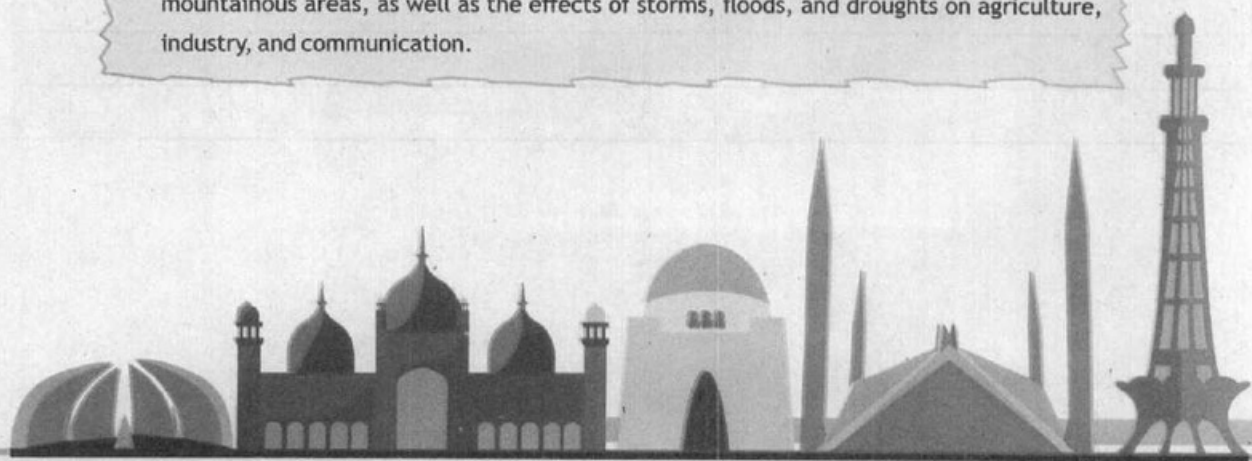


CLIMATE OF PAKISTAN AND ENVIRONMENTAL HAZARDS

In this unit the students will be able to:

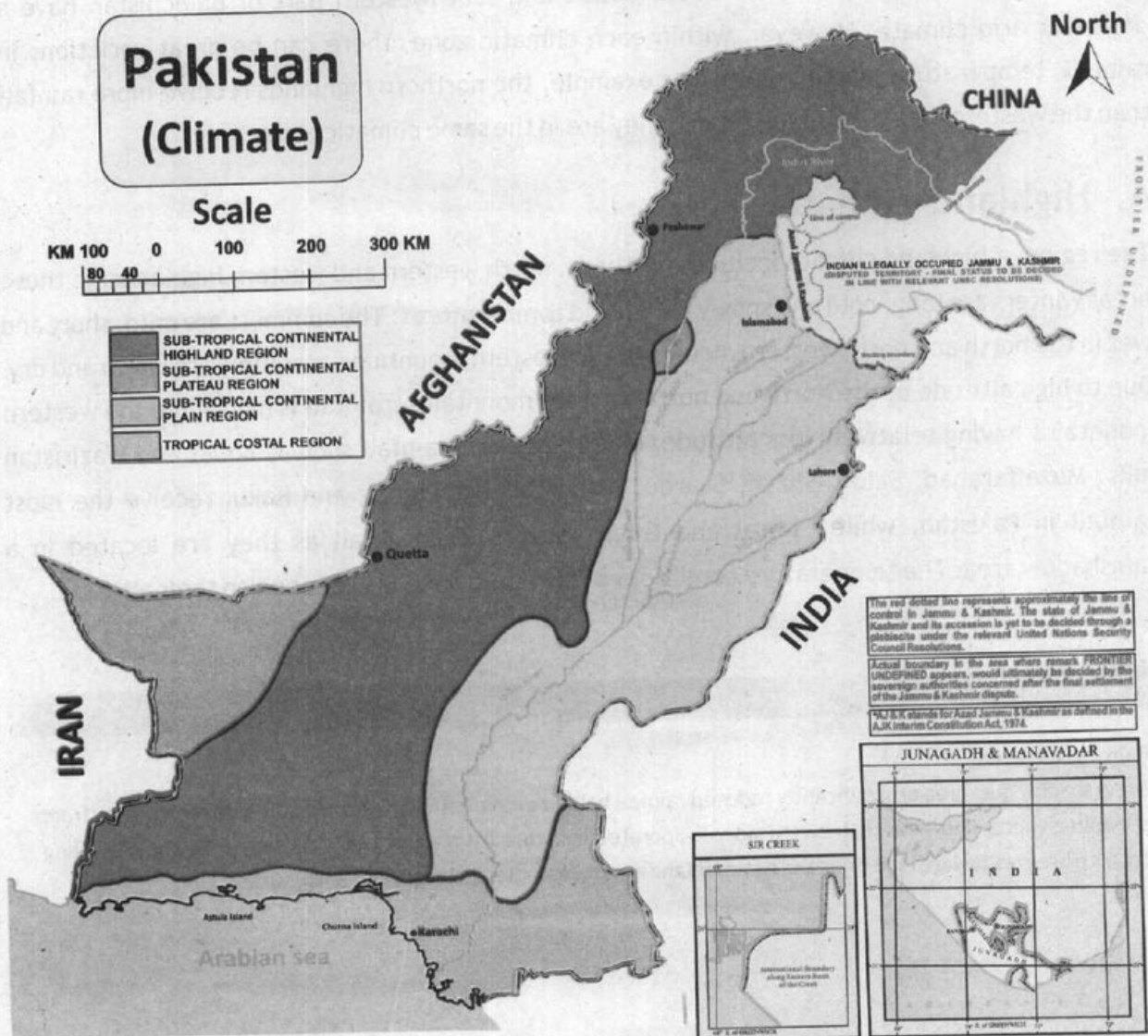
- Compare the climatic zones of Pakistan in terms of the distribution of temperature, precipitation, including monsoons, cyclones (Western Depressions), and convectional rain, using a variety of resources such as newspapers, weather charts, geographic representations, and geospatial technologies.
- Interpret the data collected on Pakistan's climatic zones to evaluate their impact on the country's physical and human geography, including agriculture, infrastructure, and transportation systems.
- Analyze the characteristics of arid, semi-arid, humid, coastal, and highland climates in Pakistan, including seasonal changes, and evaluate their impact on the physical and human geography of the country.
- Assess the ramifications of seasonal shifts in temperature, pressure, and wind patterns on Pakistan's economy taking into consideration the effects of cold, ice, and snow on mountainous areas, as well as the effects of storms, floods, and droughts on agriculture, industry, and communication.



Introduction

Pakistan's climate is mostly tropical or subtropical, and semi-arid or arid. but in the north, it is cooler and wetter. Climate may be defined as the average weather conditions in a place over a long period of time usually thirty years or more. Weather refers to the current state of the atmosphere, including temperature, humidity, precipitation, wind, and cloudiness at a place and time. The weather conditions change rapidly. In this chapter you will study about the climate of Pakistan in detail.

Climatic zones of Pakistan



The climate of Pakistan is broadly divided into four climatic zones due to diverse topographical regions. Climate of different places within a country are classified under a common category. The

divisions are:

- A. Highland Climate
- B. Lowland Climate
- C. Desert or Arid Climate
- D. Coastal or Maritime climate

The northern, northwestern, and western mountains experience a highland climate, while the Indus Plain has a lowland climate. The Makran Coast, Karachi Coast, and Indus Delta experience a coastal climate, while the southeastern desert and southwestern part of Balochistan have a desert or arid climate. However, within each climatic zone, there can be great variations in rainfall, temperature, and humidity. For example, the northern highlands receive more rainfall than the western highlands, even though they are in the same climatic zone.

A. Highland Climate

The region of highland climate includes northern, north western and western highlands. In these areas winters are long, cold and snowy with frigid temperatures. The summers are mild, short and wet in the north and north western mountains. In western mountains, summers are warm and dry. Due to high altitude of the North and north western mountains, rainfall is high while the western mountains having relatively less altitude, experience less rainfall such as Kohat and Waziristan hills. Muzaffarabad, Said-u-Sharif, Skardu, Astor, Dir, Parachinar, and Kakul receive the most rainfall in Pakistan, while Chitral and Gilgit receive less rainfall as they are located in a rainshadow area. The temperature conditions of different areas also depend on their altitude.

Do You Know?

Rainshadow Area

A rain shadow is an area of significantly reduced rainfall behind a mountainous region, on the side facing away from prevailing winds, known as its leeward side. Evaporated moisture from water bodies is carried by the prevailing onshore breezes towards the drier and hotter inland areas. Examples include Gilgit and Chitral.

B. Lowland Climate

The low land climate refers to plain areas of Pakistan located in Punjab and Sindh except the coastal areas. In these areas, summers are arid and at times extremes. Winters are mild to cool. Monsoons typically lasts from June to September. The lower Indus plain and southern parts experience way less rainfall. The north and north western of the Indus plain receive the tail end of monsoon rainfall. Most of the rainfall and thunderstorm occur during July and August. However, the number of rainy days in the Indus plain varies depending on a number of factors, including elevation, latitude, and proximity to the mountains. For instance, the areas of Pothwar plateau are wetter than the Indus plain because it receives rainfall from both the monsoon and western depressions.

C. Desert or Arid Climate

Aridity refers to low precipitation and low moisture content in the environment. The desert areas i.e., Kharan, Cholistan, Thal and Thar experience dry and hot summers and receive scanty rainfall throughout the year. During the day, hot and dusty winds blow across the plains from May to September. The diurnal range of temperature in desert areas is high. Dust storms are a permanent feature of desert climate that temporarily lower the temperature. Winters are cold with minimum temperature of 4°C.

Do You Know?

The diurnal range of temperature is the difference between the highest and lowest temperatures in a 24-hour period.

D. Coastal Climate

The region of coastal climate stretches from Ran of Kutch in Pakistan- India border to the Makran coast at the Pakistan-Iran border. The coastal strip includes the Indus Delta, Thatta, Karachi, and whole of Makran coast. This region has a maritime climate with sea breezes round the year. The proximity to the sea results in high humidity particularly between April to September. Very little rain fall is experienced in the monsoon season. Some rainfall is received from the western depression.

The Seasons of Pakistan

Pakistan has four distinct seasons namely Spring, summer, Autumn and winters. Spring in Pakistan starts from March and lasts until May with average temperatures ranging from 15°C to 25°C. Summer continues from June to September. The weather is hot and dry, with average

temperatures ranging from 25°C to 40 °C. The monsoon rains arrive in Pakistan in the summer, and they can be very heavy, especially in the southern and eastern parts of the country. The autumn season lasts from October to November with average temperatures ranging from 15°C to 25°C. There is some rain in the autumn, but it is not as heavy as the monsoon rains. Winter in Pakistan persists from December to February. The weather is cold to cool and dry, with average temperatures ranging from 5°C to 15°C. There is some snow in the winter, especially in the northern parts of the country. These seasonal variations are caused by the variations in the climatic elements which will be explained next.

Climatic Elements

There are four elements which largely influence the seasonal variations in Pakistan- temperature, pressure, winds and rainfall:

i. Temperature

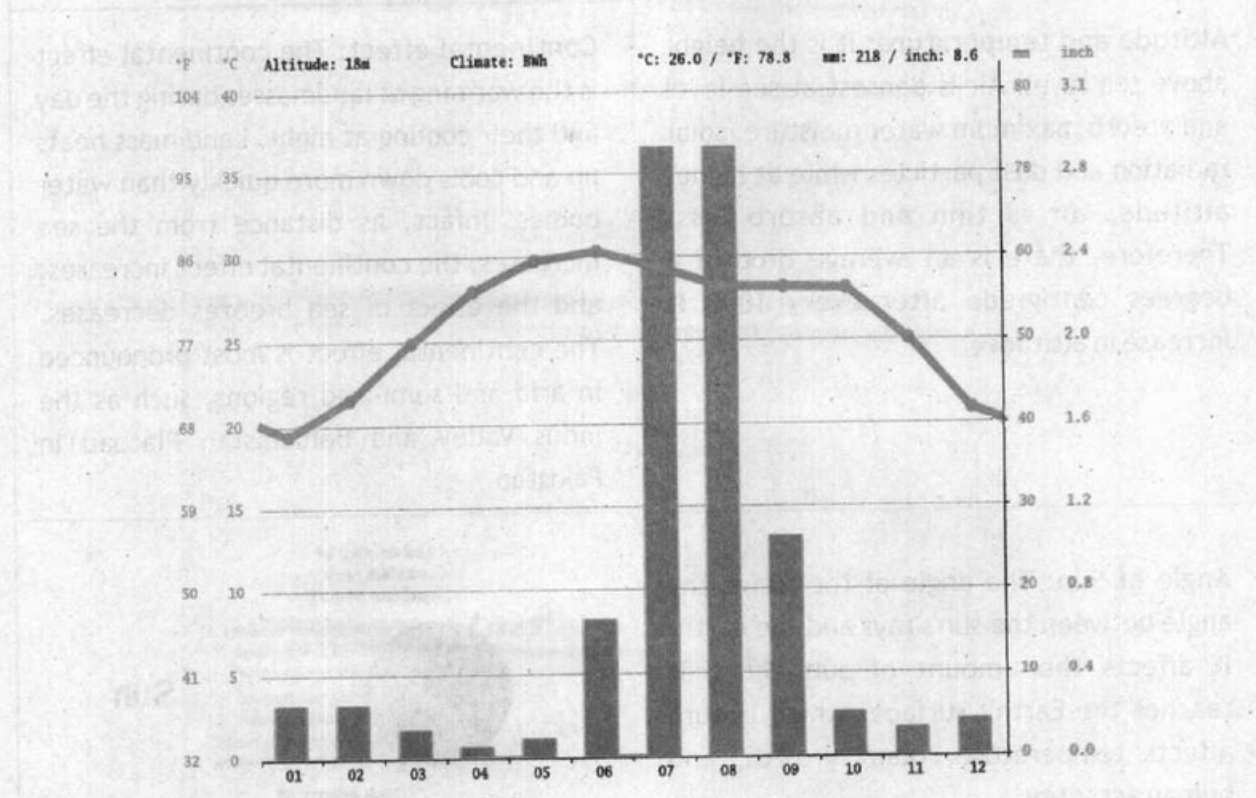
Temperature is the measure of hotness or coldness expressed in terms of any of several scales, including Celsius and Fahrenheit. The temperature distribution of an area informs us about the climatic conditions, biodiversity, and human activity of an area. The factors Affecting temperature variations in Pakistan are angle of sun, monsoon rains, cloud cover, distance from the sea, continental effect, sea breezes, altitude and latitudinal differences.

Things to Remember	Temperature in Celsius	Description
	40°C and above	Very hot
	31°C- 39 °C	hot
	21°C -29°C	Warm
	10°C-20°C	Mild
	3°C-9°C	Cool
	-5°C -2°C	Cold
	Below -5°C	Very Cold

Temperature key

The northernmost region of Pakistan is the coldest, with average temperatures ranging from 17° C in the summer to -2° C in the winter. The highest peaks of the northern mountains remain covered in snow year-round. Central Pakistan has a more moderate climate, with average temperatures ranging from 25° C in the summer to 10° C in the winter. The region includes Islamabad, and the major city of Lahore. Southern Pakistan is the hottest region of Pakistan, with average temperatures ranging from 28° C in the summer to 18° C in the winter. The region is home to the

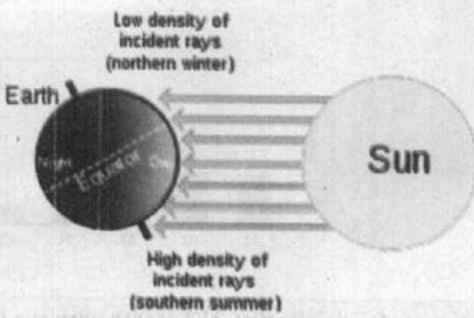
port city of Karachi and the desert region of Balochistan. According to the Pakistan Meteorological Department, the hottest months are May and June, with average temperatures of 30.5°C and 34.0°C , respectively. The coldest months are December and January, with average temperatures of 12.5°C and 15.5°C , respectively. The graph is showing the climate of Karachi in terms of temperature and rainfall.



In terms of precipitation, the month with the lowest amount of rainfall is April, recording a mere 0 mm | 0.0 inch in its entirety. This denotes an exceptionally dry period within that particular time frame. On average, the highest amount of rainfall occurs during July with a mean value of 52 mm | 2.0 inch.

Factors contributing to temperature variations in Pakistan

There are four elements which largely influence the temperature variations in Pakistan- temperature, pressure, winds and rainfall.

Latitudinal effect: At the equator, the sun's rays hit the Earth vertically at right angle, so they deliver more heat to the Earth's surface. At the poles, the sun's rays hit the Earth at a very oblique angle, so they deliver less heat to the Earth's surface.	Cloud cover: It is an important factor in determining the amount of sunlight that reaches the Earth's surface. It also affects temperature, precipitation, and visibility.
Altitude and temperature: It is the height above sea level. Air is densest at sea level and absorb maximum water moisture, solar radiation and dust particles while at higher altitude, air is thin and absorb less. Therefore, there is an average drop of 6 degrees centigrade after every 1000 ft increase in altitude.	Continental effect: The continental effect is the warming of landmasses during the day and their cooling at night. Land mass heats up and cools down more quickly than water bodies. Infact, as distance from the sea increases, the continental effect increases, and the effect of sea breezes decreases. The continental effect is most pronounced in arid and semi-arid regions, such as the Indus Valley and Baluchistan Plateau in Pakistan.
Angle of Sun: The angle of the sun is the angle between the sun's rays and the earth. It affects the amount of sunlight that reaches the Earth's surface, which in turn affects temperature, plant growth, and human activities.	

ii. Rainfall

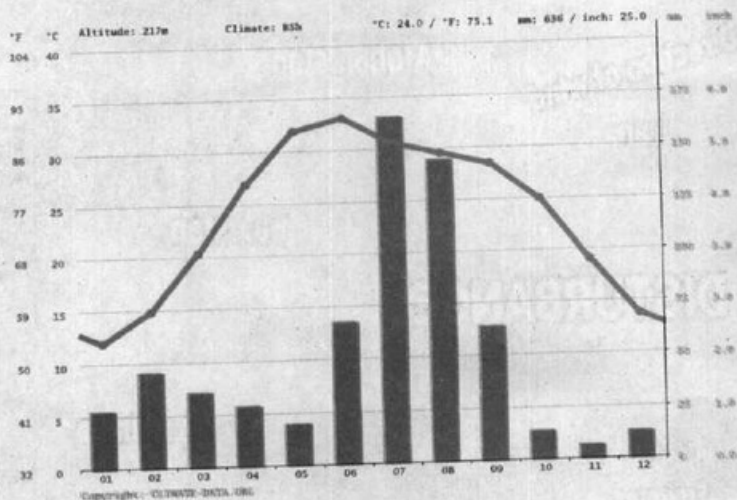
The rainfall in Pakistan decreases from the Himalayas to the south of Pakistan. There are four sources of rain which provide rain to the different regions located in Pakistan. These are:

• Monsoon Winds

The word "monsoon" comes from the Arabic word "mausim", which means "season". This is because monsoons are seasonal winds that reverse their direction twice a year. Pakistan experiences monsoon rains from two sources: the Bay of Bengal and the Arabian Sea. The monsoon season in Pakistan typically lasts from June to September.

• Bay of Bengal Monsoon

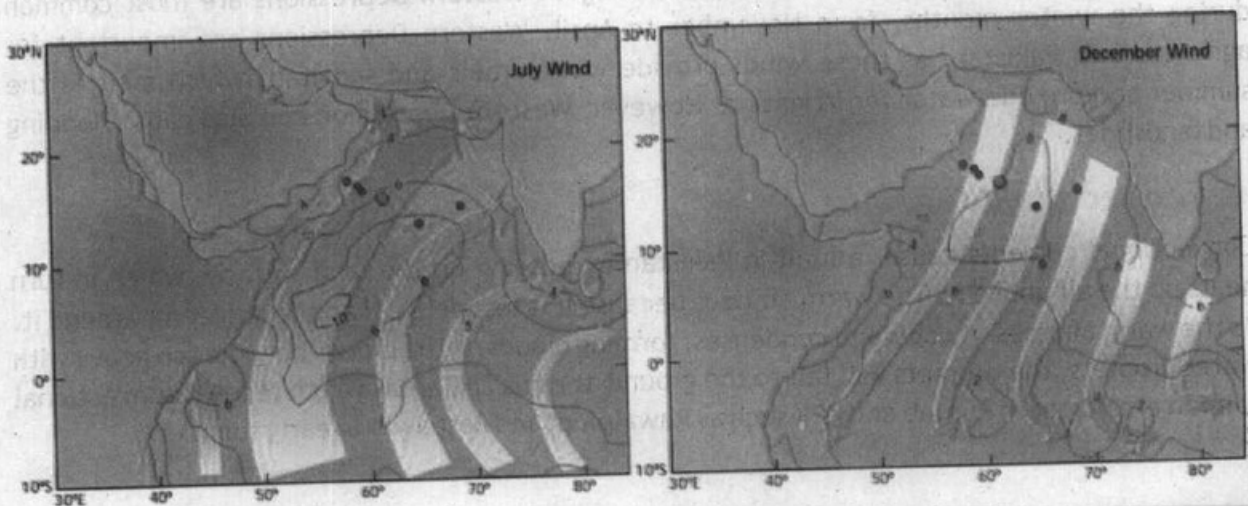
The Bay of Bengal monsoon is caused by the differential heating of the land and the sea. During the summer months, the land heats up more quickly than the sea. This causes a low-pressure area to develop over the land. The warm, moist air from the Bay of Bengal rushes in to fill this low-pressure area, resulting in heavy rainfall. These winds blow from Bay of Bengal and cross over India and straight hit the Himalayas and give rain to the areas of northern Punjab as well.



According to the graphic representation, the precipitation in Lahore is the lowest in November, with an average of 7 mm | 0.3 inch. Most of the precipitation here falls in July, averaging 166 mm | 6.5 inches.

• Arabian Sea Monsoon

The Arabian Sea monsoon rains are caused when an over active monsoon winds blow across south east of Pakistan and bring rain to the coastal areas. The Arabian Sea monsoons provide water for agriculture and replenish groundwater supplies. However, the monsoon rains also cause flooding, landslides, and damage to infrastructure sometimes.



Arabian Sea Monsoons (a) summer season represented by July (b) winter season represented by December (Honjo and Weller based on SODA data)

iii. Western Depressions



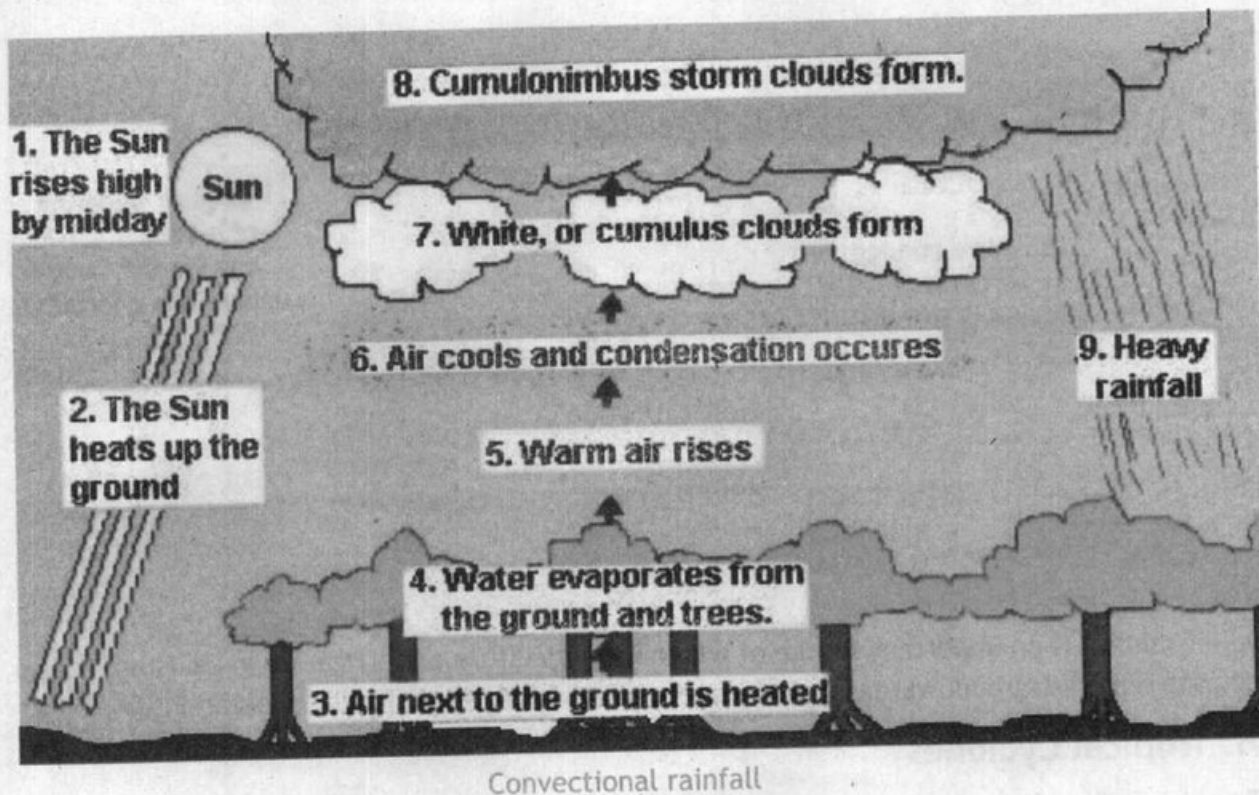
Western Depressions or Western disturbances are a low-pressure system that develops over the Mediterranean Sea and travels eastward, bringing rain and snow to the Middle East and South Asia, especially to the northern and western regions of Pakistan including Chitral, Dir, Peshawar, Loralai, Quetta, Kharan, and Makran coastal range. Western Depressions are most common during the winter months, from November to April. Western Depressions are important for agriculture in Pakistan, as these winds provide winter rains and snowfall, which melt in the summer and provide water for irrigation. However, Western Depression can also cause flooding and landslides.

iv. Convectional Currents

Convectional currents cause rainfall in Pakistan by heating up the land surface, which in turn heats up the air above it. The warm air rises because it is less dense than the cooler air around it. As the warm air rises, it cools and condenses, forming clouds. If the clouds become too heavy with water droplets, the droplets will fall to the ground as rain. The areas which receive convectional rainfall are northern Punjab and KPK such as Rawalpindi and Peshawar in early summer.



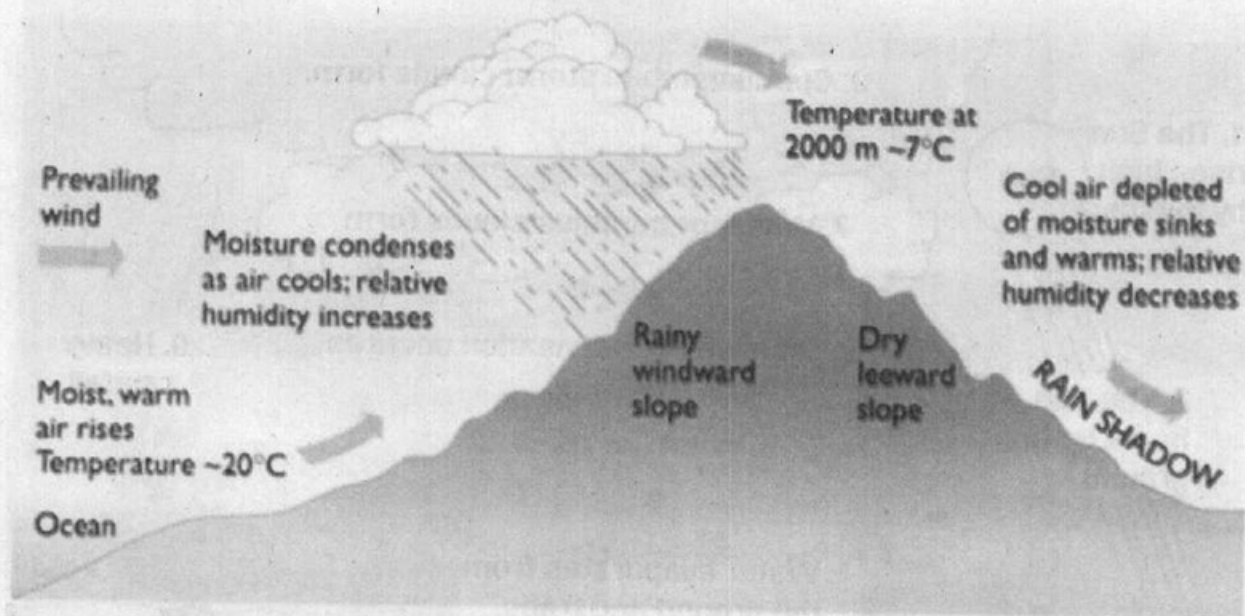
Note For Teachers: Describe the distribution of mean annual rainfall of areas having highest to lowest rainfall in Pakistan. (Source: <http://www.globalcitymap.com/Pakistan>)



Convectional rainfall does not take place in the areas south of Pakistan during summer because of the temperature inversion layer. Temperature inversion layer is a layer of air where the temperature increases with height. This forced the rising air to sink which compresses and warms as it descends back to the earth. Temperature inversion layers can trap pollutants in the lower atmosphere, leading to poor air quality and results more dryness in the area. They can also prevent clouds and precipitation from forming, which is why Karachi and adjoining areas do not receive convectional rainfall during the summer months, despite the high temperatures i.e., 40°C.

v. Relief Rainfall

Relief rainfall, also known as orographic rainfall, is a type of precipitation that occurs when moist air is forced to ascend over a mountain range. As the air rises, it expands and cools, causing the water vapor in the air to condense and form clouds. If the clouds become too heavy with water droplets, they will fall to the ground as rain. Relief rainfall is common in the northern and western regions of Pakistan i.e., the Himalayas and Karakoram. These mountains act as a barrier to the moist air from the Arabian Sea, forcing it to rise. As the air rises, it cools and condenses, forming clouds and precipitation. Some important places include Murree, Abbottabad, Swat Valley, Gilgit-Baltistan, Peshawar, Kohat, Bannu and Quetta.



Relief rainfall is an important source of water for agriculture and irrigation in Pakistan. It also helps to replenish groundwater supplies and provide drinking water for the population.

vi. Tropical Cyclones

Tropical cyclones are large, rotating storms that form over warm ocean waters. They are characterized by strong winds, heavy rainfall, and storm surges. Tropical cyclones are natural hazard and proved to be very destructive, causing widespread damage to property and infrastructure. Pakistan is located on the northern shores of the Arabian Sea, which is a region that is prone to tropical cyclones. The coastal regions of Sindh and Balochistan are the most vulnerable to tropical cyclones. The places that experience tropical cyclones are Karachi, Thatta, Badin, Pasni, Jiwani and Gwadar.



Tropical Cyclone in Karachi October 01, 2021

vii. Pressure and movement of Monsoon winds

The pressure and movement of monsoon winds is a complex system that is influenced by a number of factors, including the sun's position, the temperature of the land and sea, and the rotation of the Earth. During the summer months, the Arabian sea is warmer than the land surface. This creates a low-pressure system over the Arabian Sea and a high-pressure system over the land surface. Winds blow from the Arabian Sea towards the land surface, bringing warm, moist air to northern and central Pakistan. The warm, moist air rises and cools, forming clouds and rain in the months of July and August. While during the winter months, the Arabian Sea is cooler than the land surface. This creates a high-pressure system over the Arabian Sea and a low-pressure system over the land surface. Winds blow from the land surface towards the Arabian Sea, taking dry air with them. As a result, Pakistan receives very little rain during the winter months.

Efficacy of Rainfall for Farming

The effectiveness of rainfall for farming in Pakistan varies depending on the amount, timing, and distribution of rainfall. Farmers plan and choose crops that are suited to the rainfall patterns in their region and use irrigation to supplement rainfall where necessary.

The arid regions of Baluchistan receive less than 250 mm of rainfall per year, which is insufficient for crop production. Farmers in these regions rely on irrigation. The humid regions of the Himalayas receive over 2,000 mm of rainfall per year, which is too much for most crops. Farmers in these regions use drainage systems to prevent waterlogging.

Pothwar Plateau: The Pothwar Plateau which is a rainfed area also called 'Barani land', receives moderate rainfall, ranging from 500 to 1,000 mm per year. This is enough rainfall to support crop production, but farmers have to manage the water resources during dry years. The Indus Plain receives moderate rainfall, ranging from 250 to 500 mm per year. This is enough rainfall to support crop production, but farmers need to rely on irrigation to supplement the rainfall.

Winter rainfall plays an important role in agriculture, water storage, groundwater recharge, ecosystems, and other sectors. It helps to replenish water reservoirs, such as dams and lakes and supports a variety of ecosystems in Pakistan, including forests, grasslands, and wetlands and Industrial usage.



Note For Teachers: What can you infer about the aftermath of the cyclone based on the photograph?
Source : The News International

Natural Hazards

i. Thunderstorms

Thunderstorms in Pakistan are most common in the summer months of April to June and September to October. However, they can occur in any part of the country, but they are most common in the north and north western areas, foothills of Himalayas and Safed Koh mountains. Thunderstorms cause strong winds, heavy rain, lightening, thunder and hail which can destroy crops, orchards, flooding, landslides and power outages due to damage to power lines.

ii. River Floods

A river flood is a natural disaster that occurs when a river overflows its banks and inundates the surrounding land. Although floods deposit fresh nutrients and spread a layer of alluvium in wetlands and the Indus delta and recharge ground water but floods also have massive devastating effects on natural and human resources. There are natural and human reasons of river floods.

Natural Factors	Human Factors
1) Record breaking rainfall such as in 2010, alone in Peshawar, 312mm of rain fell in 24 hours.	1) Deforestation, as with many floods, is an issue due to the reduced infiltration and increased surface run-off.
2) Fastest melting of snow due to climate change. Increase in average temperature of the earth. 0.08°C per decade since 1880.	2) Building settlements on the floodplains. The quality of settlements close to the river is poor and prone to collapse during flooding
3) Natural embankments alongside rivers are not high enough to contain the flood water.	3) Reduced capacity of Dams to store extra or flood water.
4) Storm surge in sea level caused by a hurricane or other storm causes flooding in coastal areas.	4) Federal Flood Commission is generally under prepared in major rainfall event. There is a lack of managing effective flood control.

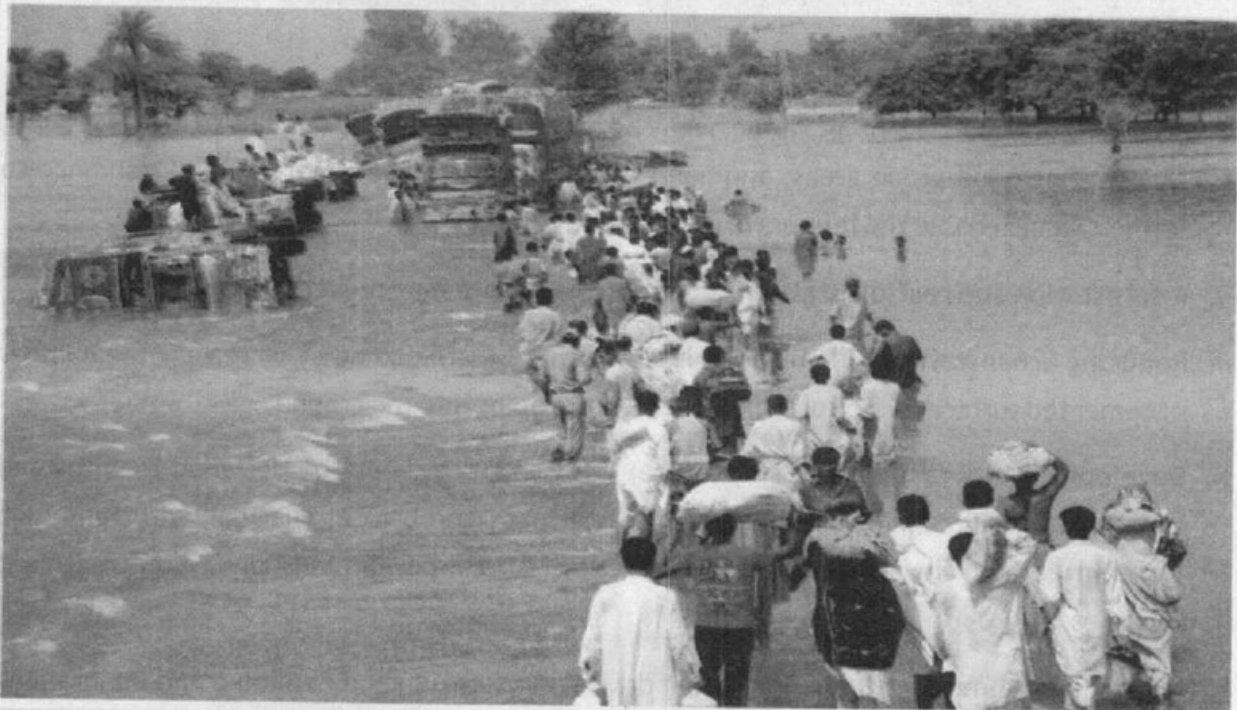
Preventive Measures

- i. **Providing preflood warning:** Farmers may be helped in evacuating animals to higher ground, sandbagging flood-prone areas, and harvesting crops early. by promoting flood insurance to farmers would enable the farmers to recover from the losses.
- ii. **Afforestation and reafforestation:** Forests regulate water and prevent the risks of floods.
- iii. **Reducing urbanization:** Urbanization increase the risk of flooding by increasing the number of cemented surfaces which prevent water from seeping into the ground.
- iv. **Developing flood-resilient infrastructure:** Infrastructure should be designed to withstand the impacts of flooding. This includes building roads and bridges that can withstand high water levels, and elevating critical infrastructure, such as power plants and water treatment facilities.
- v. **Improving drainage systems:** Improving drainage systems include building and maintaining storm drains and canals, and clearing debris from waterways.
- vi. **Constructing flood defences:** Flood defences, such as levees and floodwalls will protect communities from river floods.
- vii. **Managing water resources:** By building more small dams will reduce the risk of flooding and to mitigate its impacts.
- viii. **Raising awareness of flood risks and educating people about flood safety:** Pre-flood warning may be advertised on television and social media and educating people about flood safety. Rehabilitating centres must be built to provide medical care, psychological and social support to flood affectees.



Note For Teachers: Whole-class discussion prompt:

How does the spatial distribution of the summer monsoon rainfall in Pakistan impact the country's agriculture and economy?



Pakistan's Flood in 2010. Experts called it the 'flood of century'. It affected over 20 million people and displaced over 10 million people. The floods caused an estimated \$43 billion in damage.

iii. Droughts

Drought is a natural hazard marked by long spell of dry period. The lack of rainfall causes severe water shortages and damages crops and livestock. Pakistan is susceptible to both natural and human-induced droughts. In Pakistan drought appears in several forms:

1. **Permanent drought:** It exists in desert areas of Pakistan. Crop cultivation is hindered due to extreme aridity.
2. **Seasonal drought:** Barani areas of Potwar and southern Punjab often experience dry season due to unreliability of monsoon. This severely hinders crop cultivation.
3. **Invisible drought:** It is also known as agricultural drought. It may be directly caused due to deforestation and consistent soil erosion. Crop yield is reduced, livestock remain vulnerable due to water shortages and farmers suffer economic losses.
4. **Unpredictable drought:** It occurs because of the unexpectedly low rainfall due to climate changes resulting in crop failure, water shortages, livestock death and internal displacement of rural population.



Effects of Drought

Drought Management in Pakistan

The government and communities in Pakistan are working together to mitigate the risks of droughts and to ensure that communities are able to cope with the effects of droughts. Water conservation schemes are introduced such as lining canals, building water tanks, small local dams, reservoirs. Early warning system is developed and financial assistance is provided to affected farmers. Farmers are increasingly planting drought-resistant crops, such as sorghum and millet and using water more efficiently by adopting drip irrigation. Community-based drought management initiatives include rainwater harvesting by the collection of rainwater from rooftops and other surfaces during the rainy season and stored for use during the dry season.



Local Konkar Dam in Sindh to fight drought

Seasonal Canal Proposed to Bring Water to Thar Desert

The Sindh government is considering a proposal to build a seasonal canal from Sukkhar Barrage to the Thar Desert. The canal would bring much-needed water to the desert region, which is currently very dry and arid. Canal would be approximately 200 kilometers long and would carry water from the Indus River to the Thar Desert. The water would be used for irrigation, drinking water, and livestock. The project is estimated to cost around Rs. 50 billion. The Sindh government has approached the federal government for funding assistance. The project has been welcomed by farmers and residents of the Thar Desert. They say that the canal would bring prosperity to the region and help to improve their lives. However, some environmentalists have raised concerns about the project. They say that the canal could damage the fragile ecosystem of the Thar Desert. They also say that the canal could displace people who currently live in the desert.

By The News Desk, August 4, 2017

Effects of Climate on the lifestyle and economic activities of People

The effects of climate on the lifestyle and economic activities of people vary depending on the climatic zone. Here this will be discussed in more detail.

Highland zone

The climatic highland zone is characterized by cooler temperatures and higher precipitation than the lowlands. This zone is often home to forests and alpine meadows. People in the climatic highland zone are nomads and typically practice transhumance, subsistence agriculture and livestock herding. In the extreme north, people also rely on tourism and other non-agricultural activities for income. In Balochistan, crop cultivation is difficult in most parts due to lack of water. It also discourages human settlements.

Climate change also has a significant impact on the climatic highland zone. For example, farmers are struggling to grow crops in the face of declining water availability, droughts, floods, and landslides. This is leading to food insecurity and poverty. Climate change is also making it more difficult for people to access traditional grazing lands, which is impacting livestock herders.

Lowland zone

The lowland zone is characterized by warmer temperatures and lower precipitation than the highlands. Indus plains of Punjab and Sindh covers lowland zone. People in the lowland zone rely on a variety of economic activities, including agriculture, manufacturing, and services. However, warming temperatures are leading to more extreme weather events, such as heat waves, droughts, floods, and storms. These events may lead to crop failure, damage transportation and

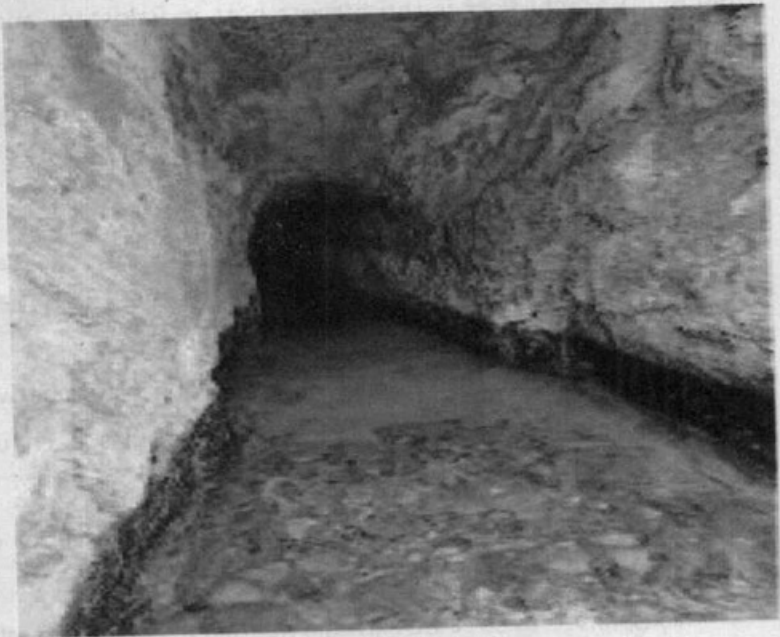
communication and disrupt economic activities. For example, heat waves can lead to crop failure and livestock deaths. Droughts can also reduce crop yields and make it difficult for people to access water. Floods and storms can damage infrastructure and disrupt transportation and communication networks.

Arid Zone

The arid zone of Pakistan is mainly consisted of desert areas. It is characterized by very dry spell of weather. These areas suffer from water shortages due to extremely low rainfall and high evapo-transpiration rate. People in the arid zone rely on a variety of economic activities, such as mining, livestock herding, and tourism. Despite the arid conditions, many people in the desert areas of Pakistan practice agriculture. Karez - an underground irrigation system-is practiced in Balochistan. Karez irrigates farmlands, orchards and date palms. They grow a variety of crops,

including wheat, rice, millet, and sorghum. In arid Zone, people also raise livestock, such as sheep, goats, and camels. Animals provide them with food, milk, and transportation. They are also used to produce wool and other products.

Many people of desert areas are skilled artisans. They produce a variety of handicrafts, such as carpets, textiles, and pottery. These handicrafts are sold in local markets and exported to other



Karez in Balochistan

parts of Pakistan and the world such as Ajrak, Ralli quilts, embroidery shawls, leather products, pottery to various countries including India, United States, United Kingdom, Canada, Australia, Germany and United Arab Emirates. Tourism is a growing industry in some parts of the desert areas of Pakistan. Tourists are drawn to the unique landscape and culture of the desert for example Cholistan Desert that is known for its rolling sand dunes, salt marshes, and ancient forts. Tourist explore deserts landscape, culture and wildlife of Thar and Cholistan by Camel safaris and Jeep tours.

Coastal zone

The coastal zone of Pakistan is comprised of delta coastline in Sindh and the hilly Makran coast in Balochistan. It is characterized by maritime climate. Cool sea breezes relieve the high temperatures of the summer months. This long coastal line is home to beaches, estuaries, and wetlands which attract tourism during winter months. People in the coastal zone rely on a variety of economic activities, including



Sindh Coastal region

fishing, tourism, and trade. The Karachi-Korangi and Qasim ports play vital role in Pakistan's economy. Karachi Port is the busiest port in Pakistan, and it handles a wide variety of cargo, including containers, bulk cargo, and liquid cargo. However, Climate change is leading to some frequent and severe storms result coastal erosion and damage to infrastructure costing very high to the economy of Pakistan.

What I have Learned

- Transhumance is the seasonal movement of livestock between high-altitude and low-altitude pastures. It is a traditional practice that has been used for centuries by pastoralist communities.
- Monsoon winds are seasonal winds that reverse direction every six months. These winds are caused by the differential heating of land and water.
- Monsoons can also cause extreme weather events, such as floods.
- A temperature inversion layer is a layer of the atmosphere in which the temperature increases with height.
- Livestock plays an important role in the lives of many people in the desert areas of Pakistan.
- Fishing is a major industry in many coastal communities.

Exercise

Answer the following questions by choosing the best answer A, B, C or D.

1: The continental effect is the:

- A. Warming of landmasses during the day and their cooling at night.
- B. Cooling of landmasses during the day and their warming at night.
- C. Warming of oceans during the day and their cooling at night.
- D. Cooling of oceans during the day and their warming at night.

2: The floods are caused by the:

- A. Different heat capacities of land and water.
- B. Inundation of river embankments
- C. Different heat reflectivity of land and water.
- D. landslides in the northern mountains.

3: The temperature inversion layer is pronounced in:

- A. Arid and semi-arid regions.
- B. Humid and tropical regions.
- C. Polar regions.
- D. South-East of Pakistan

4: Relief rainfall occurs in the:

- A. Valley floor
- B. Leeward side of the relief
- C. Desert areas
- D. All of the above

5: Which of the following is NOT a characteristic of Western Depressions

- A. They are most common during the winter months.
- B. They bring rain and snow to Pakistan.
- C. They are important for agriculture in Pakistan.
- D. They develop over the Pacific Ocean.

6: Sea breezes are caused by the:

- A. Differential heating of land and water.
- B. Same heating of land and water.

- C. Differential cooling of land and water.
 - D. Same cooling of land and water.
7. **Convictional rainfall in Pakistan is caused by:**
- A. It is caused by the heating of the land surface.
 - B. It is common in the northern and western regions of Pakistan.
 - C. It occurs in the early summer months.
 - D. It is caused by the collision of two air masses.
- 8: **Which non coastal city in Pakistan is vulnerable to tropical cyclones?**
- A. Karachi B. Thatta C. Badin D. Peshawar
- 9: **Which of the following statements is NOT true about the monsoon winds in Pakistan?**
- A. The monsoon winds blow from the Arabian Sea towards the land surface during the summer months.
 - B. The monsoon winds bring warm, moist air to Pakistan during the summer months.
 - C. The monsoon winds cause heavy rainfall in Pakistan during the summer months.
 - D. The monsoon winds blow from the land surface towards the Arabian Sea during the winter months.
10. **Which of the following regions in Pakistan does NOT receive enough rainfall for crop production?**
- A. Arid regions of Balochistan B. Humid regions of the Himalayas
 - C. Potwar Plateau D. Indus Plain.

Answer the following questions briefly.

1. What are the four climatic zones of Pakistan, and what are two key differences between each zone?
2. Describe the characteristics of the desert or arid climate of Pakistan?
3. Explain how the climate of Pothwar plateau makes it a challenging area for the farmers.
4. How does the coastal climate of Pakistan differ from the other climatic zones of Pakistan?
5. Why do many rivers flood in Pakistan during summer?
6. How does the yearly distribution of rainfall and temperature vary between Karachi and Lahore?

7. Explain the development of Monsoon winds in Arabian sea.

Answer the questions in detail.

1. How can the effectiveness of rainfall for agriculture in Pakistan be improved? Discuss the key challenges and opportunities particularly in Indus plain.
2. To what extent do storms and droughts cause problems for the people of Pakistan? Also Suggest some preventive measures and management strategies to reduce the problems.
3. Explain the sources of rainfall in Pakistan and how they vary seasonally. Give examples to support your answer.
4. Explain how temperature variations affect the lifestyle of people in different regions of Pakistan.
5. Write short notes on the following topics
 - Pressure and Winds
 - Advantages and disadvantages of floods in Pakistan

Forming opinions

Do you think that the proposed seasonal canal from Sukkhar Barrage to the Thar Desert is a good idea? Why or why not?

This is a learning activity which requires students to think critically about the potential benefits and drawbacks of the project. It also requires students to consider the different perspectives of the people who would be affected by the project, such as farmers, residents of the Thar Desert, and environmentalists.

Project

Analyze the impact of climate change on the climatic zones of Pakistan. Present your information to the class in power point presentation.

Glossary

Highland climate: A climate that is characterized by high altitudes and cold temperatures.

Lowland climate: A climate that is characterized by low altitudes and warm temperatures.

Monsoon: A seasonal wind pattern that brings heavy rainfall to Pakistan during the summer months.

Western depression: A low-pressure system that develops over the Mediterranean Sea and travels eastward, bringing rain and snow to the Middle East and South Asia, including Pakistan.

Sea breeze: A cool wind that blows from the sea to the land during the day.

Land breeze: A warm wind that blows from the land to the sea at night.

Diurnal temperature range: The difference between the highest and lowest temperatures in a given day.

Precipitation: Any form of water that falls from the sky, such as rain, snow, or hail.

List more words and write their meaning that you find difficult in this chapter.
