the district. The fisheries no doubt, are an important industry of the district. Fishes like *Swarage, Torage, Byge, Butya, bongude, hombole, nangu* (local names) are the gifts of the sea.

There are many sensitive and unique biodiversity spots. The mangrove near Kundapur is one such habitat. Of the total 17 important mangroves identified under Man and Biosphere programme, Gangolli, Tallur mangroves have secured a place in the list. The mangrove is spread over an area of 30,700 sq. km. and is not only known for biodiversity but has proved useful too. Geographical location, copious rainfall, wide forest coverage is some of the facts which have encouraged rich biodiversity of the district. Though, the percentage

of forest was reduced to 11% in the last century, there is no anomalous rainfall. It is paradoxical that though there is an average rainfall of 3,800mm. But the scarcity of water is one of the biggest problems in the district.

Sea Erosion: coastal villages like *Maravanthe, Udyavara, Padukere, Kodibengre* are subjected to sea erosion every year. In Udyavara even the embarkment was swallowed by the sea. Sea erosion is a natural phenomenon and to control this disaster by erecting embarkment is not a solution either as a means of strategy or scientifically viable. Some scientists are of the opinion that in another decade or two due to global warming, there is possibility of increased sea erosion. Coastal part should not be treated as mere heap of sand, but, a habitat. By erecting embarkment the sea shore looses its beauty as well as identity.

Water and Floods: Though there are bigger streams in Udupi district, all have a length less than 80 km. Rivers like Seetha, Swarna, Haladi, Sowparnika, although are considered important from the point of their size, most of them touch the bottom during summer period. The poor State of river is very much conspicuous from the last three to four decades. Ruthless clearing of forests in Western Ghats, tree felling on the banks of the river, unscientific methods of management of rivers and over exploitation have contributed in a big way for the present degeneration of rivers. As a result, overflow of rivers is a common phenomenon during rainy seasons. Consequent flooding is a mockery. Though the damage done by north Indian rivers cannot be compared with those of south Indian rivers, nevertheless the loss is considerable. Udupi never had a flood problem in the early times. However, today we encounter floods time and again though the rainfall is scanty. The answer lies in the physical change of the rivers. It is but natural that year by year the demand for water is growing at a rapid pace. Leave alone the factor of increased water availability, there is decline compared to the earlier times. The wells are reaching rock bottom. In the mean time, boreholes have proved futile with the decrease of water table. We are witnessing a stage where rivers carry less load of water as in the case of Udyavara. Measures have been taken to check the sea erosion by erecting embarkments. With the result the neighbouring fields have turned salty. This has led to come out with the project of linking of rivers. Unless there are efforts to conserve water and increase the groundwater reservoir, the idea of linking of rivers has little meaning.

Fuel: The average percapita consumption of fuel in Dakshina Kannada and Udupi districts was highest in the State in the decades following 1990 (Expenditure for each month was Rs. 99.71). The consumption maximum was due to the tile industries that have flourished in the district. In the 90's the total demand of fire wood by tile factories in both the district was 1,20,000 tonne each year. The situation has not improved even today. The common man is dependent every day on fire wood for his daily needs and as such the pressure on forests is understandable. Added, plywood and other industries are directly dependent on the forest products and have contributed in a large measure for shrinking of forest area.

Noise Pollution: Udupi district happens to be one of the districts of Karnataka having higher noise pollution. Most of private busses plying have recorded more than 115 decibels of noise when they horn. As an experiment, the noise level of one of the busses plying between Udupi to Karawar was measured which reached 115 decibels every 15 seconds. Such level of noise pollution will eventually reduce the capacity by 50% in ten years. It is irritating that there is higher level of noise pollution during the night also for a variety of reasons.

Use of Pesticides: It is sad that we have reached a stage that we can't grow anything without using pesticides. Of course, there is no harm in using a specific pesticide up to a certain level. But, the way people used is very disturbing. There is an immediate necessity to manage this situation and much more information needs to be collected.

Biodiversity: There are many unique habitats in Udupi district which have been identified as sensitive. And quiet a few of them will lose their identity in the near future. Notable among these are *Anekere* of Karkala, Maravanthe coast, Halethana of Malyadi, Pillarukhan of Shirwa, St. Mary's Island (Thonse par), Mangroves of Tallur and Wild life sanctuaries of Mukambika and Someshwara. The coast of Maravanthe is the home of olive ridley turtles. The sea turtles migrate from a far of places and lay eggs in the sand from August to January. Forest department has taken suitable measures to create congenial atmosphere for their reproduction. When once the eggs are hatched, the young ones numbering thousands were left to the sea taking every care. Unfortunately, the department has stopped caring the turtles for the last two years and the very survival of Olive ridley turtle is at stake.

The bird sanctuary of Malyadi is drawing attention only recently. There are about 30 bird species in the sanctuary and sometimes visited by migratory birds also. It is home for hundreds of teals and other water birds. St. Mary's island is known for a variety of sea animals and *pilllarukhan* is an ideal evergreen forest the district can boast of. Of late the mangrove of Tallur has attracted rare migratory birds like Wimbrel, Avocet etc. But, the prawn culture in this part has resulted in the disappearance of birds, probably they may not returned to this place any more. It is again poignant that many species are gradually disappearing throughout Udupi district, silently; quiet a few water bodies are becoming barren. On either wide of the national highways ponds have given place to the concrete jungles. It is unfortunate that the importance of tanks and ponds have not been realized by the authorities and the public. It is needless to say that ponds supported by the groundwater enrichment act as a shelter for innumerable lives - both Plant and Animals.
