CHAPTER II

STUDY AREA PROFILE
2.1 Introduction

Kerman city has been selected as the study area. A clear understanding of dimensions of the natural environment and physical characteristics in study area termed as the environmental setting is helpful in understanding the environmental issues, potential and limitations toward sustainable development. The physical and cultural characteristics including details regarding geographical location, topography, geology, geomorphology, soil type, climate, vegetation cover, economy, urban facilities, historical background, and tourism have been discussed in this chapter.

2.2 Geographical location

Kerman is the biggest province of Iran which is locating in south eastern part of the country and covers almost 181714 km² which is 11% of the whole country. The state is surrounded by Yazd and Khorasan from North, Systan and Baluchistan from East, Hormozgan from South and Fars from West. Southern and central areas are mountainous and have cold weather in winter and mild summer. The northern belt from east to west is desert with long hot summers and short mild winters. The province includes 16 cities which they have districts and villages. Kerman city is the central place of the province located at 57°-57°, 7’ E longitude and 30°, 14’- 30°, 19’ N latitude. The location of the city may also be expressed according to UTM system, as from 500577 to 511216 Eastings and from 3344641 to 335388 Northing (Fig. 2.1).
Fig. 2.1

Location of Kerman city

Source: Planning and management organization of Kerman state
2.3 Topography

Digital Elevation Model of the area (Fig. 2.2) which has been created by the help of ASTER (Advanced Space borne Thermal Emission and Reflection) data indicates that the elevation of the city is 1750-1800 meter above the sea level. The city is developed alongside of the northern parts of the Kerman plain. The plain reaches to Joopar Mountains towards the south direction, Zarand plain towards the north, Sirch Mountains towards east and Baghin plain and Badamooye Mountains towards west. The slope of Kerman city is in the same direction as the plain which is from southeast towards northwest direction (Fig. 2.3).

Details regarding slope of the city area are as follow:

- slope less than 0.001 percent which occupies 31 percent of the city and covers north west and south west of the city
- slope between 0.001 to 0.5 percent which occupies almost 51 percent of the city area and includes central and northern part of the city
- slope between 0.5 to 2 percent which occupies 11 percent of the city and is seen in southeast part of the city
- slope between 2 to 4 percent which occupies 1.5 percent of the city area and it is seen around Ardeshir hills in eastern side
- slope between 4 to 10 percent which occupies 2 percent of the city and comprises the area around Ardeshir castle, Dokhtar castle and margins of eastern elevations
- Slope more than 10 percent which occupies 3 percent of the city and covers the area around Dokhtar hills, eastern elevations and Ardeshir castle
Fig. 2.2

Digital Elevation Model of Kerman area

Source: ASTER GDEM data, 2009
Fig. 2.3

Slope map of Kerman

Source: ASTER GDEM data reproduced by author
2.4 Geology

The area is underlain by soluble rocks and alluvial deposits, overlying highly fractured Cretaceous limestones (Fig. 2.4). Geoelectrical studies and refractive seismographic method estimated alluvial thickness in Kerman plain to be 30-300 meters. According to geological profile provided by cartographic centre of Iran alluvial thickness underneath the city is around 180 meters which reduces towards the east side of the city. Geo-environmental studies indicate that both paleokarst and active karst features are developed in the area. The paleokarst were developed in the upper Cretaceous limestone during the cold, humid periods of post Cretaceous and probably early Quaternary time. Active karst landforms occur by combined piping-induced and limestone solution at depth in subsoils, and alluvial deposits and bajada that overly potent karstic limestones and exist as cover subsidence sinkholes and subjacent alluvial karst collapse dolines. Many factors, such as soluble compounds (salt and gypsum), desiccation cracks, and Qanat (underground tunnel carrying water), could contribute to the development of karstic landforms which are landscapes shaped by the dissolution of a layer or layers of soluble bedrock, usually carbonate rock such as limestone or dolomite.
Fig. 2.4

Geological map of Kerman
2.5 Geomorpholgy and soil type of the area

The major geomorphological units of Kerman area are: Mountains, Bajada, Playa and Sand dunes (Fig. 2.5).

2.5.1 Mountains

Mountain has occupied the eastern side of the city and with a long distance from the city is arisen in the western side of the city as well. These units constitute of costa, mass and precipice faults. Costa is in the eastern part besides Sarbaz Street, which is seen as number of combined flat irons. The slope of costa is towards northeast and eastern part. In some parts of Sahib Zaman Mount, Cretaceous limestones are seen in rather horizontal shape and they formed a unit of mass.

This morphological unit has big and small valleys formed due to fractures and erosions. Mountain alongside of the faults and fractures is divided into different parts. The dykes play an important role in the process. Precipice fault caused a difference in elevation around 40-50 meters. This has caused the formation of a vertical parapet in eastern mountain of Kerman (Sahib Zaman Mount).

2.5.2 Bajada (Bahada)

Bajada is formed of large size alluvial deposits on marginal side of the mountain, or in some parts from the drifted sand dunes. Slope of this unit is around 2 to 5 %. There are only few parts of the city which are constructed on Bajada, the area near Sarbaz Street in the east and some parts in northwest. This unit is formed of combination of some alluvial fans. One of them is the alluvial fan of Sar-Asiab area which is located in eastern part besides the Sahib Zaman Mountain. The alluvial fans are the source of sand required for building construction. Saeedi alluvial fan is formed in northeast of the city. This unit is a result of erosion in upper mountains, especially Saeedi Mountain and Balabene Mountain. Ekhtiar-abad alluvial fan is formed in northwest side of the city due to erosion of upper mountains. Ekhtiar-abad village is developed on the basis of that. This alluvial fan is also considered as source of sand. The big alluvial fan of Chari is formed due to vast activity of Chari River in a long distance from the city in southwest direction. It is the main source of sand for construction (Glomak sand mine). Sand particles in the basis of Chari alluvial fan and Ekhtiar-abad
alluvial fan are the source of formation of sand dunes in south and west direction respectively.

2.5.3 Playa

Playa occupies the most parts of Kerman plain. In Miocene period Playa was located in the present place of Badamoye and Anbaloye mountains which due to tectonic movements of Davaran fault zone and sedimentation process it has been relocated in a new place. Kerman playa is made of mostly silt and fine clay particles and in some parts of this unit, sand dunes have been formed (Fig. 2.6). Slope of playa is around 0.02-0.03 percent. Kerman city and the surrounding villages are mostly developed on playa. Kerman’s playa is formed from different parts; clay flat is one of them. This unit comprises the most parts of playa and includes most of the agricultural fields. Clay flat is formed of silt and fine clay particles. Gypsum clay flat is formed of fine sediments including vaporized minerals (gypsum). This causes the puffiness in the soil. This is located in west and southwest of Kerman city.

2.5.4 Sand dunes

Sand dunes are formed due to sand movements from the basis of the alluvial fan on the surface of Kerman plain. They are developed mostly in southern and south western parts of the city. The direction of the winds favours the movement of sand from dunes to city. In the past (around 40 years ago), southern and south western parts were sharing deposition of sand particles along the roads viz. Malek Ashtar Street, Aboozar Street, as well as the present location of Azad and Bahonar University in south. With stabilization of the sands by planting Tamarix, Haloxylon and other species of plants, the movement of sand has been restricted exhibiting the importance of plant life for society. The presence of sand dune has made it compulsory to have good durable pile foundation for buildings. Further, landscaping on the sand dunes requires special effort since they have low ability to absorb water and fertility status is low.
Fig 2.5

Geomorphological map of Kerman

Source: Cartographic centre of Iran, 2009
Fig. 2.6
Soil type map of Kerman

Legend
- Boundary of Kerman city
- Main Roads
- Alluvium Fan
- Sand Dunes
- Sand and Gravel
- Clay, Mud
- sandstone-conglomerate
- Conglomerate
- River Channel Deposits
- Marly limestone
- limestone
- limestone, Sandstone
- sandstone
- Gravel Fan and Terraces
- Paleozoic Rock
- red sandstone, Gypsiferous marl
- shale
- Acid Rock
- Pleistocene Fanglomerate
- Dolomite, limestone
- Sandy Marl, Marly Micrites
- basalt and andesites
- Sandstone, Siltstone, conglomerate
- Dolomite-limestone
- Mainly Explosive Breccia
- cretaceous, Jurassic Rock
- Sandstone, shale, limestone

Source: Geological Organization of Iran, GIS Analysis by author
2.6 Faults and Earthquakes

Kerman city is established and developed on young Quaternary alluvium and due to geological condition, young active faults of the area as well as old faults; the city has faced seismological disasters during time (Fig. 2.7). According to the scientists, the main reason of Iran’s earthquakes is Arabian plate’s movement and pressure towards North due to emergence of red sea. Iran is surrounded by Eurasian plate from North, Indian plate from East and Anatolian plate from West and hence it is affected by pressurized forces of Arabian plate. This causes compaction and thickness which appear as reverse faults in northwest-southeast direction as well as foldings. During its 2000 years history, Kerman region has faced weak and disastrous earthquakes. Historical earthquakes are the one which occurred before 1900 and more than 10 of them have been registered. Most of the registered earthquakes have occurred in 300 km from the centre of Kerman city. At present time around 20 disastrous earthquakes have been registered in the area. Although the city has never been the epicentre of earthquake but heavy ones have caused destructions inside the city.

Table 2.1

Faults in 30 km from Kerman city

<table>
<thead>
<tr>
<th>Number</th>
<th>Fault name</th>
<th>Fault’s Length (km)</th>
<th>Distance from Kerman city (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baghin</td>
<td>59</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>Davaran</td>
<td>37</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Ekhtiar Abad</td>
<td>45</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Kerman-Zangi Abad</td>
<td>22</td>
<td>Beneath the city</td>
</tr>
<tr>
<td>5</td>
<td>North of Kerman</td>
<td>34</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Kohbanan</td>
<td>34</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Saheb Zaman</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>East of Kerman plain</td>
<td>65</td>
<td>16</td>
</tr>
<tr>
<td>9</td>
<td>Joopar</td>
<td>52</td>
<td>29</td>
</tr>
</tbody>
</table>

Source: Geological Organization of Iran
Fig. 2.7

Fault distribution map in Kerman vicinity

Source: Geological Organization of Iran, GIS Analysis by author
2.7 Climate

Iran is located on the world’s dry belt. About 60% of the area is covered by mountains and the rest is arid and semi-arid lands in which the average annual rainfall is less than 250 mm which is scattered irregularly both in terms of time and area. The climate of Kerman state is influenced by that of nearby areas. Arid climate is seen in northern part of the state which is adjacent to the desert. Southern parts of the state have rather temperate and more pleasant climate. Kerman city’s climate is affected by local parameters like highlands, mountainous areas and Lut desert.

Total average annual rainfall is 145.1 mm. Due to dry climate, low amount of precipitation, clearance of the sky (fewer clouds), long period of sunny hours, and the angle of sun, the evaporation rate is high with mean annual rate of 2050 mm. Being adjacent to Lut Desert bring about sand storms in spring and hot weather in summers. Northern and northeast part of the city which are adjacent to Sahib Zaman Mountains experience cooler and milder weather while western and southern parts which are closer to desert areas have hotter summers and suffer more from the sandstorms.

The hilly areas in surroundings cause to have permanent seasonal and local winds all around Kerman districts. During summer low pressure centre is located in Persian Gulf and Jazmoorian sinkhole and as a result northern winds are dominant. In winter western winds are dominant which blow from west and southwest. Heavy winds cause sand storms. The annual average number of days with sand storm is 30 days which this number increases towards the Lut plain.

2.7.1 Temperature

Temperature of a region depends on local geographical characteristics. High altitude of 1750-1800 meters and far distance from sea are among the most important local characteristics to create arid climate. In this type of climate there are extreme differences in temperature between hot and cold seasons, as well as day and night. This is due to displacement of air from surrounding mountains near Kerman plain and vice-versa. This movement not only causes airflows but also has variable temperatures and creates extreme differences between maximum and minimum temperature. The average temperature during the last 25 years was about 16º C, which
July with the average of 26.8° C is the hottest and January with the average of 4.7° C is the coldest month of the year. The maximum recorded temperature in this period was 41.7° C in July, and the minimum recorded temperature is -15.1° C in January. Number of frozen days in which the temperature is below zero is an average number of 88.6 days per year with maximum number of 24 days in January. Freezing occurs during November to March (Table 2.2).

Table 2.2

Climatological parameters of Kerman city (1983-2008)

<table>
<thead>
<tr>
<th>Climatological parameters</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum annual rainfall</td>
<td>311 mm</td>
</tr>
<tr>
<td>Minimum annual rainfall</td>
<td>46 mm</td>
</tr>
<tr>
<td>Average annual rainfall</td>
<td>145.1 mm</td>
</tr>
<tr>
<td>Number of rainy days</td>
<td>34 days</td>
</tr>
<tr>
<td>Annual evaporation rate</td>
<td>2050 mm</td>
</tr>
<tr>
<td>Average relative humidity</td>
<td>36 %</td>
</tr>
<tr>
<td>Avg. Maximum relative humidity</td>
<td>49 %</td>
</tr>
<tr>
<td>Avg. Minimum relative humidity</td>
<td>23 %</td>
</tr>
<tr>
<td>Maximum relative humidity (January)</td>
<td>73%</td>
</tr>
<tr>
<td>Minimum relative humidity (June)</td>
<td>14%</td>
</tr>
<tr>
<td>Average temperature</td>
<td>16°C</td>
</tr>
<tr>
<td>Avg. maximum temperature (July)</td>
<td>26.8°C</td>
</tr>
<tr>
<td>Avg. minimum temperature (January)</td>
<td>4.7°C</td>
</tr>
<tr>
<td>Maximum temperature (July)</td>
<td>41.7°C</td>
</tr>
<tr>
<td>Minimum temperature (January)</td>
<td>-15.1°</td>
</tr>
<tr>
<td>Avg. maximum wind speed (March)</td>
<td>3.9 m/s</td>
</tr>
<tr>
<td>Avg. minimum wind speed (October)</td>
<td>1.7 m/s</td>
</tr>
<tr>
<td>Annual number of days with sandstorm</td>
<td>30 days</td>
</tr>
<tr>
<td>Number of frozen days</td>
<td>88.6 days</td>
</tr>
</tbody>
</table>

Source: Meteorological department of Kerman city
2.7.2 Precipitation

Imbalance in precipitation distribution is one of the characteristics of arid climate. In this kind of climate the whole precipitation of the year may happen in a single day or we may have most of the precipitation in cold seasons. Since Kerman is located in the arid region of the country it suffers from these inconsistencies. The amount of precipitation is very variable which during the past 25 years has ranged between minimum 46 and maximum 311 mm. On average there is 145.1 mm of precipitation per year (Table 2.2) which about 59 percent of it occurs during winter time. Annual number of rainy days is 34 days. Precipitation is mostly in the form of rain but in highlands and mountainous areas in cold weather precipitation may be in the form of snow as well. In summer the least amount of precipitation occurs in this region. During this time the region is affected by high pressure tropical centre and this mechanism make it impossible for any kind of precipitation. Precipitation occurs mostly during the middle of autumn and lasts till the early spring.

2.7.3 Relative Humidity

Being far from the sea, high altitude of 1750-1800 meter above the sea level, and low density of vegetation cover makes the city to have low rate of humidity. Average relative humidity is about 36 percent. Maximum and minimum monthly relative humidity is 73 and 14 percent belonging to January and June respectively. Maximum annual relative humidity is 49 percent while the minimum one is 23 percent. In hot and dry summers humidity of 10 percent also has been registered.

2.7.4 Seasons of the region

Spring in Kerman starts from early March and it lasts till early May. Summer starts with temperature of around 30º C in the middle of May. Temperature reaches to its peak in July. Maximum recorded temperature during the year is 41.7º C which belongs to July. This is the time that the region experience vertical sun angle with the longest day time. Summer continues till the early September, in which due to tilting in sun direction and fluctuations in high pressure tropical centre and its movement towards south, there would be reduction in temperature and the autumn follows which
will continue till November. The winter starts almost in early December and lasts till early March.

Table 2.3

Seasons in Kerman

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>March, April</td>
</tr>
<tr>
<td>Summer</td>
<td>May, June, July, August</td>
</tr>
<tr>
<td>Autumn</td>
<td>September, October, November</td>
</tr>
<tr>
<td>Winter</td>
<td>December, January, February</td>
</tr>
</tbody>
</table>

Source: Meteorological Department of Kerman city

2.7.5 Wind

According to Synoptic station of Kerman city which makes local observations of weather at fixed times, wind frequency tables of different months show reduction of North east, North and North west winds in autumn, following by increase in Sudanese wind which blows from southeast as well as Mediterranean winds blowing from west direction, which in fact is responsible for having a more calm weather. Generally dominant wind in autumn is blowing from southwest direction with the average speed of 3 Kilometres per hours. In winter gradually Sudanese wind notably increases and along with other parameters causes precipitation all over the state. In this season frequency of Mediterranean winds also increase. These both winds are humid and responsible for winter precipitation. Dominant winds of winter are blowing from southwest with average speed of 5 kilometres per hours. In the spring which starts from March there will be reduction in Sudanese wind which reaches to almost zero in the early summer. In early spring western wind (Mediterranean front) becomes active and causes some few spells. It remains active till early summer. In late spring gradually northeast front activates which brings hot and dry winds. Dominant spring wind blows from west, north and northwest direction with the average speed of 6 kilometres per hours. In summer, north, northwest and northeast winds carrying hot and dry winds activate all over the state. Among them northwest front is more active than the others. Since the late front cross over the hot and dry deserts of central plateau of Iran, it has no humidity and causes severe heat and dryness in the region.
Dominant wind in summer blows from north and northwest with average speed of 4 kilometres per hours. Overall maximum frequency of winds is from northwest and southwest direction whilst the minimum frequency belongs to east direction in a period of one year. The average maximum wind speed belongs to March whilst the minimum speed belongs to October with values of 3.9 m/s and 1.7 m/s respectively (Table 2.2). The maximum wind speed of 28 m/s has been registered in 1966.

There are three main important regional winds named Gheble wind, Northern wind and Shahdad wind which are blowing almost all the year with a moderate speed (Table 2.4).

### Table 2.4

<table>
<thead>
<tr>
<th>Wind name</th>
<th>Direction</th>
<th>Wind type</th>
<th>Blowing season</th>
<th>Duration</th>
<th>Speed</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gheble</td>
<td>Southwest</td>
<td>Regional</td>
<td>Late spring to Autumn</td>
<td>discontinuous</td>
<td>Moderate</td>
<td>Sometimes severe and damaging</td>
</tr>
<tr>
<td>North</td>
<td>North</td>
<td>Regional</td>
<td>Spring, summer</td>
<td>discontinuous</td>
<td>Moderate</td>
<td>Brings cool weather</td>
</tr>
<tr>
<td>Shahdad</td>
<td>East</td>
<td>Local</td>
<td>All season mostly July and August</td>
<td>discontinuous</td>
<td>Low</td>
<td>No harm</td>
</tr>
</tbody>
</table>

Source: Meteorological Department of Kerman city

### 2.8 Vegetation Cover

Kerman city and the surrounding areas are located in arid and semi-arid area. With annual rate of less than 200 millimetre of precipitation, the vegetation cover of the area is of low density pasturelands. The pasturelands are divided in to four categories of plain pastures, mountainous pasturelands, country side pastures, and median pastures which they are used seasonally for livestock grazing purposes. The pasturelands are divided in to four types in term of vegetation density.

- Median and plain pasturelands with semi density of vegetation cover which cover the foothills of Badamoo and Doran Mountains in northwest and Mountainous area of northeast
• Median and plain pasturelands with low density of vegetation cover which are seen in southeast, east, northeast, and northwest of Kerman city. These types of pasturelands are vastly developed. Solid waste disposal site of Kerman also is located in these areas in eastern side of the city.

• Plain pasturelands with low density of vegetation cover which are seen in southwest near Baghin city

• Mountainous pasturelands with high density of vegetation cover. This type is a country side pastureland and could be seen in mountainous areas of Badamoo and Doran, mountainous areas of northwest, and Joopar Mountain in south of the city

2.8.1 **Main vegetation types of the area**

Vegetation type of the area is of arid and semiarid type. Alongside with the other types, the two main type of Sagebrush (Artemisia sieberi) and Astragalus (Astragalus sp.) are seen mainly in vicinity of the city. Mostly sagebrush type is seen in south and southwest of Kerman. But the Astragalus - Sagebrush is seen mostly in east and northeast in the mountainous area. Artificial plantations of Tamarix Sp. and Haloxyylon sp. is done in adjacent desert for sand stabilization and reduction in its movement during sand storms.
Inside the boundaries of the city excluding the agricultural lands there are only artificially planted trees of mainly Pine, Cedar, Elm, Acacia, Poplar, and Ash trees. Natural vegetation cover is barely seen due to lack of precipitation. In eastern side of the city there is an artificial forest near the mountains called Ghaem with the total area of 3 km³, which is mostly covered with Pine, Cedar, and Elm trees. Almost 500 trees have been planted there which is helpful to provide pleasant weather for the area and city as well.
Fig. 2.9

Plantation types inside the city area

Source: Field survey
2.9 Economy

Cities differ in their economic makeup, social and demographic characteristics and the roles they play within the city system. Although cities are dynamic and it is difficult to categorise them into one special economic activity, there are three different defined roles for cities which are:

- Central places functioning primarily as service centres for local hinterlands
- Transportation cities performing break-of-bulk and allied functions for larger regions
- Specialized-function cities which are dominated by one activity such as mining, manufacturing or recreation and serving national and international markets

According to economic policy almost all the facilities and amenities are located in the centre of the state. The city in the previous processes had the economy on the basis of servicing activities. Due to geographical location, the city has an important role as a linkage between south-eastern zone of the country and the hinterlands. As a capital of the state some of the official structures are located in the city and it has a directing role to control the trading in agriculture division as well. Kerman has an important role in marketing, transportation, distribution and packaging of agricultural products like pistachio and fruits. It could be stated that almost all of the servicing-trading activities of agricultural division of whole state is done through Kerman city. Among the 30 states of the country the state is in fourth and ninth grade in agriculture and industry respectively, in mining in first grade and in servicing and facilities in tenth grade.

2.9.1 Mining

Kerman has a long historical background in mining. Mines of precious material such as silver and turquoise have been explored in Kerman province from ancient times causing prosperous trade conditions in the province in such manner that Kerman used to be called the “Paradise of Miners”. Major mines of Kerman are as follow: Gold, Iran Ore (Gole_Gohar mining complex, Sirjan), Titanium (Kahnuj), Copper (Sarcheshme, Meydouk and Chahar Gonbad), Chromites, Lead and Zinc, Decorative
stone (used in construction), Silicon, Limestone, Salt, Gypsum. Average mineral exploitation of the province is about 12 million tons per annum employing 2000 persons. 100 mines have so far been discovered. In addition 200 mines have been considered appropriate for private exploitation. At the moment 65 mines are active throughout the province. Kerman city itself is also surrounded by mines which are mainly of Marble, Limestone, and Gypsum types. The details of the mines in vicinity of the city are given in table 2.5.

**Table 2.5**

Main mines in vicinity of Kerman city

<table>
<thead>
<tr>
<th>Mine Name</th>
<th>Type of Mine</th>
<th>Location in regard to the city</th>
<th>Number of workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shirdoosh spring Marble stone</td>
<td>Marble</td>
<td>9 km of North-east</td>
<td>13</td>
</tr>
<tr>
<td>Khatam Marble stone</td>
<td>Marble</td>
<td>20 km of South-east</td>
<td>7</td>
</tr>
<tr>
<td>Saeedi Marble</td>
<td>Marble</td>
<td>5 km of North-east</td>
<td>-</td>
</tr>
<tr>
<td>Kerman-Dakhme Marble</td>
<td>Marble</td>
<td>12 km of North-east</td>
<td>-</td>
</tr>
<tr>
<td>Rayen Black Godar Marble stone</td>
<td>Green Marble</td>
<td>13 km of South-east</td>
<td>5</td>
</tr>
<tr>
<td>Pink Marble stone</td>
<td>Pink Marble</td>
<td>15 km of South-east of Rayen city</td>
<td>10</td>
</tr>
<tr>
<td>Hasan-ali Castle Marble stone</td>
<td>Marble</td>
<td>150 km of South-east</td>
<td>3</td>
</tr>
<tr>
<td>Baab Marble stone</td>
<td>Lime stone</td>
<td>5 km of North-east</td>
<td>27</td>
</tr>
<tr>
<td>Zarand road lime stone</td>
<td>Lime stone</td>
<td>20 km of North-west</td>
<td>5</td>
</tr>
<tr>
<td>Estakhooyee lime stone</td>
<td>Lime stone</td>
<td>48 km of North-west</td>
<td>20</td>
</tr>
<tr>
<td>Zangi-abad lime stone</td>
<td>Lime stone</td>
<td>15 km of North-west</td>
<td>3</td>
</tr>
<tr>
<td>Deh-shar white gypsum</td>
<td>Gypsum</td>
<td>20 km of North-east</td>
<td>12</td>
</tr>
<tr>
<td>Amir-abad gypsum</td>
<td>Gypsum</td>
<td>South-east of the city</td>
<td>-</td>
</tr>
<tr>
<td>Western estakhooyee gypsum</td>
<td>Gypsum</td>
<td>63 km of North-west</td>
<td>9</td>
</tr>
<tr>
<td>Karim-abad gypsum</td>
<td>Gypsum</td>
<td>43 km of North-west</td>
<td>5</td>
</tr>
<tr>
<td>Hojat-abad gypsum</td>
<td>Gypsum</td>
<td>30 km of North-west</td>
<td>8</td>
</tr>
<tr>
<td>Shahdad Lut salt</td>
<td>salt</td>
<td>56 km of South-west of the shahdad city</td>
<td>-</td>
</tr>
<tr>
<td>Sodium sulfate of Rayen</td>
<td>Sodium sulfate</td>
<td>150 km of South-east</td>
<td>-</td>
</tr>
<tr>
<td>Shahrzad Silica</td>
<td>Silica</td>
<td>150 km of South-east</td>
<td>5</td>
</tr>
<tr>
<td>Calcareous lime of Cement Factory</td>
<td>Calcareous lime</td>
<td>North-west of the city</td>
<td>15</td>
</tr>
</tbody>
</table>

Source: Geographical glossary of Iran’s places-Kerman, 2005, page 50
2.9.2 Agriculture

Agriculture of Kerman province is accounted for about 270 million dollars of the total national value. The province of Kerman has the first rank in production of pistachio and walnut, second rank in terms of palm trees and third rank in terms of citrus fruits. In 2005, 91000 hectare of Kerman area and its surrounding districts were under cultivation which 73.86 percent of it was dedicated to Pistachio, date, citrus fruits and 26.14 percent was under the cultivation of wheat, barley, corn, vegetables, and alfalfa.

At least 400 m² of land for farming, 200 m² for gardening, 1 big or two small livestock, and 5 poultries are needed for a unit to be accounted as an agricultural unit. Total number of agricultural units of the city and the surrounding districts which are under the main governing of Kerman city has been given in table 2.6. According to statistics data of 2005 total agricultural units cover more than 600 km² of the area which are mainly located outside the boundaries of the city.

Table 2.6

Agricultural units of Kerman city and its related districts, 2005

<table>
<thead>
<tr>
<th>Agricultural activity</th>
<th>Agricultural unit</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming</td>
<td>7419</td>
<td>17.79</td>
</tr>
<tr>
<td>Gardening</td>
<td>14016</td>
<td>33.61</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>50</td>
<td>0.12</td>
</tr>
<tr>
<td>Poultry</td>
<td>7007</td>
<td>16.80</td>
</tr>
<tr>
<td>Apiculture</td>
<td>67</td>
<td>0.16</td>
</tr>
<tr>
<td>Cattle breeding</td>
<td>3900</td>
<td>9.35</td>
</tr>
<tr>
<td>Sheep breeding</td>
<td>9246</td>
<td>22.17</td>
</tr>
<tr>
<td>Sericulture</td>
<td>2</td>
<td>0.005</td>
</tr>
<tr>
<td>total</td>
<td>41707</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Statistical centre of Iran, census of 2008
Cultivation is limited due to climatic condition and lack of water in the area. Farming and gardening are among the main agricultural activities. According to statistical census of 2005, Kerman’s contribution in production of Pistachio, barley, and wheat was 68.99, 15.05, and 9.59 percent respectively in the whole state.

Table 2.7

Main agricultural productions of Kerman, 2005

<table>
<thead>
<tr>
<th>product</th>
<th>state production (ton)</th>
<th>Kerman production (ton)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>89965</td>
<td>8626</td>
<td>9.59</td>
</tr>
<tr>
<td>Barley</td>
<td>26644</td>
<td>4010</td>
<td>15.05</td>
</tr>
<tr>
<td>Pistachio</td>
<td>75413</td>
<td>52028</td>
<td>68.99</td>
</tr>
<tr>
<td>Citrus fruits</td>
<td>27425</td>
<td>1516</td>
<td>5.53</td>
</tr>
<tr>
<td>Date</td>
<td>144709</td>
<td>3542</td>
<td>2.45</td>
</tr>
</tbody>
</table>

Source: Statistical centre of Iran, census of 2008

2.9.3 Industrial activity

Industrial activities in the city are mainly of small scale industries which are making machinery tools and facilities, food industries of packaging and some fabric production workshops. Totally there are 60 industrial units in the area with more than 10 workers which 39 of them have 10-49 workers and 6 units have 50-99 workers. The number of industrial units with more than 100 workers is 15 units. There are 7 main factories in the vicinity area of the city (Fig. 2.10). Golnaz Vegetable Oil Factory is located in 16 kilometre of Joopar-Kerman road in the south. The Factory has been established in 1988 and has 400 workers. This factory produces 165000 tons of Frying oil, Blend oil, Canola oil, Sunflower oil, Margarine, and mineral water per year and also it produces almost 198000 pieces of tin cans for its own uses. By product Copper industry of Shahid Bahonar is located in 20 kilometres of Kerman-Baghin road in the west side of the city. This industrial unit has almost 1400 workers in the area of 0.44 km². It produces 55000 tons of copper plate, wire, pipe, copper belts, copper round mills, brass plates, etc. Zam Zam soft drink factory has been
established inside the city near the central parts. Due to bad smell produced during production process and for the safety of public health the factory has been locked down and moved to 16 kilometre of Joopar-Kerman road near to Golnaz Oil factory in 1999. This factory has almost 500 workers and produces almost one million bottles of soft drink during the year. Barez Tire factory is located in the end of Joopar-Kerman road and like Golnaz oil Company it is located in the direction of ground water of Kerman plain currents. This factory has sum of 700 workers and produce 7800 tons of P.V.C. and Poly Ethylene pipes and some other by products per year. Pegah Diary Factory has started working in 1982 and it is located in the south inside the boundaries of the city. It has more than 200 workers and produces different kinds of Milk, Ice-cream, Yogurt, Butter milk, Cheese. Annually 20000 tons of products are produced here. Cement factory of Kerman is located 16 kilometre of Kerman-Baghin road in west side of the city. There are 8800 workers in the factory and it has three production units which produce 3600 tons of cement per day. Kermanit factory is located 16 kilometre of Kerman-Baghin road, before the cement factory. The factory has 500 workers and produces 30000 tons of asbestos plates and asbestos pipes. There are 4 industrial colonies in the area which two of them are functioning and the other two are under construction. The industrial colony number1 is located in 5 kilometre of the Kerman-Joopar road in the south which is almost 15 kilometres away from the city. It covers the area of one square kilometre and includes 70 small scale industrial units in ceramic, cement block making, stonecutting, etc. The industrial colony number 2 is located in Kerman-Baghin road after cement factory in west and its distance with the centre of the city is almost 20 kilometres. There are 90 small scale industrial units in this colony. Also there are 977 poultry and animal husbandry in the area and 25 units of fisheries in which the production rate is more than thousands of tons per year.
Fig. 2.10

Source: GPS survey by author
2.10 Urban facilities

The availability of facilities such as linkages routes, rail station, airport, fire stations, petrol pumps, natural gas network, vegetable distribution centres, electricity, telephone, public transportation, are discussed in this section.

2.10.1 Linkages routes

The main linkages routes of the city are shown in Fig. 2.11 and are as follow:

- Kerman-Baghin-Rafsanjan route with 105 kilometre in west towards North-West
- Kerman-Baghin-Bardsir route with 60 kilometre length going toward the West and South-West
- Kerman-Chatrood-Zarand route with 73 kilometre length going toward North
- Kerman-Chatrood-Ravar route with 140 kilometre length going toward North
- Kerman-Mahan-Bam route with 195 kilometre length in the South

2.10.2 Rail road

The first line of the rail road has been established in 1996 with length of 249 kilometre towards North-West. The rail road is located in southwest and it is connected to other parts of the country through Zarand in north direction (Fig. 2.11). Recently the other part of the rail road which connects the farthest southeast parts of the country to the rest of the country has started operating which made the city a linkage between southeast and the rest of the country.

2.10.3 Air port

In 1956 the construction of the airport has been started and it started working on 1970. It is located in western end of the city in the area of 6.23 km² (Fig. 2.11). There are two airplane bands with 2750 and 2025 meters length and the width of 45 meter. Most of the airline travelling, importing and exporting of material for the whole state is done through Kerman airport. Annually almost 230 thousands of air travelling which transfer almost 800 thousands of passengers is done through Kerman airport.
Fig. 2.11

Source: GPS survey by author
2.10.4 Fire fighting stations

There are three fire fighting stations in the city which they are located in Gharanee square, Shahid Sadoghi Boulevard and Biram-Abad square.

2.10.5 Petrol pumps stations

There are nine petrol pump stations out of which three of them are located in the entrances of the city and the ring road and two of them are private stations.

2.10.6 Natural Gas distribution network

In 1995 the gas distribution organization of Kerman state has started working and gradually all the city has been provided with gas pipeline network. This organization is providing gas networks for the whole state.

2.10.7 Vegetables and fruits distributing centres

There are three main centres for distributing of fruits and vegetables.

- Biram-Abad centre which has 40 platforms. It is the main distributing centre which is located in the east side of the city.
- Moshtagh centre which is called daily bazaar and it is located in old structure part of the city
- Newly established centre which is in Moshtagh square in central parts of the city

Small scale distributor centres are located mainly in southern parts of the city.

2.10.8 Electricity

The electricity has been brought to the city in 1932 and the first generator was installed in the central parts of the city. Electricity of the city is provided through national network and it is coming to the city from power stations of Zarand (in North), Sarcheshmeh (in West) and Bandarabas (in South). Two high voltage cable of 132 Kilo Watt along with converting post of 132 KW to 120 KW are located in northern side of the ring road. Electricity cables are distributed through underground cables, aerial cables and in some places there are underground or aerial transformations as
needed. Almost 124 aerial transformations are installed on electricity poles in the city. More than 80 percent of electricity is used for residential purposes.

2.10.9 Telephone

The first telephone centre has been established in 1893 with 15 magnetic line in central parts of the city. The communication was provided through wire lines with only three cities located in vicinity area of the city. In 1929 wireless system has started working which covered the connection between some other near cities. In 1973 the magnetic system has been replaced by automatic system (850 magnetic telephone numbers have been converted in to 1000 automatic numbers). Up to 1978 there were two automatic telephone centres in the city. Right now the system has been converted in to digital system and there are 269 digital telephone centres with 520540 registered telephone numbers. In mobile phone sector there are 191152 registered active phone numbers.

2.10.10 Public transportation

Most of the public transportation of the city is done by automobiles and taxis. In 1996 there were 22 buses, 12 mini buses, around 15 to 50 permanent taxis in each taxi station and the number of taxis stations were 38. Right now number of buses has been increased to 230 and some more stations have been established.

2.11 Historical background

Kerman was founded as a defence outpost, with the name of Behdesīr, by Ardeshir I, founder of the Sassanid Empire, in the 3rd century AD. In eighth century the city was famous for manufacturing of cashmere wool shawls and other textiles. The name of Kerman was adopted in tenth century. Marco Polo visited the city in 1271 and it made the city a major trade emporium linking the Persian Gulf with Khorasan and Central Asia. Although the city was sacked many times by various invaders but it survived and expanded rapidly during the Safavid dynasty. Carpets and rugs were used to be exported to England and Germany during this period. In 1794 the city has been invaded by Agha Mohammad Khan of Qajar dynasty who killed and blinded thousands of people and destroyed the city in ninety days. The present city of Kerman
was rebuilt in the 19th century in the northwest of the previous location, but the city did not recover to its former size until the 20th century.

2.12 Development process

During Sasanid Empire Kerman was limited to Dokhtar and Ardestir castles. Dokhtar castle hills, Ardshir castle, Jamaran colony and Farizan are the oldest core settlement locations of the city and they have been the political and defence centres of the city. Most of the poor populations have been settled in the margins of Dokhtar and Ardestir hills. Mostly after Islam the city developed towards the west. Due to unsafe situation of that era the city was surrounded by walls. This area which was surrounded by walls is called old and heritage structure of the city at present (Fig. 2.12). Up to 1920’s urbanization growth rate in Kerman was very slow, after wards being influenced by the other parts of the country the city came out of the old culture fences and developed more. In late 19th century map of the city has been created which the estimated area was around 4 km². At present this area is considered as the main part of old and heritage structure of the city. The area of the city is 23 times more than that at present.
Fig. 2.12

Old and heritage structure boundary

Source: GIS Analysis by author
2.13 Tourism

The Bazaar-e-Bozorg (Grand Bazaar) of Kerman is the first place in Kerman which attracts tourists to itself. It lies between the Arq and Moshtaqiyeh squares in eastern part of the city. The historical Ganj Ali Khan complex is also located in this Bazaar which comprises a school, a square, a caravanserai, a historical public bath, a water reservoir, a mint house, a mosque and a bazaar. The Khan public bath serves as an anthropology museum today and attracts an increasing number of Iranian and foreign tourists. This is a unique work of architecture with beautiful tile works, paintings, stuccos, and arches. In the closet section and main yard of the bath there are many life-like statues. This complex has been built during the Safavid era (1501 - 1722) enjoying a modern architectural style of the time. Some of the other worth-seeing places of Kerman are:

- Jabalieh dome which is a fire-temple built by Sassanid dynasty
- Kabir Jame' mosque and Sabz dome belonging to the 9th century, in which the tombs of the Gharakhatai governors are located.
- Imam Khomeini (Malek) Mosque was built during the reign of the Seljuk Touran Shah. It has numerous verandas called as shabestans, a large courtyard and aqueducts which have been built in the second half of the 5th century.
- Dokhtar and Ardeshir castles, of Sassanid monuments
- Moshtaqiyeh Dome which is built during the Qajar era which is the resting place of Moshtaq Ali Shah.

2.13.1 Kerman Handicrafts

Kerman is the source of attractive and finely woven carpets. The oldest known carpet which can be ascribed to Kerman dates back to the second half of the eighteenth century. Copper handicraft is one of the most important Persian old handicraft industries. It needs high skill and is done completely by hand. Variety of dishes, pots, statues, kitchenware, decorative things are made out of copper and the work is unique in the country. Patteh is another handcraft of Kerman which is a historical type of needle work done by women.
Fig 2.13

Some of tourist places and handicrafts of Kerman

Source: Field survey
2.14 Résumé

In this chapter the profile of the city has been given and the details regarding geographical location, topography, geology, climate, vegetation cover, Economy, urban facilities, historical back ground, development process and tourism have been discussed in detail. The next chapter would be related to environmental status of the city.