CHAPTER IV
Gujarat forms the western-most part of India and is situated between 20.1 and 24.7 degrees N-latitudes and 68.4 to 74.4 degrees East longitudes. It is bounded by Arabian Sea on the West, Rajasthan in the north east, Madhya Pradesh in the south-east and Maharashtra in the south. It covers approximately an area of 72,137 square miles.

An immense accumulation of volcanic rocks, principally basaltic lavas, known as the Deccan trap is the most important and extensive geological formation which is met with in the State. At a few places, particularly in Panchmahal and Broach districts, a few granites and gneisses are occasionally met with. The major portion of the land is however, covered by old and recent alluvium.

Classification:

The soils of Gujarat can be broadly classified into five main groups: (i) Shallow residual soil (ii) Medium black soil (iii) Deep black soil (iv) Sandy loam, (Gorat or Goradu) and (v) coastal alluvium. The soil map of Gujarat (Map-1)
shows the distribution of these five classes of soils.

The soils of northernmost districts are predominantly sandy, containing fairly large amounts of coarse sand. They are deficient in organic matter and nitrogen but respond well to manuring and irrigation. In the westernmost parts of the districts, saline soils are met with, the salt content varying from 0.5 to 2.5 percent. These soils are met with in Banaskantha, Sabarkantha and Mehsana districts.

Although 90 percent of the soils of this area are of a sandy nature, a soil which is black in colour is met with in patches and chiefly in the southwest parts of Mehsana district. To ameliorate the condition of the saline soils in the west, shading, mulching and creating a loose tilth are recommended as possible measures. Deep and thorough cultivation to enable the easy passage of leachate is the important factor; only rain water can be impounded, as well waters in this area are highly saline.

Two types of soils occur in the Ahmedabad district. Black soil and Goradu soil. Both types are met with in almost every village and it is not possible
to divide the district into distinct divisions according to the soil type. Black soil occurs however, chiefly in the south-west and the Goradu soil in the northern and eastern parts of the district. The black soil of the district is not very clayey; it contains about 20 percent of clay and about 40 percent of sand. The sub-soils invariably contain horizons of lime nodules. They are not very deep like the black soil of south Gujarat and very often contain injurious amounts of salts. Some of these soils are however deep and retain large quantities of water during the monsoon, when they do not support a cotton crop. The goradu soils are rich loams and respond very well to irrigation and manuring. They resemble in many of their characters the rich soils of Kaira district. The nutrient content of three soils from this area are given below:

Percent on Air-Dry Basis.

<table>
<thead>
<tr>
<th></th>
<th>Black Soil</th>
<th>Goradu Loam</th>
<th>Goradu Sandy</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>1.8 - 4.9</td>
<td>2.1 - 4.0</td>
<td>0.5 - 0.75</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.05 - 0.09</td>
<td>0.04 - 0.09</td>
<td>0.03 - 0.07</td>
</tr>
<tr>
<td>P2O5</td>
<td>0.03 - 0.16</td>
<td>0.12 - 0.17</td>
<td>0.03 - 0.6</td>
</tr>
<tr>
<td>K2O</td>
<td>0.4 - 0.56</td>
<td>0.42 - 0.68</td>
<td>0.2 - 0.6</td>
</tr>
</tbody>
</table>
Kaira:

The soils of the Kaira district are sub-divided into four main groups by the local agriculturists. They are (i) goradu (ii) besar (iii) black and (iv) bhatha soils. Texturally they are all loams containing large proportions of fine sand, and the practical classification is based on the content of clay. The first two contain from 6.0 to 10.0 percent, and 70 to 80 percent of sand. The other two are finer and contain 10.0 to 12.5 percent of clay and 50 to 70 percent of sand.

The soil met with along the banks of the Mahi and Sabarmati is coloured light yellow and is loose-grained and is the typical goradu soil. As we move further away from the rivers to the interior the colour of the soils change to a light grey and they then merge with the besar soils. Besar soils are grey in colour and the content of clay is quite variable. They are however, as a rule, lighter in colour than black and bhatha soil. They are fairly well distributed throughout the district. The black soils are met with invariably in low lying areas and are due to the recent deposition of finer material by flood-waters. The finer material
rarely reaches a depth greater than 6 to 8 feet, and they do not have the profile characters of true black soils. These soils are again differently named in different parts of the district. Kyari land, Kharpai, Mal, Kharaba, Kovan are some of the names in common use for this soil. The soil on the banks of Watrak particularly is known as bhatha land. It is a rich soil and is reported to give good crops without application of fertilizers.

The soils of Kaira district respond very well to manuring and irrigation.

Panchmahals:

The soils of the Panchmahal district differ radically from the soils of other parts of Gujarat. The soils of this area are chiefly residual soils formed by the decomposition of underlying granites and gneisses. The soils of other parts of Gujarat are transposed soils of alluvial origin. The soils are as a rule light coloured, shallow and infertile. Soils situated on the lower plains are however darker in colour, clayey and fertile. Such soils, wherever they occur in the district are called basar and because of their high water-holding capacity, permit of taking Kharif (monsoon) and rabi (winter) crop every year. Such fertile tracts are
situated along the banks of the Mahi, on the north and north-east of Godhra and the south of Halol. At other places situated on higher levels, the soils are stony or gravelly, shallow, light coloured and invariably of low fertility.

**Baroda:**

In the Baroda district two types of soils are met with. They are (i) black and (ii) Gorat. The first is met with in the southern and eastern parts and the latter in the northern parts of the district. The black soils contain less than 50 percent of sand while the gorat soils contains 60 to 90 percent of sand. The black soils of this area do not appear to be the true black soils. They are underlain by a sandy sub-soil sometimes containing gravel and sometimes clay. The sub-soil layer invariably reaches the water bearing strata.

**Gorat soil:**

The gorat soils are low in organic matter and nitrogen. They contain one percent phosphoric acid and about an equal amount of potash. The soils situated to the south although termed black do not contain
high percentage of clay, and contain the same amounts of phosphoric acid and potassium. They contain however 0.05 - 0.06 percent nitrogen. The gorat soils which are irrigated by the sewage of the Baroda Municipality are extremely rich.

Black soils:

The black soils met with in the eastern parts of the districts are richer in clay, but even they are not true black soils. These soils are usually poor in plant nutrients. They contain 0.03 to 0.04 percent nitrogen, 0.02 - 0.2 percent potash and are some of the few soils that have been reported to respond to phosphatic fertilizers.

Broach and Surat:

The Broach and Surat districts form the southern part of Gujarat and the soils in both these districts are predominantly black cotton soils. The black soils in the Broach district are sharply divided into three distinct classes: (i) True black cotton soil or regur; (ii) Bhatha soil and (iii) Gorat soil. All three soils are supposed to be of alluvial origin formed by the deposition of decomposed trap particles carried by the river Narmada and its tributaries. The soils become more clayey as we move
westward and along the sea-coast, there are vast areas of saline soils. The black soil is clayey, containing 45 percent clay and 20 percent sand. The sub-soil is richer in clay, it being 55 percent. They contain 0.05 percent nitrogen, 0.07 percent phosphoric acid and 0.08 percent potash. These are the true regur soils to be described later under Surat district. The rich alluvial deposits along the banks of the Narbada are known as bhatha soils. The surface soil contains 17.0 percent clay and 45.0 percent sand. The sub-soil contains 16.0 percent clay and 50.0 percent sand. The nitrogen content is high - 0.07 percent, potash content is 0.12 percent and phosphoric acid content 0.07 percent. The gorat soils contain more than 60.0 percent of sand. They contain 0.04 percent nitrogen, 0.07 percent phosphoric acid and 0.1 percent potash. All the soils of this district are rich in organic matter, which varies from 4.0 to 7.0 percent. They are low in lime which is usually about 0.4 percent.

Like the soils of the Broach district those of the Surat district can also be sub-divided into three sub-groups. They are however all black in colour except in places situated at high levels. The deep black cotton soils are met with both in this district and
the Broach district. These are also referred to as black cotton soils or regur. They have been termed as tropical black earth or tropical chernosem. They are as a rule black in colour, contain a high percentage of clay and crack heavily during summer. The cracks often times are one inch wide and extend to depths of ten feet. It is believed that these soils are formed by the washing down of disintegrated material from higher level. They are always found within the area of Deccan trap. They vary in depth according to position and when very deep have been probably accumulated as an alluvial deposit. The deep black soils shown in the map are deep and extend at some places to a depth of 20 feet.

Black soil:

No present rock or marrum is met with upto 7 feet. Owing to their dense consistency, they become unworkable during heavy rains particularly when the cracks are filled. Ordinarily, it permits easy drainage for the first rains even if they are heavy for the water drains away rapidly through the many wide cracks. They vary in colour, consistency and fertility but are invariably highly retentive of moisture. In the hot weather shrinkage due to evaporation causes the formation of numerous cracks which are often several feet deep.
This feature has given rise to the statement that "Black soil ploughs itself". The fine particles that are detached from the surface fall down the cracks and reach lower levels, and fresh new surface is exposed to weathering every year.

The content of soluble silicates, iron and alumina are fairly constant within moderate limits. The amount of magnesia is high and also constant. The content of lime however varies both in amount and in the form in which it is found. It occurs usually both as carbonate and as silicate. The content of potash varies considerably and is usually sufficient for normal crop growth. The amount of phosphoric acid, nitrogen and organic matter is however frequently low. The colloidal material of the soil is rich in montmorillonitic and beidelitic groups of minerals.

So far as the soils of Surat district are concerned, they are formed by the particles washed down by the river Tapti. The black soils contain roughly about equal parts of clay, silt and sand. They contain about 1.0 percent lime, 0.04 - 0.07 percent nitrogen, and the same amounts of phosphoric acid and 0.25 percent potash. They are chiefly used for
The bhatha soils and gorat soils are used for garden crops. Bhatha soils contain about 20.0 percent clay and 60.0 percent sand. The nitrogen, phosphoric acid, and potash contents are respectively 0.04 percent, 0.06 percent, and 0.17 percent. The gorat soils contain about 80.0 percent sand and 6-10 percent clay. Their contents of nutrients are nitrogen 0.08 percent, phosphoric acid 0.03-0.7 percent, and potash 0.25-0.33 percent.

**Saurashtra soils:**

Saurashtra can be divided into three zones. The northern zone comprises Surendranagar and a portion of Jamnagar districts in which the soils are shallow and predominantly sandy with occasional areas of silt and clay and vary in colour from ash grey to brown. In the central zone consisting of Rajkot, Junagadh, and a portion of Jamnagar districts, the soils are very deep, overlying a bed of Kankar and limestone and vary from sandy clay to clay loam. They are calcareous. The southern zone consists of coastal alluvium, fairly deep, brownish to brownish black, well-drained soils on level land.

Soils of Amreli district is a variety of medium black soil. It is the typical agricultural soil.
in Rajkot division. In the hilly parts the soils are however shallow and often gravelly. These are poor in clay and of low fertility. The soils met with along the coast line of Saurashtra are poor in organic matter and nitrogen.

The soils of Kutch are shallow and stony. Major portion of the land is saline land, the salt content being extremely high in many places. There is deposition of gypsum and calcium carbonate in the sub-soil horizons. The agricultural soils are poor in nitrogen and fair in phosphoric acid and potash content. The pH varies from 7.29 to 7.32.

Climate:

For Gujarat the year can be divided into four seasons: (i) The winter season from November to February, (ii) The hot weather season from March to May, (iii) The south-west monsoon season from June to September, (iv) The transition month of October.

The climate of Gujarat in the southern districts is decidedly moist, while the northern districts have dry climate nearly approaching that of southern Rajasthan. The rainfall in south Gujarat varies
between 30 and 60 inches and there is a greater annual range in temperature. In north Gujarat the rainfall varies between 20 and 40 inches, but it is mostly around 40 inches in Godhra and around 25 inches in Viramgam region. This area has got lower winter temperatures. In Jamnagar and Junagadh coastal regions the rainfall is generally less than 25 inches. It has lower winter temperatures. In south central high lands of Rajkot division and Cambay Gulf Regions, the rainfall is over 25 inches and there is a greater range in temperature. In Kutch the rainfall is very low.

The temperatures are normally lower in the southern districts and higher in the northern districts. Round about Baroda, during the hot weather extending from March to June, the maximum daily temperature varies from 98.0° to 115.0° F, the highest recorded being 116.2°F on the 16th, May-1925. During the cold weather extending from November to February, the night temperatures vary from 35.0° to 67.0° F, while the day temperatures vary from 70.0° to 100.0° F. The lowest recorded minimum temperature was 30.0°F on 14th, January-1935. The climate during the rainy season that is from July to October, is hot, moist and relaxing. The rains
generally cease during the latter half of September and there are usually a few weeks of hot weather between the end of the rains and the commencement of winter.