

Section 3

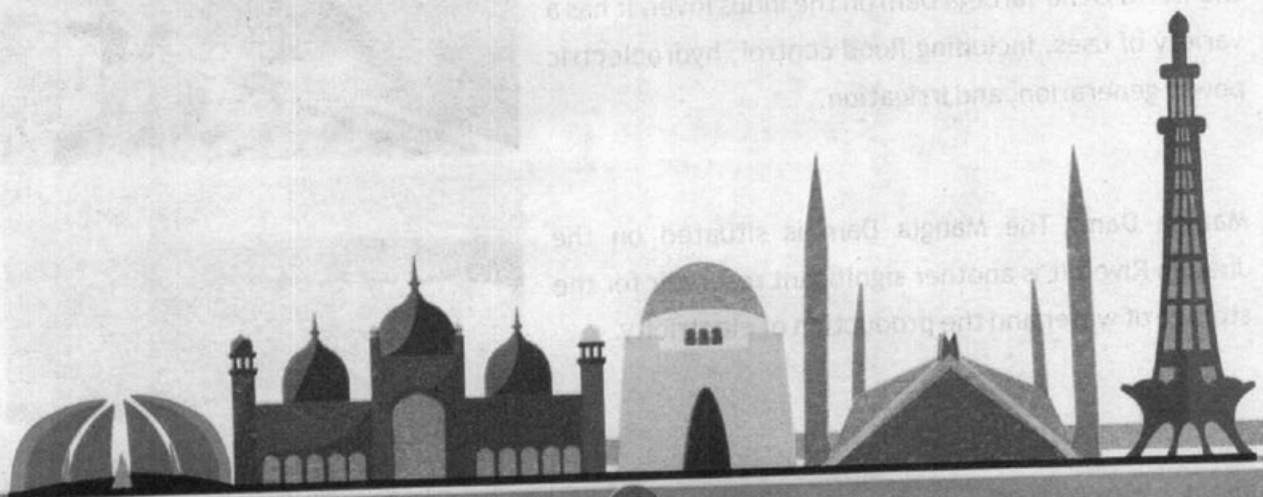
Resources and Economic Development of Pakistan

UNIT 06

WATER RESOURCES

In this unit the students will be able to:

- Describe the surface and groundwater resources in Pakistan, including seasonal fluctuations in flow and quality of water.
- Evaluate the advantages and disadvantages of the extensive irrigation system in Pakistan and suggest sustainable solutions to water resources management in order to deal with threatening issues of water pollution, water shortage and wastage.
- Analyze the vital role of dams, barrages, canals, and water reservoirs offer towards sustainable solutions, (including hydroelectric power generation, flood control and irrigation), and their potential impacts on the agriculture environment, industry and human activities.



Surface and Ground Water Resources

All types of life on Earth depend on water. Our bodies contain roughly 60% water and we cannot survive without a consistent supply of clean water. It is the foundation of human existence. Surface and ground water resources are abundant in Pakistan, which lies in South Asia. These resources are essential for the country's household, industrial, and agricultural demands. An overview of these water resources is given below.

Surface Water Resources:

Indus River: The Indus River is Pakistan's biggest and most important river. It has its sources. Jhelum, Chenab, Ravi, and Sutlej rivers are only a few of the tributaries of the Indus River that contribute significantly to Pakistan's surface water resources.



Jhelum River: One of the principal tributaries of the Indus River is the Jhelum River. It runs through the province of Punjab and the Azad Jammu and Kashmir region. It is playing a significant role in irrigation and hydroelectric production.



Chenab River: The Chenab River is another important Indus tributary. It runs through Pakistan's Punjab province. It supports both electricity and irrigation.



Tarbela Dam: One of the biggest earth-filled dams in the world is the Tarbela Dam on the Indus River. It has a variety of uses, including flood control, hydroelectric power generation, and irrigation.



Mangla Dam: The Mangla Dam is situated on the Jhelum River. It is another significant reservoir for the storage of water and the production of electricity.



Ground Water Resources:

Pakistan largely relies on its groundwater supplies, particularly in those regions which have little access to surface water. Tube wells and hand pumps are the main methods used to access groundwater for domestic, commercial, and agricultural uses in those regions.

Indus Basin Aquifer: The greatest groundwater source in Pakistan is the Indus Basin aquifer. It covers the whole Indus plain and fulfills the majority of the country's agricultural needs of water.

Baluchistan Plateau Aquifer: The Baluchistan Plateau aquifer is a vital supply of groundwater in the region of Baluchistan. It promotes agriculture and maintains local residents' means of survival.

Punjab Aquifer: Groundwater is a major source of irrigation in Punjab province. In some locations, excessive groundwater extraction is a problem because it causes dropping water tables and an increase in salinity.

Seasonal Fluctuations in Flow and Quality of Water:

Pakistan's dry to semi-arid environment, monsoon rains, and glacier melt water from the Himalayan and Karakoram mountains all have a significant impact on seasonal variations in water flow and quality. These elements cause different seasonal fluctuations in the quantity and quality of water. An outline of these variations is provided below:

Seasonal fluctuations in Water flow:

The monsoon season (July to September): It is the most crucial time for Pakistan's water flow. The southwest monsoon at this time causes a lot of rain to fall across the nation, but especially in the north and west. This downpour contributes to a rise in river flow and aids reservoir restocking. During this time, there is a noticeable rise in the amount of water flowing through the Indus River and its tributaries, including the Jhelum, Chenab, and Sutlej.

Winter and Spring (October to April): Most of Pakistan experiences comparatively little rainfall during the winter and spring months. However, water from the melting snow in the Himalayan and Karakoram peaks continuously decreases during this time. This melt water contributes to the Indus River and its tributaries, helping to keep the flow somewhat steady. It is significant to note that the snowpack from the preceding winter affects the water supply throughout these months.

Summer (May to June): When winter snowmelt fade, the summer months are often characterized by increasing temperatures and decreased water flow in rivers and streams. During this season, water shortage becomes an issue in many locations, particularly in Pakistan's south, and irrigation needs rise.

Seasonal Fluctuations in Water Quality:

1. The monsoon season (July to September): This season can significantly affect the quality of the water. In rivers and other bodies of water, heavy rains can cause overflow water that carries contaminants from urban and agricultural regions. Flooding can contaminate water sources and can be one of the reasons of lowering the quality of the water.

2. Dry Season (October to June): Because there is less pollution brought on by rainfall during the dry season, water quality tends to improve. However, due to decreased water flow and dilution in some regions, the concentration of contaminants might increase significantly. During this time, agricultural water quality problems may worsen.

2. Glacier Water: Water from glacier melt sources is often of high quality and is also cost-free.

Challenges and Concerns: Pakistan's water resources are subject to a number of problems, such as water scarcity, excessive groundwater extraction, contaminated water sources, and a lack of effective water management techniques.

Irrigation

Irrigation is the process of applying water to soil or land artificially in order to promote the growth of plants and crops. Especially in regions with low or irregular rainfall, it is an essential agricultural method used to supply appropriate moisture to plants. The main goal of irrigation is to provide water to agricultural fields, orchards, gardens, and other cultivated areas. The irrigation systems can vary, from straightforward techniques like using buckets or hoses to more complicated ones like drip irrigation, sprinkler irrigation, and flood irrigation.

Advantages of extensive irrigation system:

Pakistan's large irrigation system, which is mostly based around the Indus River and its tributaries, offers a number of important benefits. Some of which are listed below:

1. Improved Agricultural Productivity: By supplying a steady supply of water, the irrigation system enables agricultural cultivation. This dramatically increases food output by increasing agricultural productivity and enabling many planting cycles in a single year.

2. Food Security: In order to ensure food security for Pakistan's rapidly expanding population, the irrigation system's consistent water supply is essential. It makes it possible to grow important food staples for Pakistan's diet, including cotton, rice, and wheat.

3. Economic Development: Agriculture, which employs a huge section of the people and contributes to the GDP of the nation, is an important economic factor in Pakistan. By providing water for agricultural, the irrigation system aids in the development of this industry.

4. Community Stability: Millions of rural Pakistanis who depend on agriculture for their livelihood are supported by irrigation. A reliable water supply reduces these populations' vulnerability to droughts and other climate fluctuations.

5. Crop Modification: Farmers can choose from a wider variety of crops because of irrigation's accessibility to water. Farmers will be able to cultivate a greater variety of crops, such as fruits and vegetables, which can increase income and food variety.

6. Hydropower Generation: The irrigation system includes numerous dams and reservoirs that are used to generate hydropower. This reduces the nation's dependency on fossil fuels. It also assists in meeting country's energy needs.

7. Flood Control: The irrigation system includes some flood-control mechanisms, such as dams like Tarbela and Mangla. They can hold more water during the monsoon season and lowers the risks of floods.

8. Control of Salinity and Waterlogging: The irrigation system contains drainage infrastructure to handle the salinity and waterlogging issues that may arise as a result of excessive irrigation. This keeps the soil in good condition for farming.

9. Support for Livestock: By supplying drinking water and grazing for animals, reliable water sources benefit not just crop production but also livestock farming.

10. International Water Sharing: The Indus Waters Treaty regulates water sharing between Pakistan and India, which share the Indus River system. Pakistan is able to manage its portion of these foreign waters and thanks to the massive irrigation system.

Although Pakistan's massive irrigation system has many benefits, there are some drawbacks as well, such as water scarcity, poor water use, and environmental issues. To solve these issues and ensure long-term water availability, sustainable water management strategies are essential for maximizing advantages.

Disadvantages of the extensive irrigation system:

The irrigation systems in Pakistan have been essential for agriculture and food security, but they also have a number of drawbacks and difficulties. The large irrigation system in Pakistan has a number of drawbacks, some of which are listed below:

1. Water Reduction and Shortage:

Aquifers have been depleted in several areas of Pakistan as a result of over-extraction of groundwater due to the heavy use of irrigation. Falling water tables and higher pumping expenses for farmers are the results of this.

2. Salinity and waterlogging:

- a. Waterlogging, in which the water table rises to the root zone of crops and damages them. It is a result of improperly maintained irrigation systems.
- b. Salinity: Irrigation water has a high salt content, and over time, poor drainage and management can result in salinity of the soil, which lowers agricultural yields and soil fertility.

3. Effects on the Environment:

- a. Habitat Degradation: Building dams, canals, and reservoirs as part of extensive irrigation systems can have a negative impact on local ecosystems and destroy habitat.
- b. Dams and diversions can disturb river ecosystems, which can have an effect on fish populations and water quality.

4. Expensive Maintenance:

Maintenance of large irrigation infrastructure, such as canals, dams, and pumps, may be costly and difficult. It needs frequently major government investment.

5. Unfair Distribution:

- a. Unequal Access: Farmers' agricultural output and revenue vary widely because access to irrigation water is not always distributed fairly. Smallholders may not have an advantage over larger landowners.
- b. Water Theft: Common issues like water theft and unauthorized canal tapping make an uneven distribution of water resources.

6. Energy Consumption:

Pumping water for irrigation can be expensive, increasing expenses for farmers and adding to energy demands.

7. Climate Vulnerability:

sources so it makes agriculture vulnerable to unpredictable climate such as droughts or a smaller amount of water flow.

8. Social Issues:

- a. Land Displacement: The relocation of settlements during the construction of big dams and reservoirs presents social and economic difficulties for the affected inhabitants.
- b. Conflicts: Pakistan's massive irrigation systems can lead to water disputes between provinces and even with neighbors like India.

9. Problems with water quality:

- a. **Pollution:** In some instances, irrigation water may be infected with contaminants from industrial waste discharges, agricultural runoff, or untreated sewage.

10. Lack of Modernization:

- a. **Old Practices:** Poor irrigation techniques and the use of old-fashioned technology can reduce the benefits. Irrigation's potential benefits might be limited by the use of old technology, which also hinders agricultural modernization.

Pakistan must make investments in justifiable water distribution policies, better irrigation infrastructure, effective water usage promotion, and sustainable water management techniques in order to solve these drawbacks. A more sustainable agricultural system can also be achieved by reducing the over-reliance on irrigation and responding to changing climatic circumstances by encouraging the use of water-efficient crops.

Some Sustainable Solutions:

Pakistan needs to use a multimodal approach that includes legislative changes, infrastructure upgrades, and community involvement to address water pollution, water shortages, and water waste. Here are some green approaches to efficiently managing water resources:

1. **Facilities for treating wastewater:** Spend money on and increase the size of wastewater treatment facilities to handle sewage and industrial effluents before releasing them into bodies of water. Put in place strict rules to ensure agreements.
2. **Usage of Rainwater:** Promote the adoption of rainwater harvesting methods in homes and communities to collect and store rainwater for domestic usage and groundwater replacement.
3. **Effective Irrigation Methods:** To prevent water waste in agriculture, promote and encourage the use of contemporary irrigation techniques, such as sprinkler and drip systems, to reduce water waste.
4. **Desalination:** By installing desalination facilities along the coast, particularly in coastal areas where there is a severe water shortage.
5. **Geological Management:** Implement strict groundwater extraction regulations to avoid

overuse and salty water intrusion. Encourage aquifer recharge techniques to top off groundwater supplies.

6. Education and Information: Organize public awareness campaigns to raise awareness of the need for sustainable water usage, pollution avoidance, and water preservation. Education has the power to influence behavior.

7. Industrial Regulation: To reduce industries' release of pollution, impose tight environmental laws on them. Promote more eco-friendly production techniques and the reuse of industrial effluent.

8. Water management in rural areas: Build small dams, ponds, and water storage structures as part of community-based water management systems in rural areas.

Promote the growth of such type of crops which are considered drought-resistant. It will help to lower agricultural water demands and boost crop yields in times of water shortage.

9. Governmental Measures: Create and implement comprehensive water management plans that take both urban and rural demands into account. Implement price policies that promote wise water use. Research and development of water-saving technology, such as water-efficient appliances and leak detection systems, should be funded.

10. Collaboration across borders: To ensure the equitable and sustainable use of shared water resources, cooperate with neighboring nations. It will help to ensure the sustainable and fair use of shared water resources.

11. Climate Change Mitigation: Fight against climate change's consequences by implementing measures to deal with shifting rainfall patterns by creating strong infrastructure.

12. Public-Private Alliances: Water infrastructure projects can be managed and funded by public-private partnerships, which can increase effectiveness and ease the strain on government resources.

13. Monitoring and Data Gathering: Set up a thorough water monitoring system to keep checks on water supply, quality, and usage. Government and civic society must make a nonstop commitment to addressing Pakistan's water-related issues, and various parties must work together. To achieve a safe and impartial water future, sustainable solutions must strike a balance between economic growth and environmental preservation.

14. Water management: In order to solve water shortage and better manage water resources, the Pakistani government has been working on a number of water management projects, including the building of dams and reservoirs. Water governance is being improved. Water use

efficiency is being increased. Sustainable agricultural and industrial practices are being promoted.

In conclusion, Pakistan's water needs are met through a combination of groundwater resources and surface water sources, primarily the Indus River system. The development of a nation and the welfare of its people depend on the efficient management of these resources.

Role and Impacts of Water Reservoirs

Hydroelectric power generation, flood control, irrigation, and other sustainable solutions all benefit greatly from the use of dams, barrages, canals, and water reservoirs. However, they could also have an impact on human activities, the environment, industry, and agriculture. Let us examine these features in greater detail:

1. Hydroelectric Power Generation:

- **Benefit:** Dams and reservoirs are necessary for the production of hydroelectric power. They offer a dependable and sustainable energy source and help in assisting in the reduction of greenhouse gas discharges and dependence on fossil fuels. Hydroelectricity can provide a large amount of the region's electricity requirements while also promoting the production of sustainable energy.
- **Negative Impact:** Building dams and reservoirs may have negative effects on the environment. It includes the disturbance of habitats, altered river flow patterns, and potential harm to aquatic ecosystems. Large dams have the potential to uproot communities and cause social and cultural repercussions.

2. Flood Control:

- **Positive Impact:** Dams and barrages are constructed to control water flow and lessen the likelihood of flooding in communities downstream. This promotes public safety and property preservation by reducing the damaging effects of flooding on infrastructure, crops, and communities.
- **Negative Impact:** By releasing water at the wrong periods or holding back too much water, poorly maintained dams can occasionally make flooding worse. Additionally, the modified river regimes can negatively impact biodiversity and water quality in downstream ecosystems.

3. Irrigation:

- **Beneficial Effect:** Canals and reservoirs are essential for irrigating agricultural crops, particularly in areas with erratic rainfall patterns. By enabling farmers to grow crops all year

round, this improves food security by raising agricultural output and income for rural areas.

- **Negative Effect:** Poor irrigation techniques can waste water, make the soil saltier, and damage the environment. The availability of water downstream can be decreased and aquatic habitats harmed by excessive river water withdrawal for agriculture.

4. Agriculture:

- **Positive Impact:** Access to water through irrigation systems and canals increases agricultural output and assures a steady supply of food. This promotes economic growth, food security, and livelihoods in rural communities.
- **Negative Impact:** Poor water resource management can result in over-extraction, aquifer reduction, and soil degradation. Irrigation can degrade water quality and harm aquatic habitats also by allowing fertilizers and pesticides to discharge.



5. Environment:

- **Positive Impact:** Well-planned dams and reservoirs can perform as useful water supply and storage systems during dry spells. They can help in maintaining a steady supply of water for both ecosystems and human use.
- **Negative Impact:** Modifying natural river flows can damage ecosystems. It can disturb fish migration, and harm aquatic habitats. Additionally, reservoirs can contribute to the buildup of deposit, which over time reduces their capacity for storage.



6. Industry and Human Activities:

- **Positive Impact:** water is essential for industry growth and human needs. It improves the quality of life overall by guaranteeing a steady supply of water for drinking, sanitation, and enjoyment.
- **Negative Impact:** Building and maintaining dams and reservoirs can be expensive. Large-scale water infrastructure projects can come at a social and environmental cost.

In conclusion, dams, barrages, canals, and water reservoirs provide valuable sustainable solutions including irrigation, flood control, and hydroelectric power generation that support economic growth and human well-being. To reduce these water resources' negative effects on the environment, agriculture, and communities, appropriate management is essential. To balance the advantages and disadvantages, sustainable and responsible water management methods are crucial.

Exercise

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

1. Up to ----- of the human adult body contains water.
a. 60% b. 70% c. 80% d. 90%
2. Pakistan's biggest river is -----
a. Sutlej b. Chenab c. Sindh d. Jhelum
3. One of the biggest earth-filled dams in the world -----.
a. Hub Dam b. Mangla Dam
c. Diamer Basha Dam d. Tarbela Dam
4. Groundwater is a major source of irrigation in ----- province.
a. Punjab b. Sindh
c. Khabar Pakhtun kha d. Balochistan
5. Most of Pakistan experiences comparatively little rainfall during-----.
a. Summer b. Winter
c. Spring d. Autumn
6. A big Number of Pakistanis depend upon the field of ----- for their livelihood.
a. agriculture b. government jobs
c. industry d. medicine
7. The greatest groundwater source in Pakistan is the-----.
a. Baluchistan Plateau Aquifer b. Indus Basin Aquier
c. Punab Aquier d. Arabian Sea

8. The main goal of irrigation is to provide water for-----,
 - a. agriculture puposes
 - b. industrial purposes
 - c. Washing purposes
 - d. Cleaning purposes
9. The process of removing salt from seawater is called-----,
 - a. precipitation
 - b. condensation
 - c. desalination
 - d. salination
10. Water-efficient crops are those which need -----
 - a. some water
 - b. no water
 - c. more water
 - d. less water

Answer the following questions briefly.

1. Describe five positive impacts of water reservoirs on water issues?
2. What is meant by irrigation?
3. Analyze the role of dams in flood control.
4. Describe the following terms.
 - a. salinity
 - b. waterlogging
5. Describe five advantages of Pakistan's extensive irrigation system?
6. How does seasonal fluctuation affect the flow of water?
7. Suggest five sustainable measures to reduce water wastage?

Answer the following questions in detail.

1. Write a note on the surface and ground water resources in Pakistan.
2. What are the strengths of the irrigation system of Pakistan?
3. Evaluate the importance of different types of water reservoirs in obtaining sustainable solutions or water-related issues?
4. Suggest some sustainable solutions to address water pollution, water shortages, and water waste.

Compare and Contrast

How do the water resources of the Indus River and the ground water resources in Pakistan differ in terms of availability and distribution.

Project

Plan a study trip of your class to your nearest dam to explore its advantages and disadvantages.

Glossary

Abundant: plentiful, rich, generous, ample, copious.

Tributary: headwater, branch, feeder

Aquifer: A body of permeable rock which can contain or transmit groundwater.

Desalination: The process of removing salt from seawater.

Erratic: unpredictable, inconsistent

Alter: change, modify, adjust, vary

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