CHAPTER III

LAND SYSTEMS AND MORPHOLOGICAL FEATURES OF THE PENNAR BASIN

The Division of the Land use Research, CSIRO of Australia developed the concept of Land systems. The mapping unit, the land system is defined by Christianan and Stewart (in Gunn et al. 1969) as an area of group of areas with a recurring pattern of topography, landforms, soil and vegetation. The pattern of recurrence is because landform and land unit developed on similar parent rock, under identical climatic conditions and geomorphic processes show similarities in form and soil, vegetation association. Cook etal . (1974), Iyer and Srinivasan (1977), Subramanyam (1978) and Raghavswamy and Vaidyanathan (1980) have carried out mapping of land systems using aerial photographs and Remote Sensing data.

The major land systems of the Pennar basin has been categorized into (Fig 3.1)

1. Hilly terrain
2. Undulating plains
3. Rolling plains
4. Fluvial plains
5. Deltaic plains
6. Coastal plains.

HILLY TERRAIN
The system consists of ridges, hills, mesas, buttes, inselberg, isolated hills and hillocks scattered all over the pediplains zone. The Pennar basin consist of Nallamalai hills, Erramalai hills, Lankamalai hills, Kadiri-Bukkapatnam hills, Penukonda hills, Madhugiri hills and Nandi hills. The Nallamalai, Erramalai, Lankamalai, Palakonda, Velikonda, Seshachalam, Thirumala, Muttsukota hills are formed of Proterozoic formations consist of shales, limestone, quartzite, dolomite with intrusive of basic igneous rocks and lava flows.
Fig. 3.1
NALLAMALAI HILLS

The Nallamalai hills ranges in altitude from 300 to 900 meters above MSL. They run almost north south in direction and extend from Jallavaram of Cuddapah district in the south to Macharla of Guntur district in north. They run to about 210 km in length and the width ranges from 15 km to 75 km. The Nallamalai are covered with diversified species of dry deciduous forests, moist deciduous forests, semi evergreen forests, bamboos, grasses, weeds, climbers, aquatics, scrubbers, parasites, epiphytes, economic plants and medical plants. The Gundla-Bramheswaram is an important biotic valley located near Velgode of Kurnool district.

ERRAMALAI HILLS

The Erramalai hills are located in Kurnool district. They run from northeast to southwest direction from Yadiki in south to Gadivemula in north. They run to a length of about 56 km. The altitude varies from 300 to 600 meters above MSL. The Erramalai hills are covered with bushes and scrubs. They are composed of rich minerals like limestone, dolomite, ochre, copper, serpentine, barites, clay stone and steatite.

LANKAMALAI HILLS
The Lankamalai hills are found between Jallavaram in north to Sidhout in the south to length of about 28 km. The maximum width of the hills is 22.5 km. The altitude varies from 200 to 900 meters above MSL. These hills are formed of shales and quartzite and constitute good biotic environment. The eastern part of Lankamalai hills are covered with degraded forest.

PALAKONDA HILLS

The Palakonda hills are found in between Sidhout in the north to Tirupathi in the south. They run in NW-SE direction to a distance of about 120 km. The maximum width of the hills is about 70 km. The altitude varies from 300 to 1150 meters above MSL. The Palakonda hills are formed of shales and quartzite. They are composed of rich biotic environment and are famous for Red Sandals. The southern tip of the hills is known as Thirumala hills and is famous for Lord Venkateswara temple.

VELIKONDA HILLS

The Velikonda hills orient north-south direction with a slight concavity from Renigunta in the south to Cumbum in the north. They run to a length of about 220 km and the maximum width of hills is 10 km. The Velikonda hills are formed of shales and quartzite. They are broken. The river Pennar cuts across the structure
of the Velikonda hills near Somasila. The altitude varies from 100 meters to 1100 meters above MSL.

**SESHACHALAM HILLS**

The Seshachalam hills run to a length of about 75 km and extend from Parnapalli in the north to Vempalli in the south. The orientation of hills is from NNW to SSE. The maximum width of the hills is 3 km. The hills are composed of shales and quartzite. The altitude varies from 300 to 700 meters above MSL.

**MUTSSUKOTA HILLS**

The Mutssukota hills runs to length of about 40 km from Mutssukota in the north to Parnapalli in the south. These hills are formed of shales, quartzite, dolomite and limestone. The maximum width of the hills is 10 km. The altitude varies from 300 meters to 600 meters above MSL. The Nallamalai, Erramalai, Lankamalai, Palakonda, Seshachalam and Mutssukota hills from kidney shaped structure enclosing Kunderu basin and Tadipathri-Pulivendula basin. The whole structure is named as Cuddapah basin.

**KADIRI-BUKKAPATNAM HILLS**

The Kadiri-Bukkapatnam hills are composed of granitic-gneisses. They run to length of about 75 km and are discontinuous and isolated hills. The hills are
formed of scrubs and bushes. The altitude varies from 300 to 950 meters above MSL. The Bukkapatnam hills are formed of linear ridges, structural valleys and intrusive rocks consisting of dolerite and gabbro. These hills orient from northwest to southeast in direction.

**PENUKONDA HILLS**

The Penukonda hills consist of broken hills with a length of about 35 km. These hills are formed of granitic gneisses. The hills are covered with scrubs and bushes. The orientation of hills is northwest-southeast. The altitude varies from 600 to 950 meters above MSL.

**NANDI HILLS**

The Nandi hills are formed of granitic gneisses and lay the southern tip of Pennar River. The river Pennar originates in the Nandi hills. The orientation of the hills is north-south. The altitude varies from 600 to 1500 meters above MSL.

**MADHUGIRI HILLS**

The Madhugiri hills lie on southwestern part of the Upper Pennar basin and are broken. They run to length of about 125 km. They are formed of closepet granites. The altitude varies from 600 to 1250 meters above MSL. These are
isolated hills and are covered with scrubs and bushes. They extended from Hosakote in the north to Dodaballapur in the south.

**UNDULATING PLAINS**

The undulating plains consist of mainly shallow weathered pediplains, moderately weathered pediplains, deeply weathered pediplains, pediment inselberg complexes and sandstone lateritic uplands. The slope in these plains varies from 3 degrees to 10 degrees. The plains are lying parallel to hilly terrain. They are composed of granitic gneisses, shales and quartzite. The depth of soil varies from 0.5 to 1 meter. In granitic terrain the undulating terrain is composed of mainly pediment inselberg complex and pediplains. The undulating plains are used for cultivation of groundnut crop during kharif season. Rill and ravine erosion are noticed in a few pockets.

**ROLLING PLAINS**

The Rolling plains consist of mainly black soil plains formed in the Kunderu basin and Tadipathri-Pulivendula basin. The slope is very gentle and is less than 3 degrees. The Cuddapah basin is formed of mainly rolling plains. The insitu rocks are mainly shales and quartzite. The black soil plains are used for cultivation of cotton, coriander, bengal gram, groundnut, sunflower, chilies and
paddy in irrigated tracks under canal, tanks, or well irrigation. The depth of soil varies from 1 to 3 meters.

**FLUVIAL PLAINS**

They are formed in the Pennar, Chitravathi, Papagni, Cheyyeru, Kunderu and Sagiluru rivers. The Pennar River has developed a distinct valley from Tadipatri to Nellore. The width of valley varies from 0.5 to 3 km. The valley is filled with alluvial soils. The slope is very gentle. The water resources found are abundant in the fluvial plains in unconfined form. The depth of alluvial sediments varies from 10 to 30 meters. The River Kunderu also developed a distinct fluvial valley in the Cuddapah basin. The thickness of sediments varies from 10 to 13 meters. Paddy, sugarcane, turmeric, betelnut, groundnut, fruits and vegetables are cultivated in the fluvial plains.

**DELTAIC PLAINS**

The river Pennar has developed prominent delta covering an area of about 2700 km² at the apex from Nellore. The delta is formed of alluvial soils. The slope is gentle and is less than 3 degrees. The deltaic plains are boarded by sandstone lateritic uplands. The depth of sediments exceeds 1 km in the Pennar deltaic region. The delta is formed of abandoned river courses filled with fluvial sediments. The Pennar delta is used for cultivation of paddy, banana, sugarcane,
pulses, fruits and vegetables. The groundwater potential is found in unconfined aquifers.

**COASTAL PLAINS**

The coastal plains consist of beach ridges, paleo lagoons, marshes, sand dunes and beaches. They are formed of mainly coarse sandy soils deposited by wave action. The ridges are disturbed by later fluvial process and human interference. The paleo lagoons and mashes are formed of alkaline clayey soils. These are converted into aqua-farms which are used for prawn culture and aquaculture. The slope is gentle and less than 3 degrees. The beach ridges are covered with cashew -nut, coconut and casuriana plantains along the Pennar coastal delta front.

**MORPHOLOGICAL FEATURES OF THE PENNAR BASIN**

The morphological features (landforms) of the Pennar basin are mapped through visual interpretation of IRS-IB Geo-coded data on scale 1:50,000 and FCC’s on scale 1:250,000 based on tonal variations, geomorphic processes and geomorphic agents involved in the formation of landforms, alignment parallel to hilly terrain, rivers and coast, texture, shape, shade, soils and land use (Fig 3.2). Field checks and field traverses have been carried out to identify the photo geomorphic maps.
The landforms have been categorized into denudational, fluviodenudational, fluvial, aeolian and coastal landforms. The denudational landforms are formed of structural hills, cuesta hills, mesas, buttes, structural valleys, pediment inselberg complex, residual hills, shallow pediplains, moderately weathered pediplains and deeply weathered pediplains. The structural hills are found in Nallamalai, Palakonda, Seshachalam, Velikonda, Mutssukota and Erramalai hills. These hills are formed of Proterozoic formation consisting of shales and quartzite. The structure of the hills resembles to that of a kidney. The orientation of structural hills is north-south in Nallamalai, Velikonda and parts of Erramalai hills. The orientation is northwest-southeast and north north-west and south-southeast and east to west in Palakonda, Seshachalam and Mutssukota hills. The enclave of these hills is responsible for formation of Cuddapah basin.

The cuesta hills are found in Palakonda and Erramalai hills. These hills orient north-northwest to south-southeast in the Cuddapah basin, northwest-southeast in Palakonda hills and northeast-southwest in Erramalai hills. These hills are also formed of Proterozoic formations consisting of shales and quartzite. Mesas and buttes are found as isolated hills in the Cuddapah basin. The pediment inselberg complex is found in the granitic gneiss terrain in the western and southern parts of the basin. These are composed red sandy soils. The altitude in these complexes varies from 300 to 600 meters above MSL. The structural valleys
are found in the Seshachalam, Mutssukota, Palakonda hills and in between Nallamalai and Velikonda hills (Badvel valleys) and in between Palakonda and Velikonda hills (Koduru valley). The shallow weathered pediplains are found in the granitic gneissic terrain in the southwestern parts of the basin and south of Seshachalam and Palakonda hills. The soil formation is poor and varies from 0.5 to 1 meter. The moderately weathered pediplains are found in the Cuddapah basin. They are formed of black soil plains. The concentration of black soils is high in Kunderu valley and Tadipathri-Pulivendula basins. The soil formation is moderate. It varies from 1 to 3 meters. The soils are composed of sticky and clayey soils. The slope is less than 3 degrees. Mostly dry food crops like cotton, coriander, groundnut, bengal gram, fruits and vegetables are cultivated in these plains. Groundwater in these plains is confined to weathered fissured and fractured zones. The intensity of erosion is moderate. The deep weathered pediplains are found in Badvel and Koduru valleys in structural valleys of Palakonda and Seshachalam hills. The soil formation is good. The thickness of soils varies from 5 to 15 meters. The ground water potential is good. Groundwater is confined to weathered fissured and fractured zones.

The fluvio-denudational landforms consist of valley fills and bajadas. The valley fills are confined to Badvel and Koduru valleys. These valleys are filled up with sediments derived from bordering hilly terrain. The depth of sediments varies
from 10 to 20 meters. The soil is rich and groundwater in this valley is confined to weathered fractured and fissured zones. In these soils fruits and vegetables are cultivated. In Koduru valley lemon, mango, pomegranate, papaya and orange are cultivated. The bajadas are found in the southwestern part of Koduru valley bordering the Velikonda and Thirumala hills. The soil formation is good. The bajadas are composed of deep red sandy soils. The thickness of sediments varies from 20 to 30 meters. Groundwater is confined to weathered, fissured and fractured zones. The bajadas are used for cultivation of fruits and vegetables in the Koduru valley.

The fluvial plains are composed of alluvial soils deposited in the river valley of Pennar, Chitravathi, Papagni, Cheyyeru and Kunderu rivers. These are composed mainly terraces, levees and flood plains. The thick of sediments varies from 10 to 20 meters. Groundwater is found in unconfined aquifers and groundwater recharge is high. Most of the fluvial plains are used for cultivation of paddy, banana, turmeric and betel nut. In few plains around Tadipathri guava, sapota, lemon, and pomegranate are cultivated. The sandstone lateritic uplands are found at the apex of the Pennar delta. The cashew nut and casuarinas are cultivated. The gravel is quarried from these uplands for road metal. The sandstone was formed during Mio-Pliocene period. The deltaic plains of the Pennar basin are composed of abandoned river courses, levees and flood plains. The abandoned
river courses are the former river courses of the Pennar River. About seven deltaic lobes have been identified based on deposition of abandoned river courses. The levees are formed along the banks of the river Pennar formed during flood periods. They are composed of rich silt soils and rich in composition of nitrates, phosphates and potash. The coastal plains of the Pennar basin are formed in the delta front of the Pennar River along the coastline. They are formed of beach ridges, marshes, dunes, beaches and spits. The beach ridges are used for cultivation of casuriana and cashewnut. They are acting as barriers to the coastal delta front. The marshes and paleo-lagoons are composed of alkaline clayey soils. These are used for cultivation of aqua farms both for prawn culture and aquaculture along the coastal zone of Pennar delta. The sands and beaches are seen along the present shoreline. The bars and spits are formed at the confluence Point of Pennar River. In course of time they develop into barriers and enclose a lagoon behind. Later the lagoon is filled up with sediments brought by the river and converts into marshy land and finally develops into new delta front. The aeolian landforms are found in a few pockets along the major Pennar River. Due to wind action the dry sands of the river bed are migrating over the banks and develop into sand dunes and encroach rich fertile alluvial soils. The aeolian action is also found along the coastal zone in the formation of sand dunes. The sands from beaches are migrated to backshore due to wind action during low tide period and develop into sand dunes.