

Natural Resources-Water

Introduction to Natural Resources:

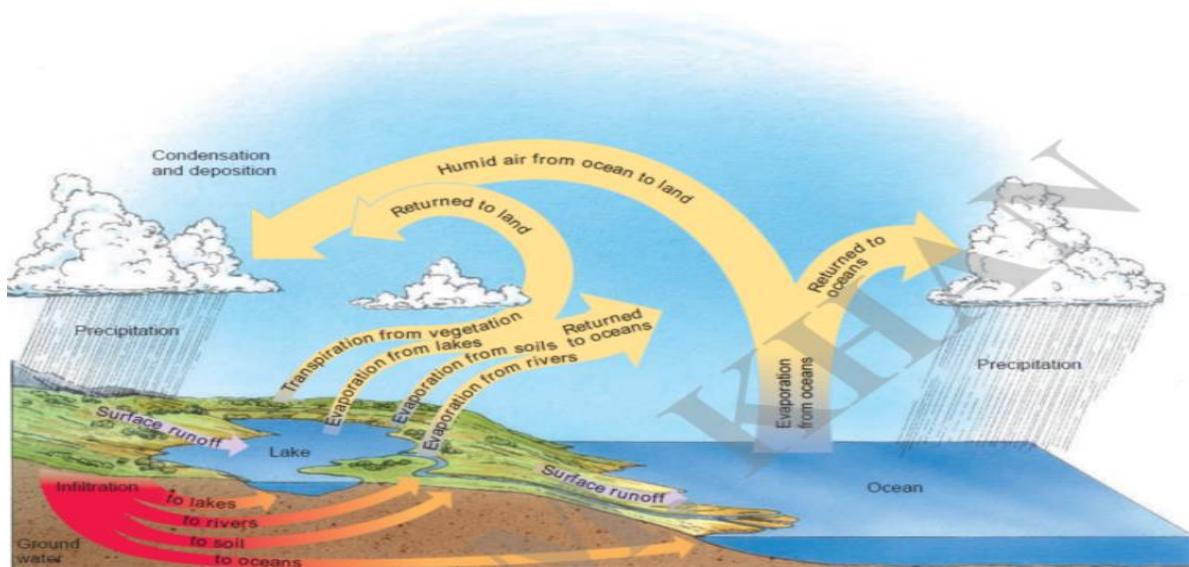
Renewable Resources: are resources that can be recycled or reused & may not run out. E.g. Solar Energy, Wind Energy, Water, Sustainable (vegetation, soil)

Non-Renewable Resources: are natural resources that form over 1000's of years & may run out if excessively used. It is in limited quantity. E.g. Fossil Fuels, Oil, metallic & non-metallic minerals.

Water: is a renewable resource. Groundwater may run out but rain may bring it back as is unpredictable.

Hydrological Cycle:

1. **Evaporation:** conversion of liquid water into water vapors due to high temperature.
2. **Transpiration:** loss of water during the process of respiration in plants through leaves.
3. **Evapo-Transpiration:** total water that reaches to the upper atmosphere from the earth's surface as a result of evaporation and transpiration.
4. **Condensation:** conversion of water vapors into droplets due to lower temperature at higher altitude.
5. **Precipitation:** total amount of water that reaches to the surface of the earth from the upper atmosphere including rainfall, hails, snow, fog, mist etc.



Importance of Rivers in Pakistan: without rivers Pakistan would be barren land.

- Indus River System
- Rivers of Balochistan

Indus River System: Indus is the largest perennial river of Pakistan, which flows throughout the year. It comprises of its eastern tributaries and western tributaries and finally flows into the Arabian Sea. This system irrigates 60% of Pakistan's 20,000,000 hectares of cultivatable land.

- Eastern Tributaries of River Indus:** Jhelum, Chenab, Ravi and Sutlej are the main eastern tributaries of river Indus. These tributaries carry water mostly during summer season, mainly because of summer monsoon rainfall & melting of snow. All the eastern tributaries have joined together by the time the Sutlej joins the Chenab at Panjnad to become the River Panjnad, which then joins the Indus near Mithankot.
- Western tributaries of river Indus:** Swat & Kabul carry a significant volume of water but the Tochi, Kurram and Gomal rarely contain much water. During winter season, water volume decreases as temp. falls & snow doesn't melt.

Rivers of Balochistan: rivers of Balochistan are usually very small in size and seasonal in nature, mainly because of limited rainfall, high temperature and dry land. There are three different types of rivers in Balochistan;

- Rivers of inland drainage:** these rivers originate on land and finally drain on land. They are either absorbed into Kachhi Sibbi Plain or evaporated/ drain into dry saline lakes on land, called Hamuns. Important inland drainage rivers of Balochistan include; Bolan, Loralai, Chakkar, & Mula rivers etc.
- Rivers of southern Balochistan:** these rivers flow to the south of Balochistan and finally drain into Arabian Sea. These are small seasonal rivers including Hub, Porali, Hingol, Mashkel and Dasht.
- Rivers of north eastern Balochistan:** a number of small seasonal rivers to the north east of Balochistan, flow eastward and eventually drain their water into river Indus, including Zhob river which drains into Gomal river which is a tributary of river Indus. Other examples include Kandhar river and Kalachi river which flow eastward and drain into river Indus.

Importance of Rivers:

- Add to scenic beauty of the area.

- Provide water to even those areas where rainfall is scanty. E.g. Sindh.
- Help generate HEP in mountainous areas.
- Increase fertility of land by carrying alluvium & organic matter.
- Fishing is practiced in rivers & lakes.
- Provides water for domestic & industrial purposes.
- Supply water for irrigation by the canals leading out for dams & barrages.

Groundwater: Water stored beneath the surface of the Earth, inside the pores of Rocks. The closer the water to rivers & lakes the sweeter it is. May be saline.

Groundwater aquifer: Underground porous rock that stores groundwater is called 'groundwater Aquifer'.

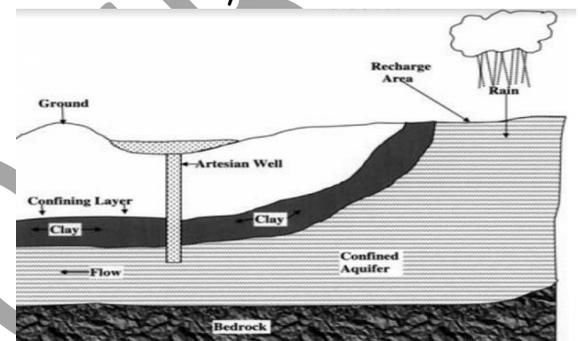
Water table: Top level of the groundwater beneath the surface of the earth is called 'water table'.

1. **Wet season water table:** during the rainy season the groundwater table reaches close to the surface of the earth which is called wet season groundwater table. Water quality is dependent on the nature of land surface and the types for pollutants exposed on the surface of the earth.
2. **Dry season water table:** during the dry season the groundwater table reaches to its lower possible limit which is called the dry season water table. Usually the water contains more salts and thus turns saline.
3. **Mean water table:** Average depth of the groundwater table, calculated on the basis of dry season and wet season water table, is called the mean water table. Water is available at its best possible quality. Different modern and traditional methods of lift irrigation are used to extract the groundwater from the groundwater aquifer.

Surface water: water exposed on the surface of the earth is called surface water. There are different sources of the surface water including rivers, streams, ponds, lakes and even manmade reservoirs.

Uses of Water:

1. Domestic uses of water: water is mainly used in cities, towns and villages for drinking, cooking, washing and for sanitation purposes.
2. Industrial uses of water: it is the raw material but in other industries it is used for cooling or washing purposes. Heavy industries are either located near the rivers or close to the Arabian Sea.



Processing water: industries in which water becomes the part of finish product. It is 5% to 10% of the total industrial use of water for examples in pharmaceutical, fresh juice and soft drink industries.

Cooling and washing water: industries in which water is used for cooling and washing purpose. It is 90% to 95% of total use of water for example in steel mill, paper mills, thermal power plants and textile industries.

3. **Agricultural use of water:** Pakistan is an agrarian country where nearly 85% of the total fresh water is used for 'irrigation' in agriculture to produce food for population and raw materials for industries. Rainfall isn't reliable in Pakistan. Different quantities, & time hence we need irrigation facilities as water from rain is too less.

Irrigation: The artificial means of supplying water to the fields are called means of irrigation. These can be classified as conventional & modern methods.

We need irrigation: Most areas are arid & rain is ineffective.

- Annual rainfall is low in the whole Sindh, most of Balochistan except for high altitude areas, & a large part of Punjab.
- Spells of high temperatures increase the rate of evapo-transpiration.
- Rainfall usually occurs in heavy showers, which is little use for farmers as the land either absorbs too much or it drains away too quickly.
- Long dry spells.
- High variability in distribution.
- Small number of rainy days.
- High rate of evapo-transpiration.
- Low amount of rainfall.

Development of the irrigation System in Pakistan:

The irrigation System in Pakistan is developed from a convectional well system to the present perennial canals & tube wells.

Uses of water by manufacturing and processing industries:

- Used as raw material in drinks, bottled water, chemicals and cement.
- Used for cooling in thermal power plants and iron-steel industry.
- Used for washing and cleaning in textile industry.
- Used as power source (water wheel) in milling industry.
- Used for boiling in food processing industry.
- Used as ice to preserve frozen food.
- Used in HEP.

- Used in chemical & tanning industry.
- Used in Pharmaceutical Industry.
- Also used to provide humidity in textile mills.

Need for irrigation in Pakistan

- Over all Pakistan is a semi-arid country where mean annual rainfall remains less than 750 mm - to fulfill deficiency of water for agricultural, industrial and domestic use, we have developed irrigation system.
- Being a tropical country Pakistan experiences long hot summers with very prolonged dry spells leading to more loss of water through high rate of evaporation and evapotranspiration - to fulfill the need of water for crop cultivation irrigation network has been developed.
- Highly variable monsoon rainfall in Pakistan;
 1. Variation in the timings of rainfall
 2. Variation in the amount of rainfall every year
 3. Variation in the intensity of rainfall
 4. Variation in the distribution of rainfall
 5. Variation in the occurrence of rainfall - in order to ensure persistent supply of water for agriculture, irrigation system has been developed
- Many farming areas in Pakistan are located far from the sources of water particularly the rivers - to supply water for cultivation in such areas means of irrigation has been developed.
- Summer monsoon is the main source of rainfall in Pakistan which brings rainfall only during summer months of July, August and September - in order to supply water throughout the year mainly for Rabi (winter) crops irrigation system was needed in the country.
- Due to natural deficiency of rainfall modernization in agriculture was compromised - to encourage use of high yielding varieties (HYV's) which require more and frequent water supplies means of irrigation were developed.
- Plants need water for their growth and to stay healthy mainly during dry seasons or in drought regions - in order to make up the deficiency of water irrigation system was needed.

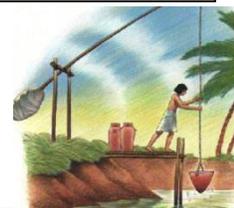
Traditional Methods of Irrigation:

Shaduf/Dhenkli: in the shaduf system water is drawn from a well, river or canal by a bucket which is attached to a pole on 1 side & weight on the other side.

Advantages	Disadvantages
No power supply required.	Limited water supply.
No capital Investment.	Infrequent water supply.
Cheap to Establish.	Dependent on availability of surface water.
No Machinery Required.	Time consuming & labor intensive.
	Only small farms can be irrigated.

Conclusion: is now obsoleted due to extensive labor & very time consuming.

Charsa: animal power is used to pull water from the well. The charsa system is not used by many farmers due to animal cruelty now. No power supply required, limited capital investment & cheap to use.



Advantages	Disadvantages
No power supply required.	Limited water supply.
Limited capital Investment.	Infrequent water supply.
Cheap to Establish.	Dependent on availability of ground water.
No Machinery Required.	Time consuming.
	Requires animal power.

Conclusion: good method of irrigation for subsistence farmers.

Lift Irrigation: method of irrigation in which water isn't transported by natural flow (as in gravity-fed canal systems) but is lifted with pumps or other means.

Wells:

Advantages	Disadvantages
No power supply required.	Limited water supply.
No capital Investment.	Infrequent water supply.
Cheap to Establish.	Dependent on availability of ground water.
No Machinery Required for water extraction.	Time consuming.

Conclusion: few small scale subsistence farmers still use wells for irrigation.

Persian Wheel: of more or less traditional design, powered by a blindfold bullock or human, using a wooden shaft, pole or log & turning a horizontal wheel attached to a vertical wheel with cups to raise water. Water then goes in through pipes & channels.

Advantages	Disadvantages
Large water supply.	Requires technical skills for its construction.
Continuous water flow.	Requires capital investment & high maintenance cost.

No electricity requires.	Dependent on availability of ground water & takes time for construction.
Produces water throughout the year.	Requires animal powers.

Conclusion: limited in use due to technical requirements. Usually used for small scale.

Ponds: small ponds are dug in the desert areas, lined with mud to avoid seepage of water into ground. These ponds are used to store rain water, which is then used for domestic as well as for agricultural purpose on a very small level.

Advantages	Disadvantages
Make better use of rain water/rain water harvesting.	Limited water supply.
Supply water for agriculture & domestic needs including drinking water.	Dependent on natural rainfall.
No capital investment for digging or maintaining the pond.	Loss of water through evaporation.

Conclusion: it is used only in the desert areas where irrigation water is not supplied through canals.

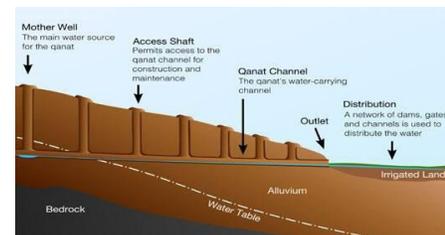
Diversion channels: a narrow version of flood canal used to divert flood water in mountainous region is called diversion canal or channel. They are taken directly from the flowing river channel to transport water for irrigation and domestic use.

Advantages	Disadvantages
Make use of flood water.	Difficult to construct these canals.
Only way to transport water in mountainous region.	Seasonal supply of water.
Supply water for agriculture and for domestic use.	Difficult to transport water to the areas located away from the river channel.

Conclusion: it is used only in the mountainous areas of northern Pakistan.

Karez: are horizontal underground canal in the foothills that brings water to the surface. Karez are irrigation channels found in Balochistan. Vertical shafts are also dug down so blockage can be cleared. Using gravity, they channel water from highland areas down to low-lying agricultural areas & minimize water loss from seepage and evaporation.

Access is provided by vertical shafts channel, so that workers can be lowered to clear obstructions. Over the past many years of tribal conflicts in Balochistan, many karez have been damaged, and recent



droughts have rendered some karez useless. Additionally, today fewer individuals are involved in the karez cleaning business and the prices they charge are high compared to the past. Rainfalls in mountains & drains to the sinks ground. It travels in tunnels & reaches surface. Owned by groups of farmers.

Advantages	Disadvantages
Makes effective use of Groundwater.	Very difficult to construct.
Gives continuous supply of water & doesn't require electricity.	Requires technical skills to construct.
Efficient method of underground water transport.	Needs a lot of labor force for construction
No loss of water due to evaporation and seepage.	Construction of karez takes long time & requires regular maintenance.

Conclusion: used only in Balochistan where surface water is limited due to limited rainfall & high water losses due to evaporation & seepage into ground.

Tank Irrigation: is practiced by constructing mud tanks across small streams to make a small reservoir which collects excess water during rainy season.

Canals:

Inundation Canals: are long canals taken off from large rivers. They receive water when the river is high enough & especially when it is in flood. These are the canals which carry flood water to divert the flow of flood water. These canals are taken directly from the rivers.

Seasonal canals: these are the canals which flow only during the rainy season, carrying water of excessive rainfall or flood. These canals are taken either from the rivers or reservoirs.

Diversion canals: a narrow version of flood canal which is used to divert water from the river in the mountainous areas. It is used mainly for irrigation purpose

Link canals: these are the canals which connect water from two or more rivers with each other. These canals can be perennial or seasonal in nature. These canals are made to transport water from the Indus, Jhelum and Chenab to the channels of river Ravi and Sutlej, which were given to India under Indus Basin Treaty in 1960.

Gated syphon: syphon is an underground canal/tunnel that transports water under the river Sutlej. It starts from sidhnai barrage on river Ravi, crossing river Sutlej at Mailsi and transporting water to Bahawalpur plain.

Feasibility of canal irrigation in Pakistan

- Canals are very easy to be made or dig on plain, flat land surface.

- Soft alluvium rich soil of Indus plain helps digging of canals.
- Gentle slope towards south and southwest direction allows water to flow smoothly and naturally in the channels of canals.
- High population density in Punjab and Sindh has made it very easy to arrange plenty of hard working labor force required for making canals
- Presence of cement factories in Sindh and Punjab has made it easy to supply cement required for the construction of lined canals, headwork's and canal closures.
- Punjab and Sindh, being very productive provinces, have plenty of capital available for the construction of canals because their economies are mainly dependent on agriculture activity.
- Indus River, the largest perennial river of Pakistan flows through the fertile plains of Punjab and Sindh and serves as a main source for irrigation water either directly when canals are taken from the river or indirectly when canals are taken from the dams and barrages made on it.
- Canals also help transporting water over longer distances from the source to cultivable lands and help land reclamation thus canal irrigation system provides water to the desert areas of Pakistan namely southeastern desert and Thal desert to make them productive parts of the country.

Types of canals: (on the basis of their structure)

Lined canals:

- These canals are properly constructed.
- Their bottom is paved or cemented.
- Rocks, concrete or cement is used for lining these canals.
- To avoid seepage of water into the ground.

Unlined canals:

- These canals are made up of mud and soil.
- Their bottom and sides are not paved or cemented.
- They allow seepage of water into the ground.
- These canals are the main cause of waterlogging and salinity.

Canal Irrigation:

Advantages	Disadvantages
Supply water to the areas with limited rainfall.	Canals are very expensive to construct.
Supply irrigation water to the areas located away from the rivers.	Unlined perennial & seasonal canals lead to loss of water due to seepage into the ground.

Supply water to the areas with very low or saline groundwater & canals supply large quantity of water for irrigation.	Unlined perennial canals cause the problems of waterlogging and salinity.
Canals give continuous supply of water & canals can provide water throughout the year.	Canals require lots of labor force for construction.
Supply of water in canals does not require power supply.	Canals are very difficult to maintain & de-silt (removal of silt from the bottom).
No running cost is involved in canal irrigation canals require a river or water storage as their starting point/source & lining canals is very difficult & expensive.	Canals lead to loss of water through evaporation canals require a river or water storage as their starting point/source.
Flood canals help irrigating the desert areas including Thal, Cholistan & Nara.	Lining canals is very difficult and Expensive.
Flood canals also help controlling flood by diverting the flow of flood water.	

Use & Effectiveness of Conventional Methods of Irrigation:

Conventional methods were olden methods which now have been shifted to modern methods by farmers.

- Irrigates limited areas as only small amount of water can be obtained.
- Required manual labor or animals are more time consuming.
- Difficult to build, maintain & use.
- Canals only flow during rainy periods.

Modern Systems:

Perennial Canals: a canal linked to dams & barrages that provides water throughout the year & irrigates vast area.

Tube wells: a method in which groundwater is brought to the surface with the help of pumps, powered either by electricity or by diesel engines.

Advantages	Disadvantages
Large supply of water.	Requires power supply in the form of electricity or oil.
Continuous supply of water.	High installation cost.
Helps controlling or maintaining groundwater table.	High running cost due to increasing prices of electricity and fossil fuels.
Controls / prevents waterlogging and salinity.	Depends on the availability of fresh groundwater.
Low maintenance cost.	Water flows into pond/reservoir/tank.
Uses groundwater / rely on groundwater.	Distributed to fields by

	Canals/pipes/sprinklers etc.
Efficient method of irrigation for large scale farming.	

Conclusion: used mostly by large scale commercial farmers to irrigate vast farming lands.

Sprinkler or Spray Irrigation: they are connected to public water pipes & centrally placed in fields. This method is far more expensive yet efficient as prevents water wastage, waterlogging & salinity.

Advantages	Disadvantages
Most effective use of water for agriculture in arid and semi-arid areas.	Very expensive to install.
No line losses.	Very high running cost.
Prevents water logging and salinity.	Very high maintenance cost.
It gives continuous supply of water.	Only smaller areas can be cultivated.
	Requires power supply.

Conclusion: most effective method used mostly in the areas where surface water is very limited.

Tankers: it collects water from ponds & lakes then supplied. It is expensive.

Drip irrigation: a scientific method of irrigation carrying desired water and nutrients direct to the root zone of the plant, drop by drop.

Advantages	Disadvantages
More crops for every drop-drought resistant.	Very expensive to install.
Early maturity-due to timely irrigation	Very high running cost.
Better quality-hyvs need more water	Very high maintenance cost.
Saves labor cost-automatic operation	Only smaller areas can be cultivated.
Yield increase up to 230%-based on water usage	Requires power supply.
Saves water up to 70%-no loss due to seepage	May lead to soil erosion.
Successfully working on more than 40 crops varieties & prevents from waterlogging & salinity	

Conclusion: ideal for terrain with problematic soft and loose soil with scarce surface water for irrigation. Only commercial farmers can afford this method.

Indus Water Treaty:

In 1947, on Pakistan's independence everything was divided. The headworks of the canals of Sutlej & Ravi remained in India. In 1948 India threatened to stop

the water supply from these headworks. The water dispute was resolved by the World Bank. In September 1960, an agreement was signed that is known as the Indus water Treaty. Under this treaty Pakistan received rights to the water of 3 western rivers (Indus, Jhelum & Chenab) & India to that of the eastern rivers (Ravi, Beas & Sutlej). Pakistan was expected to build 2 storage dams, 5 barrages, 1 gated syphon, & 8 link canals.

Importance of the Indus Water Treaty:

River water is essential for agriculture which is the main stream occupation in Pakistan. Water in the channels of Ravi and Sutlej to threatened the economic prosperity of Punjab and Pakistan it was very important to avoid desertification on Indus plain. This treaty ensured the water supply for industries in Punjab. It helped ensuring supply of water for domestic use to the settlements in Pakistan. This treaty helped controlling the problem of soil erosion due to aridity by signing this treaty Pakistan got sufficient water to be discharged at downstream Indus for the protection of Indus delta and mangrove forests.

Dams: dams are storage water reservoirs that may be used to irrigate fields & be used to generate HEP. It is built of mountainous regions.

Mangla Dam: is located on the River Jhelum. It diverts floods & conserves the flood-waters of the Jhelum for irrigation & HEP. It has been developed as a fishing center & tourist resort.

Tarbela Dam: is built on the Indus. It is the world's largest earth-filled dam. Siltation is a major problem.

Small & Large Dams:

Small Dams	Large Dams
Store water for irrigation.	Store water for irrigation.
Irrigate local areas only.	Irrigates vast areas.
Supply water for industrial & domestic use.	Supply water for industrial & domestic use.
Supply little or no electricity.	Major suppliers for HEP.
Silting problem is easier to solve.	Silting problem is difficult to solve.
Requires comparatively low initial investment. More stable to Pakistan's economy.	Initial investment cost is high.
Construction time is less & yields quick results.	Construction time is more & doesn't yield quick results.
Less important for flood control.	More important for flood control.

Very few people are evacuated in order to construct the dam.	Large scale evacuation is required. 4000 people have been evacuated for raising of the Mangla Project.
Maintenance cost is low.	Maintenance cost is high.
Small dams have little impact on rivers, watersheds & aquatic ecosystems.	Large dams generally have a range of extensive impacts on rivers, watersheds & aquatic ecosystems that are more negative & have led to irreversible loss of species & ecosystem.

Irrigation Projects in Pakistan:

Name of Project	Location
Tarbela Dam	River Indus
Mangla Dam	River Jhelum
Warsak Dam	River Kabul near Peshawar

Siltation in Reservoirs:

When the rivers leave the foothill of the Himalayas, they carry a large quantity of silt, as a result of deep erosion in the mountainous areas. It destroys the purpose of dams & barrages as irrigation & generation of HEP. Decrease in water storage capacity.

Siltation:

Abundance of silt from the Karakoram, Hindu Kush & Himalayan Mountains. Deforestation-ruthless cutting of trees for fuel & timber. Rivers form narrow & deep valleys in the mountainous areas. Most of the eroded material is washed down into the plains & piles up in reservoirs of the dams.	Blockage of canals because silt accumulates. Weakens the foundation of dams. Choking of irrigation canals. Reduced capacity of reservoir & less flow of water affects the generation of HEP. It also results in availability of less water for irrigation purposes. Flow of floodwater is hampered which may cause heavy damage to the dam because of mounds of silt which block the flow of water.	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. Regulating the flow of water such as operating the reservoir at lower level during flood & allowing free slow during low flow season for sluicing sediments from the reservoir. Raising height of the dam to increase the reservoir's capacity.
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Barrages:

- Barrages in Pakistan are very long structures used for irrigation & flood control.
- Cheaper to construct & can be built on flat areas.
- Encourages human settlements, industrial & commercial activities.

Name of Barrage	Location	Area Under Irrigation
Chashma Barrage	River Indus	Jhelum Link Canal.
Guddu Barrage	River Indus	Jacobabad & Ghotki Districts.
Sukkur Barrage	River Indus	7 canals taken out to irrigate.
Kotri Barrage	River Indus	Hyderabad, Badin & Thatta Districts.

Waterlogging & Salinity:

- Waterlogging is the saturation of soil with water.
- Salinity is the amount of salt dissolved in a body of water. When the water evaporates, salty patches appear on the surface.
- Waterlogging & salinity are 2 outcomes of canal irrigation. In perennial canals, water was available throughout the year resulting in a rise in water table. Salts in soil also rise to the surface. Surface water evaporate & deposited salts are unsuitable for farming & uncultivable.
- The rise of the water table to the surface level is called waterlogging & appearance of salty patches is called salinity.

How to solve waterlogging & salinity:

- Lining of canals to control seepage of water.
- Canal closure on temporary basis so that water passes through only when needed for irrigation purposes.
- Installing tube wells to lower the water-table & to provide extra water to flush out salts from the soil.
- Planting eucalyptus trees because their roots go into the ground & absorb water from the water table.
- Surface drain to divert surface water to nearby river or lake.
- Programs such as SCARP can be held to resolve such problems.

Surface Water Pollution:

Dumping of industrial & agricultural waste & inadequate sewage disposal systems cause surface water pollution. Waste water may flow in open drains resulting in discharge into streams, river then sea. In Karachi oil seepage from ships is another cause of water pollution. With increasing use of chemical fertilizers

agricultural waste also adds to the water pollution & water is unfit for human consumption.

Water as a Resource for Economic Development:

- Agriculture depends on water in the form of rain/irrigation. Agricultural crops e.g. cotton, rice contribute 25% to GDP. 2/5 of labor is employed in agriculture / agro-based industries e.g. cotton textile that use products as raw materials. Also exported for foreign exchange.
- Water is also used in many processing & manufacturing industries such as steel, pharmaceutical companies vital for economic development as they provide employment to industrial labor & meet local demands for industrial goods. Provides electricity to domestic & commercial users. Export earns foreign exchange adding to GDP & GNP.
- Domestic supplies of clean water is essential for population's survival. Healthy people are more productive at work & contribute to economic development. Its vital to efficient management of water to keep economy going.

Management of Water Resources:

Water is a scarce resource in Pakistan. Water Accord was signed, implemented by IRSA. Due to drought & institutional mismanagement provincial disputes arose & agricultural output decreased. Efficient management will become even more important if climate results in greater scarcity.

Water Supply Issues Leading to Conflicts:

Water crisis in the latter years impacts economy & agriculture. Himalayan Glaciers will reduce water flow by 8% in 40yrs. 25% agriculture will decrease resulting in poverty & hunger.

International Conflicts:

- Impact of Indus Water Treaty 1960.

Increasing demand from farming & other industries water shortages in upper Indus Plain. Less water in the eastern tributaries in Pakistan has remained a source of tension b/w India & Pakistan.

- Violation of Indus Water Treaty by India.

Pakistan opposed dam projects are they reduce HEP. India has control over Indus Waters, timings of release into river is also an important issue. If extra water is released during flood season, it would cause massive scale devastation

all over the Indus Plain. India held water back in dry seasons causing water shortages.

Provincial Conflicts:

- Punjab & KPK.

Kalabagh Dam on River Indus is another conflict. KPK fears that most of the water stored in the Kalabagh dam reservoir may be diverted to Punjab. It won't get any extra electricity from the dam. The project will result in large scale evacuation about 30,000 of the areas including KPK. Nowshera District would be submerged by the reservoir & even wider areas would suffer from waterlogging & salinity.

- Sindh & Punjab.

Sindh fears sea intrusion as less river water comes to the delta meant that sea water would push towards the land & sea water is salty, so it would win the land. The water availability of Sindh would be further reduced after the construction of Kalabagh Dam as the water stored in the Kalabagh reservoir might be used to irrigate farmlands in Punjab & KPK. Such seawater intrusion would literally turn vast areas of Sindh's coast into arid saline desert, & destroy Sindh's coastal mangroves. Hyderabad causing more water shortages in canal irrigated areas of lower Sindh. Kalabagh dam could not be constructed due to provincial to provincial conflicts.

Users:

- Agriculture: consumes bulk of water supply, which is reduced leading to conflicts. Less water is available to irrigated forests of the Indus Plain due to excessive use of water in agriculture.
- Industry: water is provided to Industrial use steel mills.
- Domestic & other users: water is provided to domestic supplies of Karachi.

In order to conserve and sustain the scarce water resources, the following steps should be taken

- National priorities such as the maximisation of agricultural production should be considered with regard to the distribution of water between the provinces.
- Sites for small dams should be developed to store surplus flow during the monsoon season. Small dams are more cost effective and produce quick results compared with large dams because they are constructed in a shorter period of time, are cheaper to build and easy to maintain.
- In order to avoid water loss from unlined canals, a crash programme should be launched to line the canals with cement.
- Fresh-water sources like rivers and lakes should not be used as dumping sites of solid and liquid waste.
- Natural fresh-water lakes should be conserved to develop local water sources. In Sindh, the Manchar, Kinjhar and Haleji lakes are the worst affected by pollution.
- Ground-water contamination should be prevented as far as possible by controlling the seepage of toxic waste into the ground.
- Desalination of sea-water to overcome water shortages.
- A public education and information programme should be launched to influence the attitudes of the people towards the need to conserve water because it is a diminishing natural resource. The media, NGOs and educational institutions should take part in this programme.