

UNIT 3

DEVELOPMENT OF WATER RESOURCES:

The **Indus** provides the key water resources for the economy of Pakistan. The River also supports many heavy industries and provides the main supply of potable water in Pakistan.

The ultimate source of the Indus is in **Tibet**; The Indus then flows northwest through Ladakh and Baltistan into Gilgit, just south of the Karakoram Range. The **Shyok** River and **Gilgit** streams carry glacial waters into the main river. It gradually bends to the south, coming out of the hills between Peshawar and Rawalpindi. It flows swiftly across Hazara, and is dammed at the Tarbela Reservoir. The **Kabul River** joins it near **Attock**. The remainder of its route to the sea is in plains of the Punjab and Sindh, and the river becomes slow-flowing and highly braided. It is joined by **Panjab** River at **Mithankot**. Passing by Jamshoro, it ends in a large **delta** to the east of **Thatta**.

We have world's largest and unified irrigation system that consists of three major reservoirs (Chashma, Mangla, and Tarbela); 19 **barrages** (Ferozepur, Sulemanki, Islam, Balloki, Marala, Trimmu, Panjab, Kalabagh, Sukkur, Kotri, Taunsa, Guddu, Chashma, Mailsi, Balloki, Sidhnai, Rasul, Qadirabad, and Marala); 12 link canals; 45 irrigation canals.

Key Points:

Natural resources:

- Land, water, air.
- Natural resources can be described as renewable or nonrenewable resources.

(a) Renewable resources:

- RS can be recycled or reused.
- They can be used over and over again e.g. water, sunlight, wind power, tidal power, and geothermal power.
- Sustainable e.g. vegetation, soil, landscape.

(b) Non renewable resources:

- NRS occur in limited quantity.
- If their use continues they will run out like fossil fuels and minerals.

Hydrological cycle:

- The water that reaches the ground from the atmosphere falls in various ways such as rain, snow or hail. This is called **precipitation**.

- Some of the water runs directly off the earth's **surface** as rivers and streams draining into lakes and the sea.
- The rest of the water is either utilized by plants or soaks into the **ground**.
- Water is returned to the atmosphere as water vapor through evaporation from surface water and by transpiration from plants.
- Rising into the atmosphere the water vapor cools to form water droplets and this system is called **condensation**.
- This cycle is called the hydrological cycle.

The Indus system:

- Indus is the largest river of Pakistan
- It is watered by the **glaciers** of the **Karakorum** and **Hindu Kush**.
- After crossing the Himalayas it turns into south west and enters Pakistan.
- After leaving the mountainous region of kalabagh the river enters the plains of Punjab and Sindh.
- Finally the Indus flows into Arabian Sea.
- The Indus basin covers an area of about one million square kilometers.
- The system irrigates about **60 %** of Pakistan's cultivatable land.
- The source of river Indus is at the lake **Mansorowar** at Tibet China.
- The river Indus forms a **delta** at its mouth.
- The total journey of the Indus from source to mouth is about 2900 km.
- On its way from source to mouth Indus is joined by some Eastern and Western tributaries.
- Eastern tributaries are **Jhelum, Chenab, Ravi, Beas and Sutlej**.
- Rising in the Himalayas and passing through Kashmir, the rivers enter the plains.
- The river Beas joins river Sutlej before entering into Pakistan.
- All the Eastern tributaries join at **Panjnad** and then flow for about a unified stream and join the Indus at **Mithankot** after a distance of 72 km.
- The river Indus has the highest mean monthly discharge in June and July.
- The western rivers are Swat, Kabul, kurram, Tochi, Gomal, Zhob.
- These are smaller in length and width and have less water than the eastern tributaries.



Baluchistan River System:

- **Quetta** being a high altitude region has the central position in the drainage pattern of Baluchistan.
- Rivers like **Zhob, Khandar and the kalachi drain into river Indus** because they flow eastwards.
- The rivers **Loralai, Chakar, Bolan and Mula are absorbed into Kalachi Sibi Plain.**
- The rivers **Hab, Porali, Hingol and Mashkel drain into the Arabian Sea.**
- There are many small rivers that flow westward and drain into shallow depressions called Humuns.
- There are so many rivers in Baluchistan those are absorbed in the land and do not join any other water body.
- This unique pattern of drainage is called Inland Drainage. Braided river channels are the depressions those are flooded only when there is heavy rainfall and otherwise they remain dry.

Ground Water:

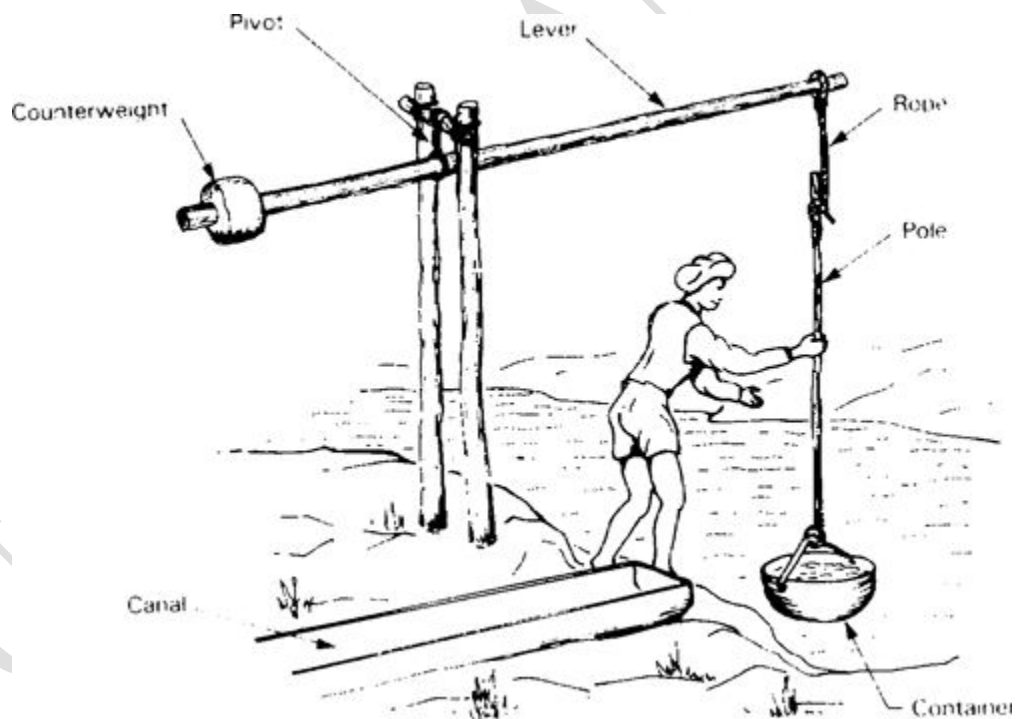
- The water available under the ground is called ground water.
- This water is brought to the ground by the method of lift irrigation by shallow **wells**, **tube wells** and the **Karez** system
- GW can be sweet or saline. But it cannot be saline near the sources or recharge.

Methods of irrigation:

Traditional Methods:

(i) **Shaduf:**

A large pole balanced on a crossbeam, a rope and bucket on one end and a heavy counter weight at the other. By pulling the rope it lowered the bucket into a canal or river. The operator would then raise the full bucket of water by pushing down on the counter weight.



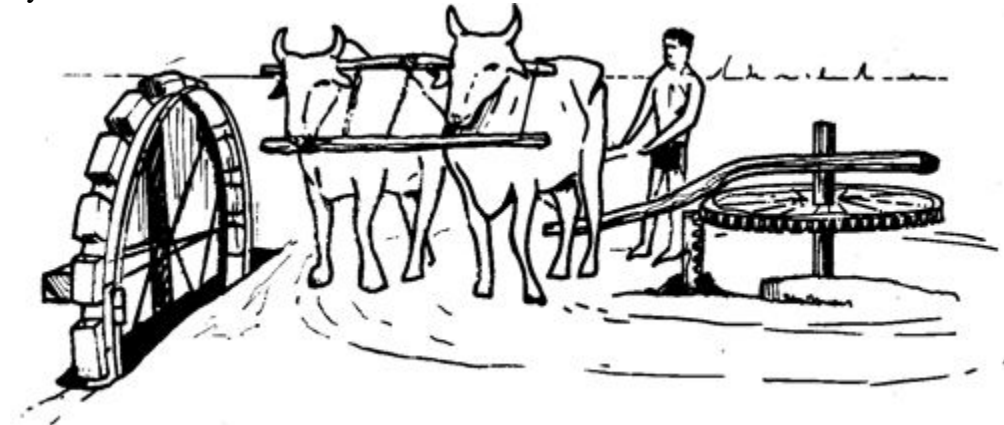
(ii) **Charsa:**

In charsa irrigation, animal power is used to pull out water from the well. In this the small area irrigates and lots of time is waste in this system of irrigation.

(iii) **Well:** A well is a hole dug in the ground to obtain the subsoil water. An ordinary well is about 3-5 meters deep but deeper wells up-to 15 meters is also dug.

(iv) **Persian Wheel:**

Persian water wheel is a device used to raise water out of well or river. It is a system of a chain of buckets slung round a vertical wheel, which is turned by a system of another interlocking vertical and horizontal wheels powered by an ox or bull driven in a circle. With the passage of time the wooden wheel is replaced by metal.

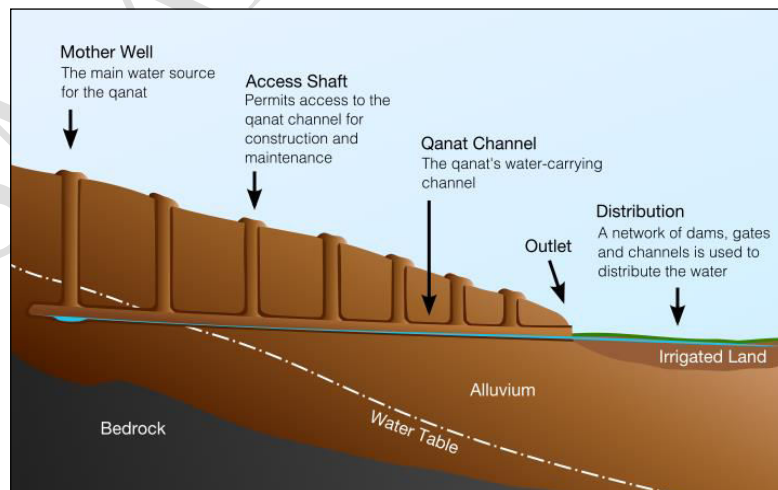


(v) **Karez:**

(An underground irrigation channel), it is an underground structure for collecting groundwater and conveying it to the surface. Such structures are in use in the mountainous and foothill areas. Water from a *karez* is used for water supply and irrigation. *Karez* tunnels can be as much as several kilometres long.

(vi) **Inundation canals:**

Inundated canals are long canals taken off from large rivers and it receives water when the river is high enough and especially when it is in flood.



Modern methods:

(i) Perennial canals:

- They are linked to dams and barrages to provide water throughout the year and they irrigate a vast area.

(ii) Tubewells:

- Tubewells have diesel or electrically operated pumps that can raise water from the depth of 92 meters (300 feet) to irrigate farms of more than 1000 hectares.
- Tubewells also help to lower the water table thereby protecting the land from water logging and salinity.

(iii) Sprinkler:

- Sprinklers are connected to public water supply pipes.
- They are centrally placed in fields to water the plants.
- They are used mainly in orchards and market gardening.
- It works efficiently with much less water wastage.

Uses of water:

- Major uses of water are agriculture, domestic and industrial.
- 95 % of water is used for the irrigation purposes.

(a) Domestic uses:

- Drinking
- Cooking
- Washing
- Sanitation

(b) Industrial uses:

- Pharmaceutical industry
- Tanning industry(washing, dyeing)
- Food processing (juices, syrups)
- Chemical industry (acids, liquid bleach)
- Textile industry(washing, printing)
- Mineral water industry.
- Iron and steel industry.
- Thermal power stations(to produce steam that make the turbine move)
- Hydro – electric power stations.

(c) Irrigation

- Irrigation is an artificial supply of water.
- In Pakistan 75 % of the cultivated area is under irrigation.
- By canal irrigation millions of gallons of water are utilized that would flow into the Arabian Sea.
- Canal system irrigates a vast area. Even the deserts have been made productive.
- Irregular supply of water in the rivers is then regulated by construction of dams and barrages.
- Huge quantities of water from monsoon rainfall and melting of snow can be stored in reservoirs during summer season.

Siltation in Reservoirs:

- The deposition of materials brought by the rivers in the reservoirs is called silt.
- This leads to the decrease in storage capacity of the reservoirs.

(i) Causes:

- Abundance of silt eroded from the Karakoram, Hindukush and Himalayan mountains.
- Deforestation
- Rivers from the narrow and deep valleys in the mountainous areas. Most of the eroded material is washed down into the plains and piles in reservoirs of the dams.

(ii) Effects:

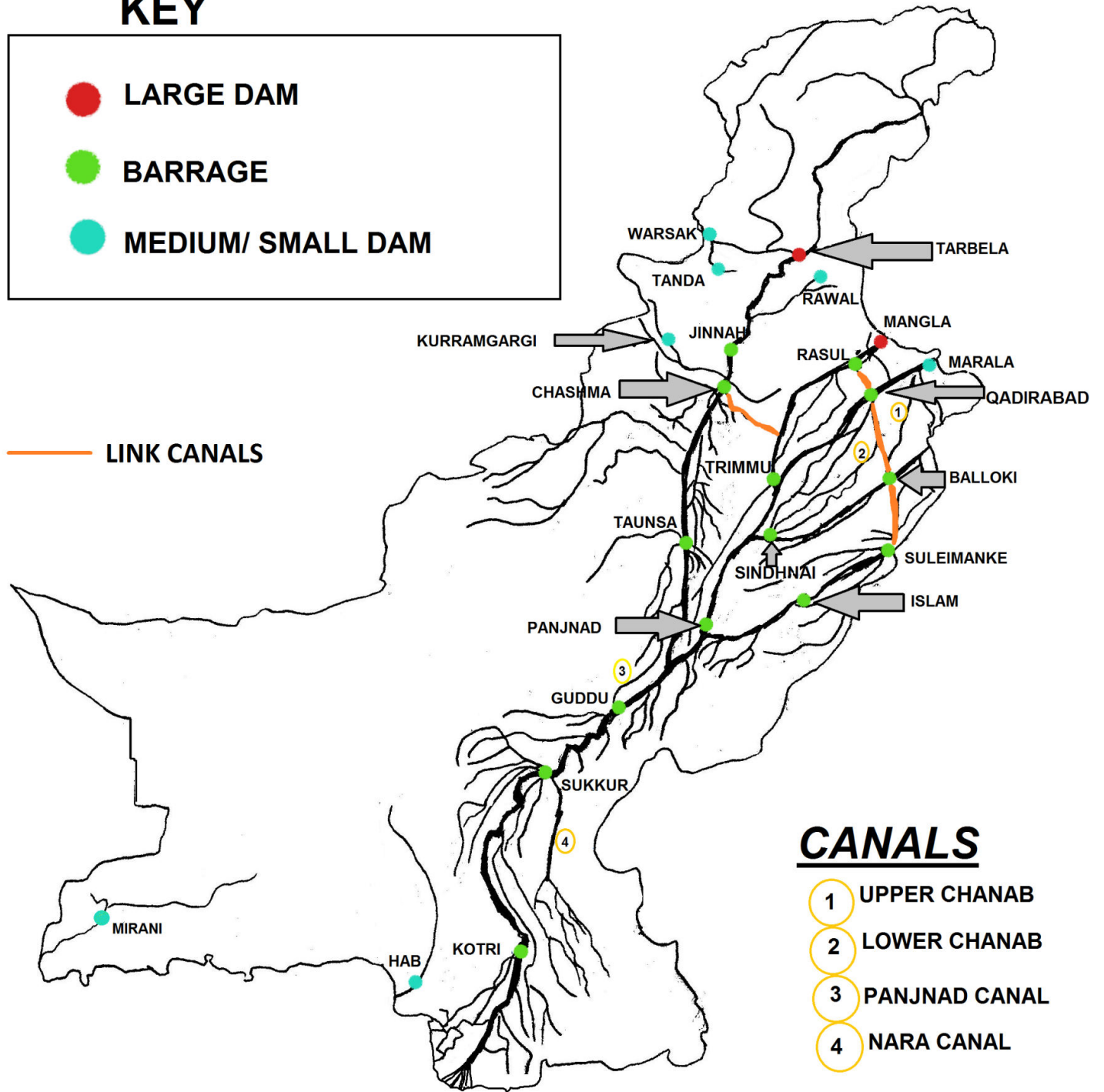
- Blockage of canals because silt accumulates.
- Weakens the foundation of dams.
- Choking of irrigation canals.
- Reduced capacity of reservoir and less flow of water affects the generation of Hydro electric power. it also results in availability of less water for irrigation purposes.
- Flow of flood water is hampered which may cause heavy damage to the dam because of mounds of silt which block the flow of water.

(iii) Control:

- Large scale afforestation especially on the foothills of the Himalayas.
- Cemented embankment of canals to make cleaning easier.
- Installation of silt trap before the water flows to the dams.
- Raising height of the dam to increase the capacity of the reservoir.

KEY

- LARGE DAM
- BARRAGE
- MEDIUM/ SMALL DAM



Types of Canals:

(i) Inundation Canals /seasonal canal

- These canals provide water for irrigation only when there is high water table in the rivers.

(ii) Perennial Canals

- These canals provide water for irrigation all year round.

(iii) unlined canals

- The canals which do not have concrete or cemented embankments.

(iv) lined canals

- The canals having concrete embankments.

Water logging and salinity:

- The condition when the water table of the ground rises is called water logging.
- When water level comes close to the ground.
- Salinity occurs when ground water rises and evaporates leaving the salt behind.
- Unlined perennial canals and the slow movements of water causes water logging and then salinity.
- This occurs when water from the unlined perennial canals penetrate into the ground causing water logging and salinity.

Solution to water logging and salinity:

(i) Installation of tube wells.

- Tubewells are installed to solve the problem of water logging and salinity.
- Boring is done 100 meters below the ground using machines.
- Tubewells use electric pumps to lift the ground water.
- After the water is lifted, the water table of the ground goes down.
- Tubewells were used for the first time in 1953 and since then it has become the second largest source of irrigation after canal irrigation.

(ii) planting of Eucalyptus tree

- It is the tendency of eucalyptus tree to be grown in waterlogged areas.
- It absorbs and utilizes the extra water present in the soil.

(iii) Lining of canals.

- Canals are lined from the banks to avoid absorption of water through the banks.

(iv) SCARP programme.

- Water logging can be controlled by the launching of the scarp (salinity control and reclamation project)
- It was framed in 1959 in which the Indus basin was divided into 28 zones.
- WAPDA was given the responsibility to carry out the project.
- Tube wells and surface drains were used to lower the water table and flush out salt from the soil