Land is one of the prime factors of production. It is defined as the physical environment and includes climate, relief, soils, hydrology and vegetation. It is put into many uses and benefits. Development and maintenance of land resources are of paramount importance in meeting the existing demand for food, and fiber. Land units in natural form are not fit enough to be of effective use for productive purposes. Hence there is need to develop the lands appropriately according to land use. Land resources evaluation includes both qualitative and quantitative land classifications. It consists of the study of physical characteristics to classify the land suitable for cultivation and land not suitable for cultivation. Young (1978), described six basic principles of land suitability and land evaluation. Kellogy (1961), described soil productivity as that quality of a soil, which summarizes its potential for producing specified plants or sequences of plants, under defined sets of management practices. Anderson (1971), Hilwing et. al. (1974), Anderson et. al. (1976), Van Genderan et al (1978) and Robinson and Spieker (1978), have described the principles of land use and land cover mapping using remote sensing data. Anderson (1971) and Ackerson and Fish (1980), studied land use and land cover classification of different terrains. In India Shafi (1969), has given a good account of methods and techniques of land use planning, land classification and land capability. Ali Mohammed (1978), described the land capability classification based on slope, erosion, susceptibility, stoniness, salinity, presence of high water table, land use, soil texture, soil moisture and soil fertility. Gautham and Narayan (1982), have described the methods of land

The land resources of Chittoor district have been studied using remote sensing data (False colour composition scale on 1:250,000 (plate .2.1), IRS I-B Geo-coded data on scale 1:50,000). The data has been used to study the landforms, soils, land use and hydro-geomorphology. The Survey of India topographic sheets on scale 1:50,000 are used to study the relief, drainage, and slope of the district. Based on physical characteristics mainly relief, slope, landforms, geology, soils, land use and hydro-geomorphology, the land capability of Chittoor district has been brought out.

PHYSIOGRAPHY:

Physiographically Chittoor district is divided into mountainous plateau on the west comprising 31 mandals of Madanapalle Revenue division, and the plains on the east comprising the mandals of Puttur, Narayanaavaram, Vadamalapet, R.C.Puram, Karvetinagar, Vedurukuppam, S.R.Puram, Palasamudram, Nagari, Nindra, Vijayapuram, Pichatur, Nagalapuram, Sathyavedu, Varadayapalem, B.N.Kandriga, K.V.B.Puram, Thottambedu, Srikalahasti and Yerpedu. The broken Western Ghats are predominant in western region and gradually bend towards the sacred Tirumala hills passing through Chandragiri mandal. The mandals of Chittoor, G.D. Nellore, Putalaput, Penumur, Gudipala, Yadamari, Thavanampalle and Irala stand almost a dividing line between the western mountainous plateau region and eastern plain region. Altitudinally the western mountains plateau region ranges from 600 to
900 meters (Fig 2-1). The eastern plain region varies in altitude from 50 to 100 meters and less than 50 meters. The relief varies from 300 to 600 meters in central and northern mandals of the district. In between the central mandals and eastern mandals the altitude varies from 100 to 300 meters. The altitude exceeds 900 meters in the parts of Horsely hills located in western part of the district. The broken Eastern Ghats enter the district near Kuppam on south-west corner, and then pass northwards to the eastern parts of Palasamudram and Punganuru and bending towards east near the hills of Thirupati. At this spot the range is intersected by a long valley, which passes northwards into Cuddapah district. The general elevation is 762 meters. The spurs of Eastern Ghats run through Chittoor upto west of Puttur. A broad fertile valley runs through Puttur area closes on the eastern side by a range known as Nagari hills, which extends northwest into Srikalahasthi. These hills, which look like suddenly, upheaved over the valley, look like cliffs facing the valleys. The prominent cliff, popularly known as Nagari nose, is conspicuous for kilometers around. The Seshachalam hill over which the famous pilgrim center of Tirumala is located is perhaps one of the most picturesque spot in Chittoor district. The Horsely hills which have been developed as a picnic spot in Madanapalle area form a plateau engulfing Palamaneru, Punganuru, Madanapalle and Vayalpadu.

**DRAINAGE:**

There are no perennial rivers in the district. Some of the important minor rivers flowing in the district are the Papaghni, Pincha, Koundinya, Palar, Ponne, Arani, Swarnamukhi, Bahuda, Kalyani and Kusasthali. The Papaghni river rises in the Nandhi hills of Karnataka and after flowing through Madanapalle and Thambalapalle, enters Anantapur district. The Pincha, a tributary of Bahda river, rises in the forest of Avulapalle in Punganur mandal, flows northwards in Punganur and Vayalpadu before entering Cuddapah district to join the river Pennar. The Palar river takes its origin near Nandhidurg in Karnataka State and after flowing across Kuppam from north to south, it enters North Arcot district of TamilNadu. Ponne, a tributary of the Palar, takes its
origin in the western hills of Chandragiri and flows south words in Chittoor
district before joining Palar in North Arcot district. The Arani river takes off
near Thadaku village and after following through Puttur and Sathyavgdu enters
into Changalput district. The Swarnamukhi river rises in the Chandragiri hills
and passes through the broad valley of Tirupati town and reaches Srikalahasthi.
From Srikalahasthi it flows in a northeastern direction into Nellore district and
finally joins sea near Siddavaram. The rivers Kalyani, Kusasthali, Pedderu and
Chinneru are the other minor rivers that flow in the district (Fig :2-2).

GEOLOGY:

Geologically 2/3 of Chittoor district is occupied by rocks of Peninsular
gneissic complex and granitoids. The Peninsular gneissic complex in Chittoor
district comprises of a vast spectrum of lithovariants and exhibits wide variation
in their external forms, structural patterns and is their formation. They range
from uniformly banded gneisses to faintly foliated homogeneous granitoids.
The major litho-units exposed are migmatites and associated granitoids. The
older metamorphics namely amphibolities, mica-schist and ferruginous quartzite
occur as enclaves of different shapes and sizes. The older metamorphic rocks,
namely amphibolities, hornblende–quartz, mica-schist and banded ferruginous
quartzite occur as enclaves and also as detached bands with the migmatites.
Bands of amphibolites are restricted to the Kuppam area and southern parts of
Palamanceru. The bands of ferruginous quartzite are restricted in the
northwestern part. The youngest phase of acid igneous activity is manifested by
Quartz veins and reefs as shear/fracture fillings. The Nagari quartzites occur as
inliers amidst the Pullampet shales. They are pink in colour and they are
completely disturbed by fracture planes. The Pullampet shales are well exposed
in parts of Chittoor district near Karakambadi, Vedullacheruvu and Tirupati.
The outcrops of Baironkonda quartzites are seen exposed north of
Krishnapuram village. Quartzites are pale brown to purple in colour. (Fig 2-3 ).
SLOPE:

The slope of Chittoor district is worked out using Wentworth (1930) method, on scale 1:50,000. The slope units are categorized into nearly leveled slope, with less than 1°. They are formed in fluvial plains and colluvial valley fills of the district. The gently sloping category ranges from 1° to 3° and they are formed in wash plains bordering the fluvial plains. The moderately sloping units with 3° to 5°, slope are found in moderately weathered pediplains and shallow weathered pediplains of the district. The strongly sloping category with slope ranging 10° to 20°, are found in western broken Eastern Ghats consisting of residual hills and pediment inselberg complex. The very strongly sloping units with more than 20°, are found is the denudational hills on parts of the eastern hills of the district (Table 2-1, Fig 2-4).

LANDFORMS:

The major landforms are identified from study of IRS 1-B Geo-coded data on scale 1:50,000. They are denudational hills, residual hills, piedmont plains, moderately weathered pediplains, shallow weathered pediplains, colluvial valley fills, fluvial plains and wash plains. The denudational hills are located in the northeastern and eastern parts of the district in the form of Tirumala and Nagari hills. The altitude of these hills vary from 100 to 600 meters above MSL, The Tirumala and Nagari hills are composed of Proterozoic formations consisting of Cheyyaru quartizite and upper Gondwanas. The residual hills with pediment inselberg complex which are part of broken Eastern Ghats lie in northeast, southwest direction, enter Chittoor district near Kuppam pass through central uplands of Chittoor district before merging with Tirumala hills in north-eastern part of the district. They are composed mainly of unclassified crystalline rocks of granite gneisses, and granitoids of Archaean age. The altitude of these hills varies from 300 to 900 metres above MSL. The piedmont plains are found around the Nagari hills and eastern parts of Tirumala hills. They are composed of colluvium with medium to coarse-grained deep red sandy soils. The thickness of colluvium ranges from 10 to 30 metres.
moderately weathered pediplains are found in the western uplands of the district. The weathering varies from 5 to 10 metres. They are formed by coalescence of pediments with shallow soil formation. The shallow weathered pediplains are formed in northeast and eastern plains in between Tirumala and Nagari hills. The depth of weathered zone varies from 3 to 5 metres. The colluvial valley fills are found in central residual hills and western uplands, They consist of colluvium mixed with clayey soils and are used for cultivation purposes. The fluvial plains constitute the flood plains. They are located along the Swarnamukhi river valley in a narrow band. They are composed of alluvial soils deposited by river Swarnamukhi during flood periods. The wash plains are found parallel to the fluvial plains in narrow band and consist of mixed soils derived from shallow weathered pediplains and fluvial plains (Fig 2.5).

SOILS:

The major soils of Chittoor district are red sandy soils, alluvial soils, mixed soils and insitu soils. The insitu soils are found on the Tirumala hills, Nagari hills and residual hills with pediment inselberg complex. They are divided from the basic lithological units present in the hills. The deep red sandy soils are found in the piedmont plains of Tirumala and Nagari hills. The depth of these soils varies from 10 to 30 metres. The moderate red sandy soils are noticed in colluvial valley fills and part of shallow weathered pediplains. They consist of medium to fine red sandy loams with thickness of soil varying from 5 to 10 metres. The shallow red sand soils are found in moderately weathered pediplains and shallow weathered pediplains. They are also loamy near tanks. The thickness of soils varies from 1 to 3 metres. The alluvial soils are found along the Swarnamukhi River in the flood plain. The rich clayey soils are deposited by Swarnamukhi river during flood period. The thickness of alluvial soils vary from 10 to 30 metres. The mixed soils are found as wash plains bordering the fluvial plains. They consist of colluvial and clayey soils (Fig. 2.6).
### SLOPE UNITS OF CHITTOOR DISTRICT

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>SLOPE</th>
<th>SLOPE CATEGORY</th>
<th>LAND FORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&gt;1°</td>
<td>Nearly leveled plains</td>
<td>Fluvial plains and collivial valley fills.</td>
</tr>
<tr>
<td>2</td>
<td>1°-3°</td>
<td>Gently sloping</td>
<td>Wash plains.</td>
</tr>
<tr>
<td>3</td>
<td>3°-5°</td>
<td>Moderately sloping.</td>
<td>Moderately weathered pediplains and shallow weathered pediplains.</td>
</tr>
<tr>
<td>4</td>
<td>5°-10°</td>
<td>Strongly sloping</td>
<td>Piedmont plains</td>
</tr>
<tr>
<td>5</td>
<td>10°-20°</td>
<td>Very strongly sloping</td>
<td>Residual hills with pediment inselberg complex.</td>
</tr>
<tr>
<td>6</td>
<td>&gt;20°</td>
<td>Steeply sloping</td>
<td>Denudational hills</td>
</tr>
</tbody>
</table>

Table: 2-1
LAND USE:

The land use of Chittoor district has been studied using Geo-coded data of IRS 1-B of September 1998. The broken Eastern Ghats consisting of residual hills with pediment inselberg complex are covered with degraded forests. A thick forest is found in Tirumala and Nagari hills. The undulating upland consists of wastelands with or without scrubs. The barren hills with ridges and rocky outcrops are scattered as wastelands in western uplands, central residual hills and eastern plains. The salt effected land is found in small pockets in eastern plains. The cropped area both under wet and dry conditions is found in central and eastern plains. The western upland consists of mainly cropped area under dry conditions (rainfed). Lakes and tanks are found in western uplands and eastern plains (Fig 2.7).

HYDRO-GEOMORPHOLOGY:

The hydro-geomorphology map of Chittoor district has been prepared using IRS 1-B Geo-coded data and geo-hydrological characteristics present in different lithological formations. The excellent ground water potential is found in Swarnamukhi flood plains or fluvial plains. The depth of ground water varies from 3 to 5 metres. The very good ground water potential is noticed in wash plains. The good ground water potential is found in piedmont plains. The depth of ground water level ranges from 5 to 8 metres. The very fair ground water potential is found in colluvial valley fills. The ground water recharges colluvial valley fills from the surroundings uplands. The depth of ground water level varies from 6 to 9 metres. The fair ground water potential is found in moderately weathered pediplains and shallow weathered pediplains. The depth of ground water level ranges from 8 to 12 metres. The poor ground water potential is noticed in residual hills and pediment inselberg complex. The runoff zone is found in Tirumala and Nagari hills (Fig 2.8).
LAND CAPABILITY:

The land capability of Chittoor district has been evaluated based on physical characteristics namely landforms, slope, soils, land use, hydro-geomorphology and intensity of erosion. Eight classes of land are recognised (Table 2.24 & Fig 2.9).

Class-I:

The class I land consists of fluvial plains and flood plains of Swarnamukhi river. The slope is less than 1°. The soils are alluvial. The land use is cropped land under irrigation. The ground water potential is excellent. The intensity of erosion is low. The land development activities that could be taken up are land leveling and land mulching. The proposed crops that could be cultivated in class I category of land are paddy, sugarcane, sunflower, groundnut, fruits and vegetables.

Class- II:

The class II land consists of colluvial valley fills consisting of mixed colluvial red sandy loams. The slope is less than 1°. The land use is cropped land under wet and dry conditions. The ground water potential is very fair. The intensity of erosion is low. The land development activities are land leveling and land mulching. The proposed crops recommended for cultivation are paddy, sugarcane, sunflower, groundnut, fruits and vegetables.

Class- III:

The class III lands consist of wash plains. The slope varies from 1° to 3°. They are gently sloping. The soils are sandy and clayey. The cropped land is under wet conditions. The ground water potential is very good. The intensity of erosion is very low. The land development activities are land leveling and land mulching. The crops recommended for cultivation are groundnut, sunflower, fruits and vegetables.
## LAND CAPABILITY OF THE CHITTOOR DISTRICT

<table>
<thead>
<tr>
<th>SL No.</th>
<th>CLASS</th>
<th>LAND UNITS</th>
<th>SLOPE</th>
<th>SOILS</th>
<th>LAND USE</th>
<th>HYDRO-GEO-MORPHOLOGY</th>
<th>INTENSITY OF EROSION</th>
<th>LAND DEVELOPMENT ACTIVITY</th>
<th>PROPOSED LAND USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I</td>
<td>Fluvial plains</td>
<td>&gt;1°</td>
<td>Alluvial</td>
<td>Cropped land with wet</td>
<td>Excellent</td>
<td>Low</td>
<td>Land leveling &amp; land mulching</td>
<td>Paddy, sugarcane, sunflower, groundnut, fruits &amp; vegetables</td>
</tr>
<tr>
<td>2.</td>
<td>II</td>
<td>Colluvial valley fills</td>
<td>&gt;1°</td>
<td>Mixed red sandy</td>
<td>Cropped land with (wet &amp; dry)</td>
<td>Very fair</td>
<td>Low</td>
<td>Land leveling &amp; land mulching</td>
<td>Paddy, sugarcane, groundnut, sunflower, fruits &amp; vegetables</td>
</tr>
<tr>
<td>3.</td>
<td>III</td>
<td>Wash plains</td>
<td>1°-3°</td>
<td>Sandy clayey</td>
<td>Cropped land (wet)</td>
<td>Very good</td>
<td>Low</td>
<td>Land leveling &amp; land mulching</td>
<td>Groundnut, sunflower, orchards, mango, citrus, lemon, orange, fruits &amp; vegetables</td>
</tr>
<tr>
<td>4.</td>
<td>IV</td>
<td>Piedmont plains</td>
<td>5°-10°</td>
<td>Deep red sandy</td>
<td>Cropped land (wet &amp; dry)</td>
<td>Good</td>
<td>Moderate</td>
<td>Land leveling, land bunding &amp; land mulching</td>
<td>Dry food crops soybeans, Groundnut, sunflower, and fruits &amp; vegetables, watershed development programme</td>
</tr>
<tr>
<td>5.</td>
<td>V</td>
<td>Moderately weathered pediplains</td>
<td>3°-5°</td>
<td>Moderately red sandy</td>
<td>Cropped land (dry) Undulating upland with or without scrubs</td>
<td>Fair</td>
<td>High</td>
<td>Land leveling, land bunding &amp; land mulching</td>
<td>Dry food crops soybeans, Groundnut, sunflower, and fruits &amp; vegetables, watershed development programme</td>
</tr>
<tr>
<td>6.</td>
<td>VI</td>
<td>Shallow weathered pediplains</td>
<td>3°-5°</td>
<td>Shallow red sandy</td>
<td>Cropped land (dry &amp; wet) Barren hills or rocky outcrops</td>
<td>Fair</td>
<td>High</td>
<td>Land leveling, land bunding &amp; land mulching</td>
<td>Afforestation activities to arrest soil erosion, watershed development programme</td>
</tr>
<tr>
<td>7.</td>
<td>VII</td>
<td>Residual hills</td>
<td>10°-20°</td>
<td>In situ soils</td>
<td>Degraded forest</td>
<td>Poor</td>
<td>High</td>
<td>land bunding &amp; land terracing</td>
<td>Afforestation activities to arrest soil erosion, watershed development programme</td>
</tr>
<tr>
<td>8.</td>
<td>VIII</td>
<td>Denudational hills</td>
<td>&gt;10°-20°&gt;20°</td>
<td>In situ soils</td>
<td>Thick and degraded forest</td>
<td>Run-off</td>
<td>High</td>
<td>Land terracing, terrace bunding slope above 20° should not be disturbed</td>
<td>Afforestation activities to arrest soil erosion, watershed development programme</td>
</tr>
</tbody>
</table>

Table: 2.2
**Class-IV:**

The class IV lands consists of piedmont plains. The slope is strongly sloping and varies from 5° to 10°. The soils are deep red sandy soils. The land use is cropped land under wet and dry conditions. The ground water potential is good. The intensity of erosion is moderate. The proposed land development activities are land leveling, land bunding and land mulching. The recommended crops for cultivation are dry food crops, soybeans, groundnut, sunflower, fruits and vegetables. The watershed programmes should be taken up in this category of land.

**Class-V:**

Class V land consists of moderately weathered pediplains. The slope varies 3° to 5°. The soils are moderately red sandy soils. The land use categories are cropped land under dry conditions and the undulating uplands with or without scrubs. The ground water potential is fair. The intensity of erosion is high. The land development activities recommended are land leveling, land building and land mulching. The recommended proposed crops are groundnut, sunflower, soybeans, fruits and vegetables. The watershed programmes should be implemented for conservation of land and water resources in this category of land.

**Class –VI:**

This category of land consists of shallow weathered pediplains. The slope varies from 3° to 5°. The land use is cropped land under dry and wet conditions and barren hills or rocky outcrops. The ground water potential is fair. The intensity of erosion is high. The land development activities recommended are land leveling, land bunding, and land mulching. The crops recommended are dry food crops, soybeans, groundnut, sunflower, fruits and vegetables. Afforestation activity has to be taken up to minimise soil erosion. The watershed development programme should also be implemented is this category of land.
Class -VII:

It consists of residual hills and pediment inselberg complex. The slope ranges from 10\(^{\circ}\) to 20\(^{\circ}\). The soils are insitu. The land is categorised into degraded forests with scrubs. The ground water potential is poor. The intensity of erosion is high. The proposed land development activities are land bunding and land terracing. Afforestation activity has to be taken up to arrest soil erosion. The watershed development programme should be implemented for conservation of soils in this area.

Class-VIII:

This class of land consists of denudational hills. The slope ranges from 10\(^{\circ}\) to 20\(^{\circ}\) and more than 20\(^{\circ}\). The soils are insitu. Land use categories are thick and degraded forests. Hydro-geomorphologically the class VIII lands are run-off zones. The intensity of erosion is high. The land development activities are land bunding and land terracing. Slope above 20\(^{\circ}\) should not be disturbed. Afforestation activity has to be carried out to arrest soil erosion in degraded forest areas. Watershed programmes should be implemented for conservation of land, soil and water resources.