CHAPTER 3
STUDY AREA

3.1: INTRODUCTION:

This chapter is an introduction to Pune University Campus (Pune city) and Pardisan Pine forest (Kerman city), as the selected study areas in India and I.R. Iran, respectively. Both selected areas are known as the major urban hot spots for urban carbon sequestration which fall in Asia.

3.2: PHYSICAL ENVIRONMENT OF STUDY AREAS:

Two areas were selected to study the present terrestrial carbon sequestration, one from Pune (India) and second study area was from Kerman (I.R. Iran).

3.3: PUNE UNIVERSITY CAMPUS (STUDY AREA NO. 1):

The area selected for present investigations is located in Pune City. It falls in Maharashtra state (India), which is physiographically divided into four natural divisions-the coastal strip (Konkan), Western Maharashtra, Marathwada and Vidarbha. The state represent rich biodiversity including one of the biodiversity hotspot - The Western Ghats, also called the Sahyadri. The Pune city is located on the eastern fringes of Western Ghats which provides the perennial water sources for the Pune urban area. Due to the nearness with Western Ghats it harbours rich plant diversity. Pune lies on the leeward side of the Sahyadri ranges (Western Ghats) at the confluence of Mula and Mutha rivers, which are tributaries of the Bhima. Two more rivers, Pavana and Indrayani traverse the Northwestern outskirts of the urban area. The Sinhagad-Katraj-Dive Ghat range is the Southern Boundary of the urban area. The highest point in the city is Vetal Hill (800 m ASL). About 12% area of the city is hilly area.

Pune earlier famous as Poona is one of the most important city of western India. It is aptly called as the ‘Queen of Deccan’ after its elevated position atop the Deccan Plateau and its salubrious climate and surrounding hills. The city is nicknamed variously
such as ‘Pensioner’s Paradise’, The ‘Oxford of the East’, ‘Detroit of India’, the cultural capital of Maharashtra’ and upcoming ‘IT-BT’ capital of India. The city derives name from old name *Punya nagari*, which means ‘The city of virtuous deeds’.

### 3.3.1: Pune Urban Area: Past and Present:

Pune used to be at the center of the Maratha Empire in the old days. It is the cultural center of Maharashtra that wears a rich historical legacy characterized with the glorious period of Marathas. Located in Sahyadri hills, near the west coast of India, Pune city has been developed into a Pune metropolitan area, just equal in area to that of Greater Mumbai. Equally interesting to note that Pune finds passing remarks in some of the *Puranas* and research evidences show human civilization that existed 100,000 years along the Mutha River originating from the Sahyadris. Pune comprises a cosmopolitan community and a broad range of economic and social populace. It is one of the biggest industrial towns of Maharashtra and known as the Automobile hub as many big automobile companies have their headquarters here.

When the British captured Pune by defeating the Marathas in 1818, the city was hardly 5 sq. km. The city gradually expanded during the British rule with the formation of Pune Municipality and the establishment of Pune, Khadki and Dehuroad cantonments. The city expanded explosively after the post independence period. During the 180 year period (1817-1997), Pune urban area has grown from a mere 5 km$^2$ to 700 km$^2$ which is 140 times the original area. Between 1901 and 2001 (estimated) Pune's urban population has grown from 1.64 lakh to about 42 lakh (2001) which is 25 times the original figure.

### 3.3.2: Location:

Pune lies between 18°25’ N to 18°37’ N and 73°44’ E and 73° 57’ E and at 560 m ASL (Fig. 3.1). Pune urban area measuring about 700 sq km. Pune is the eight largest cities in India. It consists of Pune and Pimpri-Chinchwad Municipal Corporations. In Pune, there are two cantonment areas. Pune city is well connected to the cities of Nashik, Mumbai, Ahamadnagar, Solapur and Bangalore. It is located 192 km (by rail) and 160 km (by road) from Mumbai.
Studies on above and below ground biomass of selected plant species and its relevance to carbon sequestration.

Fig. 3.1: Pune University Campus, Pune, India
3.3.3: Geology:

Almost all the rocks of Pune are varieties of Deccan trap-basalts. They were formed by the outpouring of enormous lava flows called as Plateau basalts. The rock is dark grey to greenish grey in colour. Generally two types are seen. The non-vesicular types are hard, tough, compact and medium to fine grained, with conchoidal fracture. The vesicular or amygdular types are comparatively soft and break more easily. They are quarried on a large scale in near areas. Weathered traps, moram, along the slopes of the cliff sections are quarried.

3.3.4: Soil:

Pune consists of different types of soils namely black or kali, red or tambdi, and coarse gray or barad. In some places each class of soil blends with the other in varying proportions and in turn is modified by sand, gravel, lime-salts, and other ingredients.

3.3.5: Climate:

Pune experiences three distinct seasons: summer, monsoon and winter. Typical summer months are from March to May, with maximum temperature ranging from 35° to 40°C. Monsoon winds blowing from the Arabian Sea are a welcome relief in June, bringing with them heavy showers. The city receives an annual average rainfall from 600 to 700 mm, between June and September as a result of southwest monsoon. The rainfall is comparatively lower than the adjoining Western Ghats. Owing to its geographical location, the climate of the city is cool and pleasant throughout the year. Pune experiences winter from November to February. The temperature hovers around 29°C while night temperature is below 10°C for most of December and January, often dropping to 5-6°C (Gazetteer of the Bombay presidency, 1985).

3.3.6: Drainage:

Pune is crossed by many rivers and streams, which take their rise in and near the Sahyadris, and, bounded by the east-stretching spurss, flow east and south across the district. The chief river is the Bhima, which crosses part of the Pune district and for more
than a hundred miles forms its eastern boundary. The main tributaries of the Bhima are the Vel and the Ghod on the left, and the Bhama, the Indrayani, the Mula-Mutha, and the Nira on the right. Pavna is a feeder of the Mula. During the rainy season all of these rivers flow with a magnificent volume of water and during the hot season shrink to a narrow thread in broad stretches of gravel.

The city is located in the upper Bhima basin. The Mula or Mula-Mutha is formed of seven streams which rise at various points along the crest of the Sahyadris. The flow of the Mula River is checked by the great Khadakvasala dam about ten miles further down. Below the dam the Mutha flows north-east past the Parvati hill by the north-west limit of the city of Pune, till it confluences the Mula at a point known as the sangam.

3.3.7: Vegetation:

Pune has got good natural climatic condition for flora and fauna. Pune city is situated in transition zone between the Deccan Plateau and Western Ghats. Biodiversity of Pune is characterized by higher habitat diversity within a relatively smaller area and steep habitat gradient. The types of vegetation viz., scrub, mixed deciduous and evergreen are governed mainly by rainfall and altitude and all represent and correspond to the eastern, central and western zones of low, medium and high rainfall, varying from 15 to 150 inches. Urban flora is mixture of native and exotic species.

3.3.8: Land Use Pattern:

During the 1970's the urban activities spilled beyond the erstwhile city limits and it was felt that for comprehensive and integrated planning, a metropolitan region converging on Pune be defined. Accordingly, Pune metropolitan region was established in July, 1967. It has few semi-urbanized villages on the periphery.

The changes appear striking between 1967 and 1998. The area under settlement has increased 2-3 times during these 30 years; the area under agriculture and grassland-scrub has decreased by 31% and 39% respectively, the area under `Hills and Forests' and
water-sheets remain apparently same, though there was some encroachments over some hill slopes. To conclude, the urban sprawl appears to be at the cost of agriculture and grassland-scrub, especially the later (Nalawade, n.d.). Sulochana (2007) concluded that almost 70-80% of open/vacant/cultivable land was brought under urban land use. Most of the vacant lands close to the roads are converted for residential purpose or are under construction.

The rapid urbanization and industrialization with better job opportunities has attracted migrants from various corners of the country to Pune resulting in expansion of the settlements of Pune whereas Presence of urban hot spots such as Pune University campus or Empress Garden are the main reasons of balancing of city atmosphere (Revised Action plan for control of air pollution in Pune city, 2003-2004).

3.3.9: Sampling sites:

Pune University campus includes 166 hectare, out of that almost 50% is covered by deciduous plants dominated by Dalbergia melanoxylon and Gliricidia sepium, and evergreen trees such as Mangifera indica, Ficus benghalensis, etc. This area is considered as the biggest urban hot spot of Pune city, which playas very important role in carbon sequestration and eventually local climate sustainability. Fig.3.1 shows the study area of Pune University Campus.

3.4: KERMAN CITY (STUDY AREA NO. 2):

The city of Kerman is bordered with Kavir-e Lut (Lut Desert) in the central south of Iran (Fig. 3.2). It is situated between 30° 17' 38" N and 57° 5' 3" E at a height of 1755 m above the mean sea level. The city has moderate climate and the average annual rainfall is 135 mm. According to the census in 2010 the population of the city is 753001. Bordering with the Lut Desert has caused hot summers and in the spring it often has violent sand storms. It is safe to say that no project on terrestrial carbon sequestration had been undertaken on Kerman city urban forests.
Fig. 3.2: Pardisan forest, Kerman, I.R. Iran
3.4.1: Pardisan Forest:

Pardisan man-made forest was planted 50 years back. According to the climatic condition of the city, *Pinus pinaster* (Maritime Pine) was selected as the most suitable and adopted species to the hot summers and cold winters of the region. The area covers 230 hectares out of those 73 hectares are planted with *Pinus pinaster* trees.

Fig. 3.5: Pardisan forest (Source, Google earth, 2011).