

UNIT 4: CLIMATE

Climate is a composite term referring to elements such as temperature, air pressure, wind, rainfall, and snowfall, etc. which act as climatic factors along with latitude, coastal and continental location, and altitude. Climate is an important subject of scientific enquiry as it has a direct impact on vegetation and soil, and also influences human life and livelihood. Agriculture, important especially in Pakistan, is greatly influenced by climate because it determines the types of crops and the need for irrigation. Natural hazards like storms, floods, and desertification are the results of climatic changes. Extreme temperatures whether hot or cold, affect human, animal, and plant life, while solar energy and wind are used for power generation.

Climatic factors

Temperature

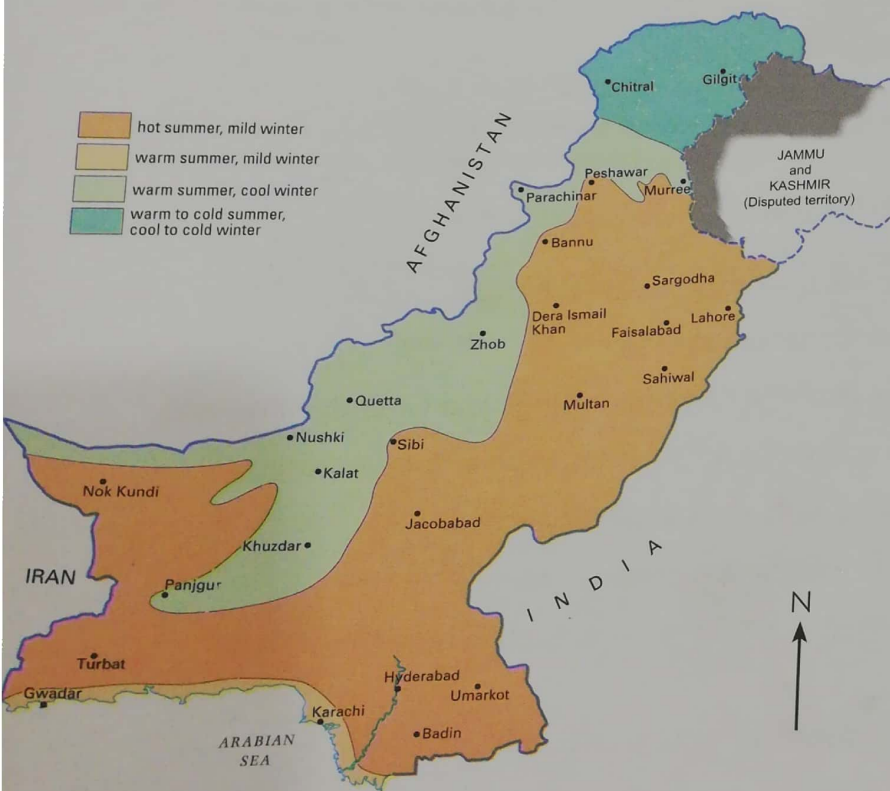


Figure 4.1: Main temperature regions in Pakistan

The Sun is the main source of temperature changes in the air. Regions between the Tropics of Cancer (23.5° N) and Capricorn (23.5° S) receive direct, vertical rays of the Sun and experience higher temperatures than those which are outside the tropics and receive slanting rays, and become colder towards the Poles. Pakistan, located just above the Tropic of Cancer, records high summer temperatures and is among the hotter countries of the world.

Because the atmosphere is heated by terrestrial radiation, i.e. the Sun's heat radiated from the Earth outward into space, the temperature steadily drops with the rise in altitude; thus the high mountains in Pakistan's north record very low temperatures and the peaks are perennially snow-bound. Since oceans have a moderating influence on temperature as they are warmer than land in winter and colder in summer, the coastal region of Pakistan has milder temperatures in summer and winter, while interior Sindh and Punjab experience a continental climate with sharper differences in temperature.

Air pressure and winds

Because air has weight, it also exerts pressure. Air pressure is measured by a barometer in units called millibars (mb) or in centimetres. A column of air exerts a pressure of one kg per sq cm at sea level and the normal pressure is noted as 1013 mb/76 cm, and decreases to 1/30 of its value with the addition of every 275 metres in elevation. At a height of 6 km, air pressure is reduced to half, and at 12 km to one fifth. This decrease in air pressure with elevation also affects air temperature.

Even at sea level, air pressure does not remain constant: when the temperature rises, air pressure falls and, alternatively, when the temperature falls, air pressure rises. Other factors also affect air pressure; readings below the normal 1013 mb/76 cm are considered low, while those above it are considered high. These differences cause winds to blow from areas of high pressure to areas of low pressure and the development of intense low pressure areas sometimes leads to serious storms.

Air pressure and winds in Pakistan

Air pressure distribution in Pakistan shows a marked contrast in summer and winter: in summer, air pressure remains extremely low, while in winter it is high. As a result, the pattern of prevailing winds is also different in the two seasons.

In summer, air pressure throughout Pakistan begins to decrease in April and continues falling till July. At this time, Sindh becomes one of the lowest pressure areas in the country, bounded

Isotherms are the lines that join places with the same temperature; isobars are lines that join areas with the same air pressure.

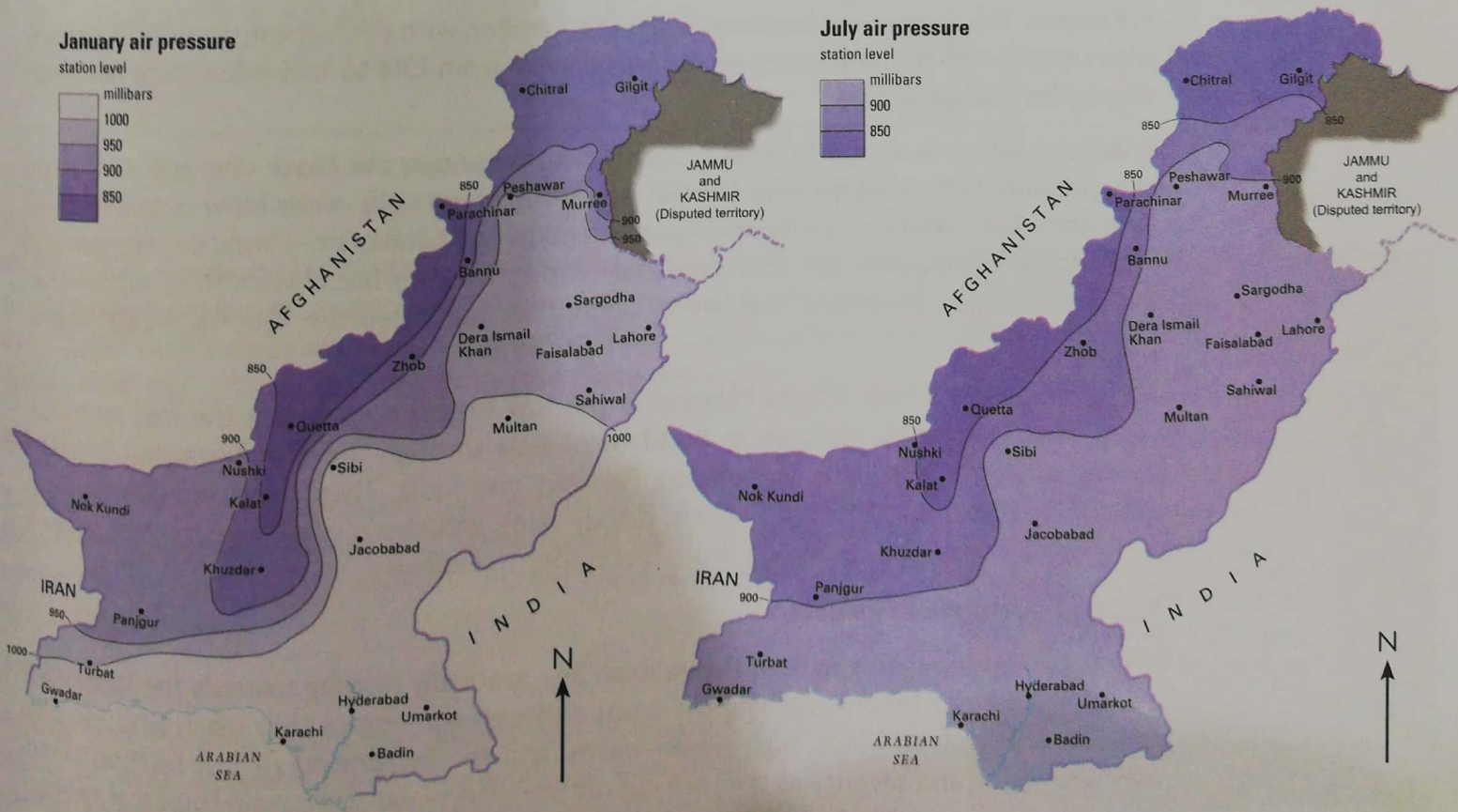


Figure 4.2: January and July air pressure readings in Pakistan

by an isobar of 994 millibars. After July, the pressure begins to increase but is relatively low up to September, after which low pressure readings cease in the area.

The effect of latitude on climate

Latitude affects climate with respect to the location of a place vis à vis the Sun, the extent and duration of sunlight, temperature, local and global wind movements, air pressure and rainfall. The latitudinal position of Pakistan and other South Asian countries is such that they are on the path of the permanent North-East Trade Winds which move towards the Equatorial Low Pressure Belt as do the South-East Trade Winds coming from the southern hemisphere. The North-East and South-East Trade Winds merge near the equator. This region is called the Inter-Tropical Convergence Zone (ITCZ).

The development of an intense low pressure belt over Pakistan in summer disturbs the global wind system and brings about a number of climatic changes.

- The Equatorial Low Pressure belt weakens.
- The ITCZ moves north over South Asia.
- The North-East Trade Winds disappear.
- The South-East Trade Winds cross the equator into the low pressure belt over Pakistan, and being deflected by the Coriolis Force* they become South-West winds.
- A complete reversal of wind patterns and directions takes place over the Indian Ocean: these summer winds are known as the monsoons (derived from the Arabic word *mousim* meaning season).
- The monsoon winds first hit India's western coast and move in towards Assam and Bangladesh; they turn north and enter Pakistan after passing over India.
- Strong winds originating over the Indian Ocean near the Mascarene Islands, because of high pressure, add to the intensity of the monsoons.

In Pakistan, the air pressure begins to rise by September, with the highest readings in January when most parts of the country record air pressure from 1014 to 1016 mb, except for Sindh where the change is slow.

Wind circulation in winter in areas close to Pakistan undergoes these changes: an intense high pressure belt develops over Central Asia from where cold winds blow outwards in all directions, but Pakistan is protected against them by the Karakoram–Hindu Kush ranges and the Himalayas. However, the cold Kandahari Winds do enter Balochistan from Afghanistan and descend into Sindh and Makran; in Sindh, they are called the 'Quetta Winds' and in Makran, *Goorich*.

The other event which affects Pakistan is the low pressure system in the mid-latitudes, sometimes leading to cyclones in South-west Asia through the Mediterranean Sea and moving eastward into Iran, Afghanistan, Pakistan, and India. They are called the Western Disturbances and lead to squally winds, cloudy skies, and also rainfall. Pakistan falls in their path during the winter, especially from December to February.

Tropical cyclones in Pakistan

In Pakistan, cyclones originate in the Arabian Sea, gradually moving towards the land. Very often they die out before reaching the coast although sometimes they reach land, causing damage with violent winds, high ocean waves, and the cyclone surge; but further inland they lose speed and severity as they are cut off from the ocean, their main source of energy.

A typical tropical cyclone lasts seven to ten days. Tropical cyclones occur either in the pre-monsoon season from May to June or in the post-monsoon season from September to October. Unlike Bangladesh and east India, Pakistan does not suffer from frequent tropical cyclones; however, the entire coastal region of Pakistan is vulnerable to them. Cyclone Phet touched Balochistan's coast on 4 June 2010 with strong winds, heavy rains, and high tides. On 6 June, the storm hit Karachi with high winds and rainfall, disrupting transport and power systems, and by evening it reached the Indus deltaic region, causing similar damage. Phet left thousands homeless, many injured, and some dead.

Thunderstorms and dust storms

Thunderstorms, usually about 20 per year, occur in northern Pakistan during May-June (pre-monsoon) and in October-November (post-monsoon); the number drops southwards. These are convectional storms rising to 6000 metres and higher; once condensation takes place, updraughts come down as downdraughts with strong winds, thunder, heavy rain, and sometimes hail; these are intense storms, in limited areas for short durations, for example,

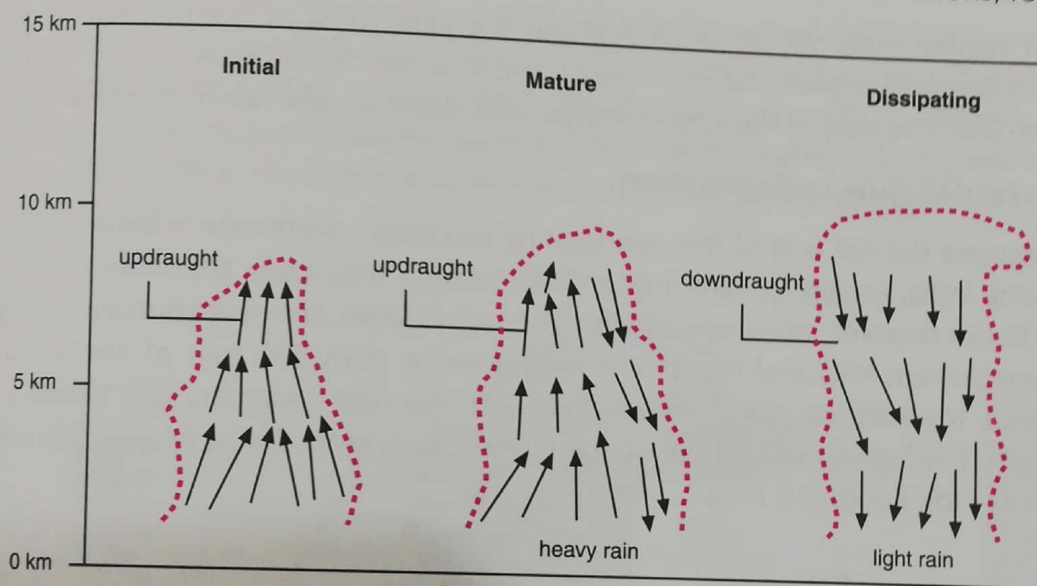


Figure 4.3: Stages of a thunderstorm

an hour. Dust storms are associated with intense heat and the development of convectional currents. In the absence of moisture, dust is whipped up as a storm. Dust storms are most common in Sindh, particularly in the desert areas where 15 to 20 dust storms take place every year.

Rainfall

Rainfall is not equally distributed throughout Pakistan. Areas with low, insufficient rainfall are termed arid, while humid areas are those where there is sufficient rainfall. Arid and humid areas are determined by evapotranspiration.

Arid areas

Arid or dry conditions prevail over a major part of the country across the whole of Sindh, southern Punjab, and southern Balochistan. The annual rainfall here is less than 250 mm. Farming is done with the help of irrigation.

Evapotranspiration is the loss of water from soil. It is a compound word made up of two words, 'evaporation' (turning of liquid into vapour) and 'transpiration' (the release of water vapour through plants).

Semi-arid areas

The semi-arid areas in Pakistan are as extensive as the arid areas and cover northern Balochistan, a large part of northern Punjab, and a major part of Khyber Pakhtunkhwa. The annual rainfall here ranges from 250 to 750 mm. Irrigation is extensively practised, but some *barani* areas have developed which are productive in years of good rainfall. In Gilgit-Baltistan and some parts of the northern Khyber Pakhtunkhwa, the annual rainfall is less than 250 mm. However, these areas are classified as semi-arid because they are located at very high altitudes.

Humid areas

Only a small area in northern Punjab, the adjoining parts of Khyber Pakhtunkhwa, and a small area around Parachinar experience humid conditions. Here, the rainfall exceeds 750 mm; however, even in this region, irrigation is necessary because rainfall is irregular.

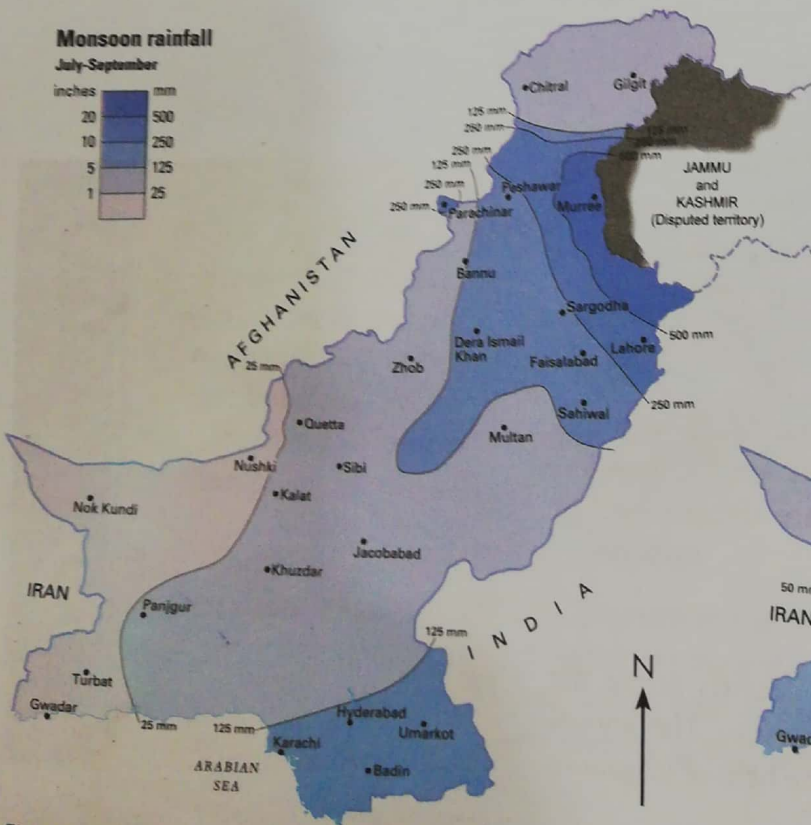
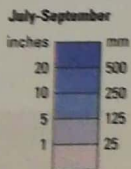
Seasonal distribution of rainfall

In Pakistan, rainfall does not occur throughout the year. Most of the rain falls in summer from July to September (with the monsoons), and in winter from December to March (with the Western Disturbances). In the intervening periods there is some rain during thunderstorms.

Monsoon rainfall (July to September)

Pakistan receives the tail end of the rain-bearing monsoon winds which enter the country after crossing India, usually in early July and sometimes into early September. As a result, eastern Pakistan receives more rainfall with the secondaries entering southern Punjab and Sindh. The northern hills and mountains record more than 500 mm of rainfall and the volume drops towards the plains to less than 250 mm near Sargodha and below 125 mm further south. The highest rainfall during the monsoons is recorded at Murree (813 mm) and the lowest at Nok Kundi (2.5 mm).

Monsoon rainfall



Winter rainfall

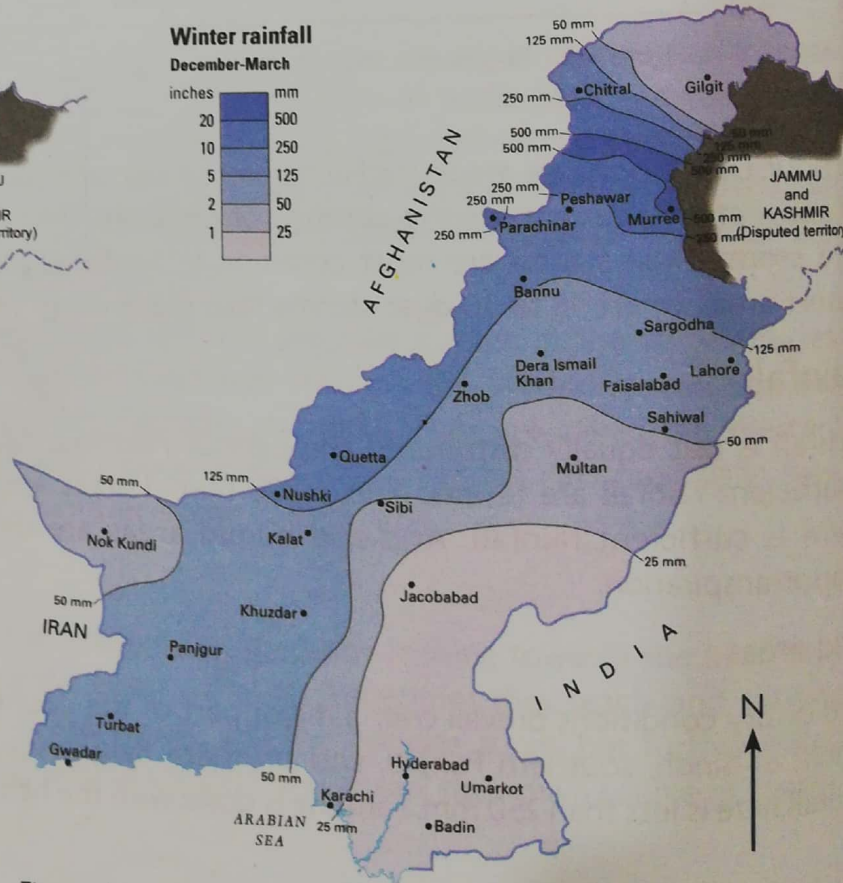
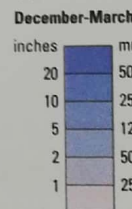


Figure 4.4: Monsoon rainfall

Figure 4.5: Winter rainfall

Rainfall from the Western Disturbances (December to March)

Although the Western Disturbances enter Pakistan from Iran and Afghanistan where they deposit most of their moisture, the Western Highlands receive more rainfall from this weather condition than from other sources. These rains begin in December and continue up to March, after which they lose their intensity. Since this period coincides with the winter season, precipitation at higher elevations is often in the form of snow.

Rainfall from thunderstorms

Thunderstorms in Pakistan occur during the driest season, particularly in October and November, and bring sporadic and localized rainfall. From April to June, areas in the extreme north, like Chitral, the Murree Hills, and Safed Koh, register more than 125 mm of rainfall. In the rest of Pakistan, rainfall from thunderstorms is less than 50 mm, while in most of Sindh and Balochistan it is less than 25 mm.

Annual rainfall

In a belt running from Murree to Dir via Saidu Sharif, the annual rainfall is more than 500 mm and most of it (250 mm) is from the Western Disturbances. Northern Punjab, the hilly areas of Khyber Pakhtunkhwa, and northern Balochistan receive 125 to 250 mm of rainfall annually. Except for the south-eastern part of Sindh which receives 125–250 mm rain during the monsoons, Sindh is the driest area of the country where the average rainfall recorded is less than 25 mm.

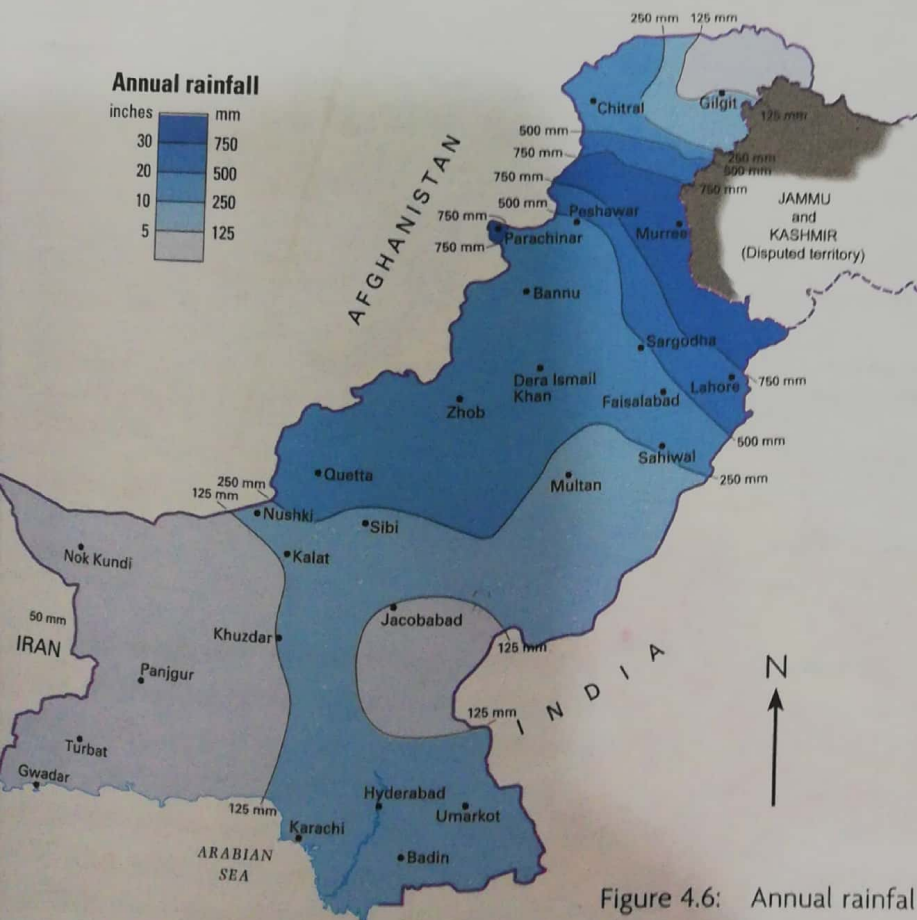


Figure 4.6: Annual rainfall in Pakistan

FACTS AND FIGURES

The average annual rainfall is 217 mm in Karachi, 115 mm in Ormara, 100 mm in Pasni, and 114 mm in Jiwani.