4. Geography and Geology of the Southern Neolithic Settlements

The peninsular southern India is distinct from the alluvial plains of the Indus and Ganga. It is composed of ancient rocks forming hills and running along the western side of the peninsula are hills known as the Western Ghats (Sahyadris), that appears as high sharp 'steps' above the western coastal plain. The Sahyadris reach elevations of over 1000 m between the Tapti river in the north and rise much higher, culminating in the Nilgiri Hills in the south, upto 2600 m.

The gradual eastward slope of the interior plateau that extends to the east of the Western Ghats has resulted in the eastward drainage of all major rivers. The three largest drainage systems are the Godavari, Krishna and Kaveri. The Bhima, Tungabhadra, Malaprabha, Ghataprabha, etc. are the other major tributary streams. To the east of this, the eastern half of the peninsular south of the lower Krishna watershed is the Pennar river, including the Kunderu river as a tributary from the north.

The areas of land between the confluences of two major, roughly parallel rivers, is often referred to as a Doab, notably the Shorapur Doab west of where the Bhima joins the Krishna, and the Raichur Doab where the Tungabhadra joins the Krishna. The plateau area south of the Raichur Doab and Tungabhadra river is sometimes referred to as the Rayalaseema (the territory of the medieval Rayas of Vijayanagara).
4.1 Climate and Vegetation

The Indian Ocean monsoon system not only greatly influences the seasonality and climate in India but also ties together South Asia with other regions bordering the Indian Ocean such as East Africa and the southern Arabian peninsula. The monsoon, together with patterns of sunlight and temperature, results in three seasons in most of India: the wet season (monsoon), roughly from June to mid-December, the ‘cool’ season from mid-December through February, and the hot dry season from March to the end of May/early June until the rains start. The wet season is further divisible into that of the advancing and retreating monsoons. The main monsoon advances from the
southwest. During the late wet season/early cool season (October to December), the wind direction reverses towards the southeast. This is known as the retreating monsoon. This brings some additional rainfall, but the only large quantities come off the Bay of Bengal onto the southeast coast, especially Tamil Nadu and to a lesser extent southeastern Andhra Pradesh. Some rain also comes off from the Himalayas onto the northwestern subcontinent during this period.

The Southwest Monsoon strikes first in early June (maximum in July or early August) the Malabar Coast and the Western Ghats, which receives high quantities of rainfall, creating tropical evergreen forest conditions, whereas on the eastern side an extensive rain shadow area exists. It is in this rainshadow, east of the Western Ghats that the semi-arid savanna lands occur. This rain shadow effect is more pronounced towards the southern Deccan, e.g. Karnataka. The regional rainfall minima occur in the region around Bellary, where rainfall may not exceed 60 cm per annum. The driest region of the peninsula is that centered around Bellary (classified as sub-desertic with tropical tendencies, with a dry season of nine months), while the adjacent Chitradurga region to the south is somewhat wetter (Tropical Medium Dry, 5-6 month dry season), and the areas to the north, including Kurnool, Raichur and Shorapur are Tropical Accentuated Dry, with a 7-8 month dry season.

The eastward drop in rainfall, rising again east of the Bellary District, means that the peninsula of India (the northern and southern Deccan) can be divided into roughly north-south strips of rainfall zones, corresponding generally to vegetational zones.
4.2 Tropical Evergreen Forest

Tropical Evergreen forests cover the stretch of highest rainfall, along the Western Ghats, southwards from Mumbai. Under this climatic regime, complex forests develop that are well-storied (four to five storeys), with a high canopy of 50 m or more. A number of useful species, especially for food, are found in this and other forests types. Amongst the common canopy trees in these forests are the source of commercial cinnamon (*Cinnamomum verum* J. Presl., sny. *C. zeylanicum*) and *Ficus racemosa* L. (sny. *F. glomerata* Roxb.), an edible fig. The toddy plam (*Caryota urens* L.) is found in the second storey, while amongst the lower lines is found *Piper nigrum* L., the source of black pepper. Mango trees, *Mangifera indica* L. also occur in the canopy of some patches of this forest. The herbaceous flora includes numerous Zingiberaceae (ginger and turmeric family).

The Wet Evergreen forest can also be divided into latitudinal and altitudinal variants. These latitudinal variations take on particular significance in palaeoclimatic reconstruction. At the southern end of the Western Ghats, in Kerala and Tamil Nadu the dry season is under four months. Moving northward the dry season lengthens and some of the dominant species change accordingly. Further north still, in Uttara Kannada and Goa, where the dry season lengthens to six months. Further north in Belgaum District and Maharashtra high scarps above 700 m develop a somewhat distinct Low Montane Wet Evergreen Forest. The High Montane Wet Evergreen is the shoal forest of the Nilgiris.

The transition from the Tropical Evergreen to the moist deciduous forests is the "Tropical Semi-evergreen" found surrounding the patches of Wet Evergreen towards both east and west. Here dry seasons are of 3 to 4 months and rainfall averages 150-200 cm. This contains many of the same canopy trees as the Evergreen
Forests, including cinnamon and some mango, but with the toddy palm absent or rare. *Madhuca indica* Gmel., the source of the mahua flowers traditionally made into a fermented beverage in many parts of India occurs occasionally. *Zizyphus* spp., common sources of edible fruits, enters the shrub flora and representatives of this genus remain significant in all drier ecological zones. *Limonia acidissima* L. (syn. *Feronia limonia*), the edible ‘elephant apple’ occurs in this forest band in Dakshina Kannada, with quite high frequencies. Climbers include yams, *Dioscorea* spp., with some Zingiberaceae.

Tropical Moist Deciduous (or Moist Deciduous Teak) forest is the next band to the east and occurs widely in regions surrounding the wet evergreen forests. This vegetation represents the transition from areas of forest to regions of more open or shrubby landscapes of the inner peninsula. These forests are also sometimes considered as degraded from formerly evergreen forests. The upper storey of these forests includes teak (*Tectona grandis* L.f.), and *Phyllanthus emblica* L., source of the sebesten plum, *Syzygium cumini* (L.) Skeels (Indian jamobos), and *Careya arborea* Roxb., the patina oak with edible seeds. The canopy of these forests generally becomes leafless in the dry season (March or April), while other trees begin to produce leaf and the undergrowth stays green. *Zizyphus* spp. Continue to be important amongst the shrubs, while herbaceous plants include numerous legumes, *Dioscorea* spp. as well as grasses. In this zone, as well as the evergreen and semi-evergreen trees, thickets of bamboos occur, often along streams and shaded slopes. It is within the grassy clearings of this zone where wild mungbean is primarily found, especially in southern Karnataka.

Moist Deciduous teak forest also occurs east of the Deccan plateau on some of the Eastern Ghats where it is associated with *Hardwickia binata* type forests. The
largest moist teak forest on the eastern peninsula is restricted to the Nallamalais, although it also occurs on some hill groups further north. These forests also include wild black pepper (*Piper nigrum* L.). At slightly lower elevations in the Nallamalai, Velikonda to the south, *Hardwickia* forests dominate and intergraded with dry deciduous and thorn/scrub forests.

### 4.3 Dry Deciduous and Thorn Forests

The next zone eastwards is the Tropical Dry Deciduous zone, where forests remain leafless throughout most of the dry season. New leaves appear in April if showers come, or else in May. This is one of the most extensive vegetation types in the Deccan, including the association of *Tectona grandis- Anogeissus latifolia-Terminalia tomentosa*, which is transitional between the Wet Deciduous and other dry vegetation types. Falling within this grouping is the Red Sanders Forest of Kurnool, Chittoor and Nellore. These forests have an uneven and loose canopy of trees, most of which are shared with the adjacent moist deciduous zone. *Phyllanthus emblica* L. is reported from these forests, as is the jujube (*Zizyphus mauritania* Lam.), and other *Zizyphus* spp. *Acacia* spp. and other thorny shrubs are part of this vegetational zone, as are a larger number of grasses, including *Andropogon* spp. and *Panicum* spp.

The *Anogeissus-Hardwickia* subtype of this forest type is considered to be the climax condition of much of the eastern peninsula, the southern Cuddapah district and parts of Anantapur, which lie to the south and east of the driest part of the central peninsula in this region. This and the previously mentioned variant occur on hills and more water retentive soils in central Karnataka, such as the Sandur Hills area west of Bellary. The central portion of the southern Deccan, including the Bellary and Chitradurga Districts, Raichur and Shorapur Doabs, falls within the region with the
lowest annual rainfall on the Indian peninsula. Variant of this type are now classed as 'Dry Evergreen'.

4.4 Geographical Divisions of Karnataka

Karnataka occupies an advantageous geographic position on the western half of peninsular India. It is bordered on the northwest by Goa, on the north by Maharashtra, on the east by Andhra Pradesh, on the south by Kerala and Tamil Nadu and to the west is the Arabian Sea.

Karnataka, in terms of physiography, rainfall and vegetation can be divided into four natural regions/ecosystems: the Karavali (coastal plain); the Sahyadris (Western Ghats); the Malnad (hilly region) and the Maidan (plain open country), which can be further divided into Northern Maidan and Southern Maidan.

4.4.1 The Karavali

The Karavali extends over 350 km from north to south and covers the coastal districts of Uttara Kannada and Dakshina Kannada. Geologically the area is represented by granite-greenstones and Quaternary alluvial and littoral formations. It is a narrow tract of land gradually rising in altitude from sea level to about 250 m at the foothills of the Western Ghats. The width of the tract never exceeds 70 km. The southern stretches are broader than the northern. However, in comparison with the coastal tracts of Maharashtra, Goa and Kerala, the Karnataka coast is relatively broader. The region is drained by 57 swift flowing rivers. The Kalinadi, Aghanashini, Gangavali and Netravati are some major rivers. These rivers are navigable by canoes and sail boats. Aided by fertile soil, a humid climate and an assured heavy rainfall (2000 to 4000 mm) the Karavali vegetation is of a mixed-evergreen type. The
foothills of the Western Ghats and the western escarpment are covered by woodlands and savannas of moist deciduous type. In the coastal region thickets tree savannas and scattered scrubs are found interspersed with cultivated lands. The deciduous and mixed forests (lighter stocked woodlands) provide considerably better grazing ground for large herbivores through most of the year. Elephants prefer to live in areas covered with tall deciduous forests, areas where the ground is hilly or undulating and where bamboo grows in profusion. They feed on various types of grasses and leaves. Gaur and sambar are common, spotted deer or chital rare, wild pig abundant. A variety of monkeys inhabit the region. Among the predators tiger and panther though rare are found over most of the area.

The prevailing hot and humid conditions support rice cultivation, and farming of coconut, areca, cashew, etc. the Karavali mineral resources include manganese and iron ore.

4.4.2 The Sahyadris

The Sahyadri plateau forms a continental divide and runs parallel to the west coast of Karnataka. The continental divide separates the west and east flowing rivers. In the north-south direction the height of the plateau caries between 1000 and 2000 m, and across the plateau in a west-east direction rises along the precipitous western scarp to peaks varying from 2000 m and slopes to 1300 m on the east. The core region is covered by evergreen rain forest and also reveals a vegetation gradient from west to east along the path of the monsoon rains (rainfall over 4000 mm). The medium elevation type (Memecylon umbellatum — syzygium cumini — actinodaphane augustifolia) occurs on the higher regions of the plateau. Moist deciduous forests (Lagerstroemia microcapra — Tectona grandis — Dillenia pentagyna type) are found
towards the east and beyond, where the rainfall becomes lower, and dry deciduous forests (*Anogeissus latifolia* – *Tectona grandis* – *Terminalia alata* type) make their appearance further east on the plateau. In the climax evergreen forest tree-leaves, woody matter, fleshy fruits are also abundant. This vegetal wealth adds to the food resources of mammals. Due to the absence of bamboo and low lying foliage this ecosystem is unsuitable for elephants and other grazing herbivores but supports a rich variety of insects, amphibian and reptilia because of the high humidity and ample scope for refuge. A study of the feed potential of the evergreen forest this habitat is eminently supports arboreal animals, wild-pig sloth bear whose dietary requirements are low.

Teak, rosewood and many other soft and hard woods are exploited by modern society. The region is also rich in minerals like iron-ore and manganese. The region forms the source of the plateau rivers that drain the southern Maidan, the rivers of the northern Maidan have their source in the Sahyadris of Maharashtra. The plateau forms the upland region of the coastal district of Karnataka. Cool and temperate conditions prevail over this area.

### 4.4.3 The Malnad

The Malnad is a transition zone from the higher plateau of the Sahyadris on the west to the lower peneplaned plateau on the east. It runs along the eastern ridge of the Sahyadris for a length of 650 km from north to south and includes the districts of Belgaum, Dharwad, Uttara Kannada, Shimoga, Chikmagalur, Hassan, Dakshina Kannada, Kodagu and Mysore. The region is a combination of hills, valleys, lush green forests and waterfalls. This is an area of very heavy rainfall (2000 to 4000 mm) on the leeward of the Western Ghats. Vegetation cover is similar to that of the
Karavali belt. Tubers are common. The Malnad forest gas a maximum width of about 50 km and along the Karavali belt encircles the evergreen rain forest of the Sahyadri. The region forms the headwaters of the youthful rivers flowing eastwards in deep valleys. The climate is also cool and temperate. The area is known for coffee plantations, sandalwood and spices. The population is thin and the settlements are generally along the Ghat routes. The lower slope of the region is known for wild life sanctuaries such as those at Dandeli (Uttara Kannada district), Bandipur and Nagarahole (Mysore district). The Malnad is rich in iron ore and mica.

4.4.4 The Northern Maidan

The Northern Maidan is a geologically old landscape with an extensive rolling plateau. It covers the districts of Bidar, Gulbarga, Bijapur, Raichur, Bellary, and parts of Dharwad and Belgaum. The region presents an endless cover of black cotton soil across open treeless scrubland. Between the castellated granitic tors - inselberg landscape there are pockets of red soil as well. The soil is rich and fertile but rainfall is so low (500 – 600 mm) as to qualify parts of Raichur and Bellary as arid on the ecological map of the Subcontinent. While Bellary records 30 annual rainy days the northern town of Gadag in Dharwad District records 45 rainy days. This region supports the cultivation of dry crops such as jowar, wheat, cotton, groundnut, castor and other oilseeds. The river Krishna is the arterial stream with major tributaries such as the Bhima, Tungabhadra, Malaprabha and Ghataprabha and drains about 60% of the area in Karnataka. The Manjra and Karanja rivers of the Godavari system drain the northern district of Bidar.

The region falls in the rainshadow zone of the southwest as well as the northeast monsoons. The vegetation cover is typical of scrubland ecosystems, is
dominated by Graminae, Tubuliflorae with Acacia, Artemesia, Rhamnaceae and Cyperaceae (Paddayya, 1982). This is much less productive when compared with the other ecosystems in Karnataka. It is suitable for deer (gazelle), some smaller mammals like the hare and to a lesser extent for the deer and the gaur. In areas of climax vegetation wherever preserved (like at Raichur and Ranibennur Reserve Forests) black-buck is abundant and the wolf is common. On the whole the occurrence of wild grazing animals is low. The vegetation includes grass, insects, herbs, tree-leaves, woody matter, fleshy fruits, seeds, frogs and lizards. Tubers are rare.

Geologically the northern Maidan is covered by a complex of granite-greenstones, basalts, Kaladgi sandstone-quartzites, Bhima limestones, cherts, dolerite, gabbro, etc. The terrain is a good repository of gold, copper, silver, iron ore, chromite, etc. Owing to extreme climatic conditions, its location far inland and low elevation (600 m AMSL) the climate is hot and dry and has typical scrubland vegetation. This phenomenon is peculiar to lower latitude grasslands when compared with those of higher latitude grasslands which are relatively more luxuriant and possess higher carrying capacities.

The region as a whole is very sparsely populated and the settlements are few and far between. This is the heartland of the nomadic Lamani community, the region possesses adequate subsurface water resource and the surface water collects in the granitic foothills and in the depressions along escarpments in the Kaladgi Basin,

4.4.5 The Southern Maidan

The river Tungabhadra divides the Northern Maidan from the southern one which lies at a relatively higher elevation (900 m AMSL) and also receives higher
rainfall (600 – 1000 mm). The climate of the region is also relatively mild and cool. The region is covered by moist deciduous and dry deciduous vegetation and is accompanied by shoals, intergrade by grass and shrubland. In climax forests grass is rare, whereas tree-leaves, woody matter, fleshy fruits and seeds are abundant along with the commonly occurring herbs, shrubs, bamboo, tubers and insects. This habitat is ideal for a variety of mammals and other species of animals. Rich in wild life the elephant population is very high and gaur, sambar, spotted deer, wild-pig and bonnet monkeys are ubiquitous.

Geologically the oldest rocks of the earth form the basement of this region comprising a wide variety of mineral resources such as gold, copper, mica, magnesite, bauxite, silver, etc. The southern Maidan includes the districts of Chitradurga, Tumkur, Mandya, Bangalore and Kolar and parts of Shimoga, Chikmagalur, Hassan and Mysore. The extensive cover of red soils is in contrast with that of the northern Maidan. The topography is similar to the granitic terrain of the northern Maidan but there is a cover of deciduous teak forest marked with small trees and shrubs together with herbaceous plants. The river Kaveri and its tributaries such as the Hemavathi, Arkavati, Kabini and Shimsa drain the region.

4.5 Geology and Soils

The peninsular India is a large block of various igneous and metamorphic rocks broadly divisible into two regions

1. a northern and western one in which the Cretaceous Deccan Trap volcanic rocks dominate as bedrock and
2. the more southern and eastern one dominated by Archaean granites and gneisses.
The boundary between these geological regions lies in northern Karnataka in the Bijapur and Gulbarga districts, and runs north-south nearly on the western boundary of the state of Andhra Pradesh. On these Deccan Traps, deep black soils (known as “black cotton soil” or “regurs”) which are highly fertile have developed. These soils also occur in the granitic zone along the courses of the Bhima, Krishna and Tungabhadra rivers, thus covering much of the Raichur and Shorapur doabs. The black colouration is mostly due to the moisture retaining nature of the soil and making it available to plants long after rains have stopped. The property of black soils of expanding and contracting to an unusual degree results in the thorough mixing of the soil vertically. The montmorillonitic nature of soil causes moisture retention and in turn causes it to be of a darker colour. The palaeo black soils formed due to the erosion of the Deccan Trap are transported by rivers like the Krishna and Tungabhadra and are deposited. Thus the deposited black soils are shallow when compared to the deep deposits of the Deccan Trap area.

The granitic terrain, which includes the Bellary, Anantapur and western Kumool districts, is largely covered by lighter black soil (vertisols) mixed with red, sandy soils that form around the granite hills. The granitic super-region is criss-crossed by dykes of intrusive dolerite rocks, which served as the raw material source for the Neolithic ground stone industry.

The northwestern portion of the southern region (focusing on the Dharwad district) consists of greenstone formations (Dharwar schists, metavolcanics, etc.). The upper Tungabhadra, flows through this terrain. Light reddish loamy soils form on this geology, although this represents a narrow strip of soil bordered on the west by the laterite of the Western Ghats. The Dharwar schists contain exploitable deposits of iron.
Other schist belts in Karnataka contain deposits of gold, such as the Hutti-Maski Belt which extends through the western Raichur Doab and the Shorapur Doab, and the Kolar schist band in southeastern Karnataka. Ancient mining sites exist along the Hutti-Maski beds in the same general areas as Neolithic sites, suggesting that exploitation may date back to the Neolithic times.

The geological history of Karnataka is mainly confined to the two oldest eras—the Archaean and the Proterozoic. The later periods of the geological timescale from the Cambrian onwards are not represented in the geological history of Karnataka apart from some minor deposits of Recent age in the Western Coast and the Deccan Trap. A large part of North Karnataka is covered by the Deccan Trap, the basaltic lava from the volcanic lava from the Cenozoic era.

According to Radhakrishnan and Vaidyanadhan (1997), there are four main types of geological formations in Karnataka:

1. The Archean complex made up of Dharwad schists and granitic gneisses: These cover around 60% of the area of the state and consist of gneisses, granites and charnockite rocks. Older Gneiss Complex is the basement for a widespread belt of schists. A younger group of gneissic rocks mostly of granodioritic and granitic composition is found in the eastern parts of the State. The next in the order of age are the schist belts first the auriferous and then the Dharwar schists. The narrow belt of younger closepet granites marks the end of the Archaean era. Some of the minerals found in this region are dolomite, limestone, gabbro, quartzite, pyroxenite, manganese and iron ores and metabasalt.

2. The Proterozoic non-fossiliferous sedimentary formations of the Kaladgi and Bhima Series: The Kaladgi Series has horizontal rocks that
run for 160 km in the districts of Belgaum, Raichur, Dharwad and Bijapur districts. The Bhima series that is present on either side of the Bhima River consists of rocks containing sandstone, limestone and shale and this is present in the Gulbarga and Bijapur districts.

3. The Deccan Trappean and Intertrappean deposits: This is a part of the Deccan traps which were formed by the accumulation of basaltic lava. This is made up of greyish to black augite-basalt.

4. The Tertiary and Recent Laterites and Alluvial deposits: Laterite capping are found over the Deccan Traps and were formed after the cessation of volcanic activity in the early tertiary period. These are found in many districts in the Deccan plateau and also in the coast.

The area of interest in this work lies in the heart of the Deccan plateau and the geology of the Bellary-Raichur is of much importance. This region like most parts of the Deccan Plateau has a basement of the Archaean Gneiss complex mostly of the Younger Gneissic Complex with a composition of granodiorites and granites. These Gneisses are dated to 3.0 2.6 Ga and encloses the auriferous schist belts. There are four narrow auriferous schist belts, namely, Hutti-Maski Schist Belt, Manglur Schist Belt, Hungund-Kushtagi Schist Belt and the Deodurg-Raichur Schist Belt. The metasediments in these schist belts include minor cherts, banded iron-formation, garnet-bearing rocks and biotite-schist. The gold mineralization in these belts has resulted in many ancient gold workings throughout the area. The belts are intruded by the younger granites. The Sandur basin in the region belongs to the schist belts of the Dharwar type and is characterised by manganiferous greywacke, phyllite and numerous bands of banded magnetite and haematite quartzite (banded iron
formation). The basin is known for its rich accumulation of both iron and manganese ore. Like the Auriferous Schist Belts, the Sandur Basin also has intrusive younger granites.

A striking feature in the geological map of Karnataka is the occurrence of a long linear belt of granite extending in a N-S direction for nearly 500 km and keeping an average width of about 20 km. The linear aspect of the belt extends from Kabbal in the south to Bellary in the north for about 300 km and the granites spread out over a wider region north of Bellary. These granites lie between the Archaean nucleus in the west and a younger remobilized and reactivated block of the Purana Basins belonging to the Proterozoic era to the east. The granites generally form high hills and are abruptly demarcated from the surrounding gneissic plains. These lofty masses of granite with their characteristic weathering into spherical boulders of immense size, bare of vegetation, form some of the most picturesque hill masses of Karnataka. Physiographically, there is a clear-cut demarcation of the granite belt, the younger granite forming a hilly rugged country, in contrast to the featureless plains formed of the older gneisses. These younger granites hold the Sandur Schist Belt as an enclave, surrounding it on all sides.

The most characteristic rock type of these Younger Granites is the coarse-grained porphyritic granite with tabular and prismatic crystals of K-feldspar. These granites are the youngest intrusives in the Archaean complex of Karnataka with an age of around 2600 m.y. Coarse porphyritic grey and pink granites occur as oval to circular plutons and the rock is rudely foliated.
Fig. 4.2: Sketch map showing the distribution of deep black soils (dark banded) and shallow (thin lines) soils in Karnataka.

Towards the north of the Younger Granites consisting of the modern districts of Belgaum, Bijapur, Bagalkot, Gulbarga are the Purana Basins of Kaladgi and Bhima of the Proterozoic Era. Orthoquartzite (quartzitic sandstone), argillite (shale and mudstone) and carbonates (including dolomite and limestone) are the principal sediments comprising the Kaladgi sequence. Conglomerates of cobble-sized quartzite, vein quartz and cherts, fragments of jasper and chert breccia are also found in plenty in the Kaladgi Basin. Parts of north and west of the Kaladgi Basins are covered by the Deccan Traps. The Bhima Basin extends over the modern districts of Bagalkot and Gulbarga Districts of Karnataka. The lithology of the region consists of shales,
limestone, sandstone and quartz conglomerates. The end of Archaean era saw dyke activity and thus the Purana Basins do not consist of any dykes. Dolerite dykes are abundant in the areas belonging to the Younger Gneissic Complex mainly the Closepet Granites.

4.6 Geography of Kurnool-Cuddapah region

The interior plateau extends east of the Western Ghats and also slopes eastwards and hence the drainage of all major rivers. The three largest drainage systems are the Godavari, Krishna and Kaveri. The Bhima, Tungabhadra, Malaprabha, Ghataprabha, etc. are the other major tributary streams. In the eastern half of the peninsular and south of lower Krishna, the Pennar river is the watershed with its tributary from north the Kunderu.

The areas of land between the confluences of two major, roughly parallel rivers, is often referred to as a Doab, notably the Shorapur Doab west of where the Bhima joins the Krishna, and the Raichur Doab where the Tungabhadra joins the Krishna. The plateau area south of the Raichur Doab and Tungabhadra river is sometimes referred to as the Rayalaseema (the territory of the medieval Rayas of Vijayanagara).

Along the eastern side of the peninsula, hills that divide off the coastal strip are patchy, with the Eastern Ghats being confined largely to the area of Orissa, northwestern Andhra Pradesh, and in southern Andhra Pradesh and northern Tamil Nadu. The latter group of the Eastern Ghats extends westwards as a series of hill chains running roughly north- south: the Velkonda, Nallamalai and Erramalai. The Nallamalais are the highest and most extensive of these hills. They have traditionally been inhabited by 'hill tribes' including the Chenchus and Yanadis and are separated
from the Erramalai by the plain of the Kunderu river (Nandyal valley), the valley through which the artificial Kurnool-Cuddapah canal runs. It is the Erramalai on the northwest, and the Seshachalam hills, on the southwest, that divide the hills and valleys of the limestone-shale landscape of southern Andhra (the Cuddapah basin geological series) from the granitic peneplain of the Anantapur district of Andhra and north-eastern Karnataka. This western plateau area extends as far as the western Ghats in the southern Deccan (Mysore Plateau). This area, approximately the old Principality of Mysore (with the addition of Kunderu valley) is a well-recognised historical geographical area, separated from the Tamil-speaking plains of the southeast. The rise from the Tamil plains to the Mysore plateau is delineated by the southern groups of Eastern Ghats (Nagari, Javadi and Shevaroy), which run southwest to join the Western Ghats in the high hills of the Nilgiri and Annamalai. This area can be separated from Maharashtra on the north on both linguistic and geological grounds.

Like in the case of geology so also physiographically, the Cuddapah basin has a distinct imprint. The landforms occurring in Cuddapah basin are predominantly formed as the result of geologic structures. The prominent landform units are the escarpments and the sharp-crested ridges. Isolated tablelands and intermontane valleys are also noticed in the region. The entire Rayalaseema region has the ‘hot steppe’ climate and the annual average rainfall in the region is between 50cm to 90 cm.

4.7 Geology and Soils of Kurnool-Cuddapah Region

East of the granitic terrain of Bellary-Anantapur is a crescent-shaped geological region stretching from the Krishna river to south of the Pennar river just east of Cuddapah city. As described above, this geological region is defined by three
hilly hill ranges, the Velikonda, the Nallamalai and the Erramalai. The eastern area of this crescent, including the Nallamalai is the Cuddapah supergroup, while further west, i.e. much of the Nandyal valley and the Erramalai, is the Kurnool supergroup. The geologically earlier and generally eastern portion is the Cuddapah supergroup comprised largely of alternating quartzites and shales with numerous igneous intrusions, including dolerites, basalts and some granites. The shales are rich in argillaceous sediments that provide parent materials for the clay-rich black cotton soils found in the Kunderu river valley. The later and westerly Kurnool supergroup is composed of quartzites (which served as a raw material source to the prehistoric man) and shales as well as sandstones and limestones. The western part of this supergroup is capped by grey-brown soils classified as red earths with clayey subsoils.

The geological record of Andhra Pradesh is continuous from the Older Supracrustals and Dharwar Schists of the Archaean period to the Laterites and alluvium, river terraces of the recent Holocene age. Like already mentioned, the region under study is the Kurnool-Cuddapah region which belongs to Purana Basins of the Middle Proterozoic Era. The region in question is belongs to the larger Cuddapah Supergroup which comprises of three subgroups. The Cuddapah Basin has formed on a cratonic part and belongs to the period of Middle and Late Proterozoic. The deposits in this basin are due to the mechanical erosion and chemical weathering of vast stretches of exposed continental crust and so are clastic sediments associated with chemical precipitates. The crescent shaped Cuddapah Basin in the south-central part of the state covers parts of Chittoor, Anantapur, Cuddapah, Kurnool, Mahabubnagar, Nalgonda, Guntur and Krishna Districts. The basin is surrounded by the Archaean gneisses on the northern, western and southern sides and to the east of the Basin is the metamorphosed Dharwar schists. Two litho-stratigraphic groups, each
with distinctive rock assemblages and ages, constitute the Cuddapah Basin. The lower and older Cuddapah Supergroup occupying the entire basin, is overlain in the western part by the younger Kurnool Group. The former is composed mainly of arenaceous and argillaceous sediments with minor carbonates and the latter consists of carbonate sediments with minor clastics.

The Cuddapah Supergroup is predominantly comprised of argillaceous and arenaceous sequences with subordinate calcareous sediments. The Cuddapah Supergroup is characterised by three formations (Papaghni, Chitravati and Nallamalai) and each of these starts with quartzite and ends with shale representing cyclic repetition of quartzite-shale sequence reflecting successive transgressions and regressions in the basin. Igneous activity at the time of sedimentation is manifested as sills of dolerite, Kimberlite dykes, flows and other intrusives.

The Kurnool Subgroup overlies the Cuddapah sediments in the west-central part of the Cuddapah basin. The Kurnool sub-basin in the Kunderu valley occupies parts of Kurnool, Cuddapah and Anantapur Districts. The litho-stratigraphy of the Kurnool supergroup has repetitive succession of the quartzite-limestone-shale sequence. Banganapalli quartzite consists of dark red, grey or brown sandstone which is coarse-grained and gritty and consists a zone of conglomerate. It is feldspathic and ferruginous. This is overlain by the Narji limestone, a highly siliceous limestone with pink and purple colour and thin lenticular lenses of gritty ferruginous sandstone. The succeeding buff, white, purple Owk Shale is covered by the ferruginous Paniam Quartzite with conglomerates. The Koilkuntla Limestone which follows is siliceous in nature and is overlain by the Nandyal Shale with earthy calcareous shale intercalations. The cyclic deposition of quartzite-shale with carbonate rocks and the nature of conglomerates and quartzite point to a shallow marine shelf environment.
The larger area of Cuddapah Basin is covered by three different kinds of soil. The Red earth with clayey sub-soils is found in Kurnool and Anantapur districts in association with black soil. The surface soil is brown to red-sandy loam and the subsoil is clay loam. The districts of Cuddapah and Nellore and some other parts of Rayalaseema are covered by Red loamy soils which are shallow to moderately deep and are of coarse to moderate textured with fine loamy to clayey sub-soils. The top soil is pale brown to reddish brown with uniformly reddish brown to dark reddish coloured subsoils. These are found in gently undulating plains under moderate erosion. The Black soils are seen in parts of Cuddapah, Kurnool and Mahabubnagar Districts. These soils are highly fertile and have high clay content.