Chapter- 3
WATER

STUDY NOTES

Water

Three-fourth of the earth's surface is covered with water but only a small proportion of it accounts for freshwater that can be put to use. Water is a renewable resource.

1. 5 per cent of the total volume of world's water is estimated to exist as oceans and only 2.5 per cent as freshwater.
2. Nearly 70 per cent of this freshwater occurs as ice sheets and glaciers in Antarctica, Greenland and the mountainous regions of the world, while a little less than 30 per cent is stored as groundwater in the world's aquifers.
3. India receives nearly 4 per cent of the global precipitation and ranks 133 in the world in terms of water availability per person per annum.
4. The total renewable water resources of India are estimated at 1,897 sq. km per annum.

Water is a renewable resource:

1. Three-fourth of the earth's surface is covered with water, but only a small proportion of it accounts for freshwater that can be put to use.
2. This freshwater is mainly obtained from surface run off and ground water that is continually being renewed and recharged through the hydrological cycle.
3. All water moves within the hydrological cycle ensuring that water is a renewable resource.

Water Scarcity and the Need for Water Conservation and Management

Scarcity of water means shortage of water, an imbalance between demand and supply.

The availability of water resources varies over space and time.

- Water scarcity is caused by over-exploitation, excessive use and unequal access towater among different social groups.
- Water resources are being over-exploited to expand irrigated areas for dry-season agriculture.
- In some areas, water is sufficiently available to meet the needs of the people. But, those areas still suffer from water scarcity due to bad quality of water.

The need of the hour is to conserve and manage our water resources:

- To safeguard ourselves from health hazards.
- To ensure food security, continuation of our livelihoods and productive activities.
- To prevent degradation of our natural ecosystems.

WATER STRESS occurs when water availability is less than 1,000 cubic meter per person per day. India's rivers, especially the smaller ones, have all turned into toxic streams (population growth, agricultural modernization, urbanization and industrialization)

Entire life stands threatened.
The assault on India's rivers –

1. from population growth,
2. agricultural modernization,
3. urbanization and
4. industrialization –

is enormous and growing by the day. This make entire life stands threatened.

Multi-Purpose River Projects and Integrated Water Resources Management

In ancient times, we used to conserve water by constructing sophisticated hydraulic structures like dams built of stone rubble, reservoirs or lakes, embankments and canals for irrigation. We have continued this tradition in modern India by building dams in most of our river basins.

Hydraulic Structures in Ancient India

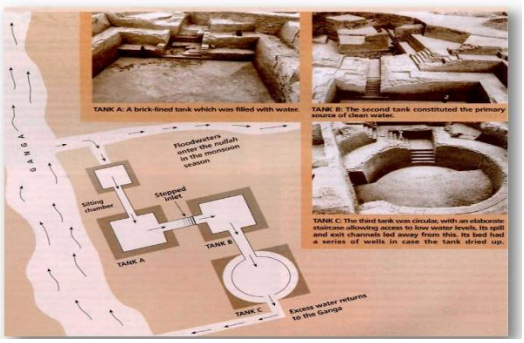
• In the first century B.C., Sringaverapura near Allahabad had sophisticated water harvesting system channelling the flood water of the river Ganga.

• During the time of Chandragupta Maurya, dams, lakes and irrigation systems were extensively built.

• Evidences of sophisticated irrigation works have also been found in Kalinga, (Orissa), Nagarjunakonda (Andhra Pradesh), Bennur (Karnataka), Kolhapur (Maharashtra), etc.

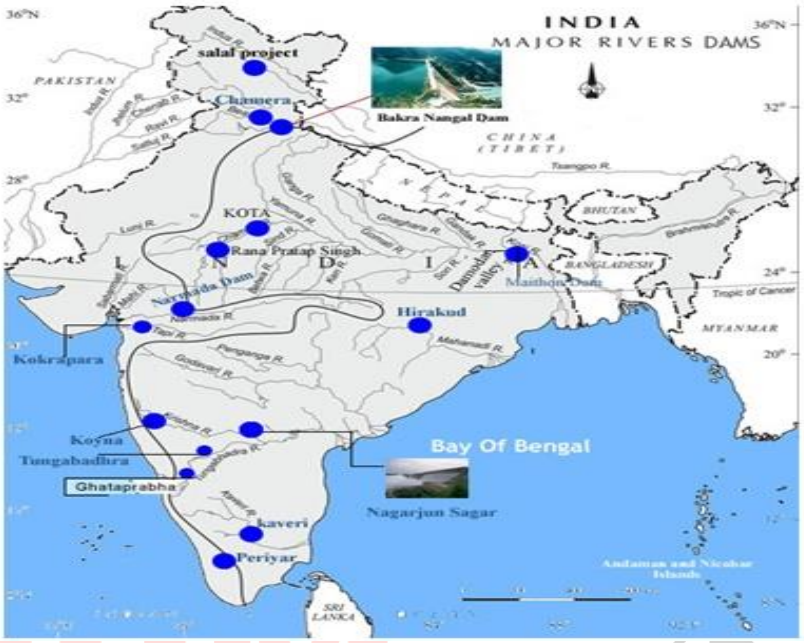
• In the 11th Century, Bhopal Lake, one of the largest artificial lakes of its time was built.

• In the 14th Century, the tank in Hauz Khas, Delhi was constructed by Iltutmish for supplying water to Siri Fort area.



Integrated Water Resources Management

Dams



A dam is a barrier across flowing water that obstructs, directs or retards the flow, often creating a reservoir, lake or impoundment.

"Dam" refers to the reservoir rather than the structure

Uses/Dams are built:

- To impound rivers and rainwater that can be used later to irrigate agricultural fields.
- For electricity generation.
- Water supply for domestic and industrial uses.
- Flood control.
- Recreation, inland navigation and fish breeding.

Side effects of Creating Dams

- Regulating and damming of rivers affect their natural flow.
- Poorer the habitats for the rivers' aquatic life.
- Fragment rivers make it difficult for aquatic fauna to migrate.
- Dams created on the floodplains submerge the existing vegetation and soil leading to its decomposition over a period of time.
- Creating of large dams has been the cause of many new environmental movements like the
  'Narmada Bachao Andolan' and the 'Tehri Dam Andolan' etc.
- Many times local people had to give up their land, livelihood and their control over resources for the construction of the dam.

Most of the objections to the projects arose due to their failure to achieve the purposes for which they were built. Most of the dams were constructed to control floods but, these dams have triggered floods. Dams have also caused extensive soil erosion. Excessive use of water has resulted in earthquakes, caused water-borne diseases and pests and pollution.

Have a look at the India Major Rivers and Dams in the map below:

Name of the dam	River	State	Year of completion
Bhakra Nangal Project	Sutlej	Punjab and Himachal Pradesh	1963
Beas Project	Beas River	Punjab, Haryana and Rajasthan	1974
Indira Gandhi Canal	Harike (Satlej and Beas)	Punjab	1965
Koshi Project	Kosi River	Bihar and Nepal	1954
Hirakund Project	Mahanadi	Orisa	1957
Tungabhadra project	Tungbhadra - Krishna	AP-Karnataka	1953
Nagarjuna Sagar Project	Krishna	AP	1960
Chambal Project	Chambal	Rajasthan and Madhya Pradesh	1960
Damodar valley project	Damodar	Jharkhand, West Bengal	1948
Gandak project	Gandak	Bihar-UP	1970
Kakrapar project	Tapti	Gujarat	1954

Koyna Project	Koyna- krishna	Maharashtra	1964
Malprabha project	Malprabha	Karnataka	1972
Mayurakshi Project	Mayurakshi	West Bengal	1956
Kangsabati project	Kangsabati and Kumari river	West Bengal	1956

ADVANTAGE OF MULTIPURPOSE PROJECT -

(1) It controls floods.
(2) It provides irrigation facilities and navigation.
(3) It generates electricity.
(4) It promotes inland irrigation, fishing and afforestation.
(5) Human consumption.
(6) It provides power generation.

DISADVANTAGE OF MULTIPURPOSE PROJECT –

(1) It induces earthquakes.

(2) Population gets displaced.

(3) Aquatic life gets affected.

(4) Flow of underground water is also checked.

(5) River water gets diverted.

(6) Extensive forests submerged under water.

Rain Water Harvesting

Rainwater harvesting is a simple method by which rainfall is collected for future usage. The collected rainwater may be stored, utilized in different ways or directly used for recharge purposes.

Different methods have been adopted in different areas for Rain Water Harvesting.

1. In hill and mountainous regions, people built diversion channels like the '**guls**' or '**kuls**' of the Western Himalayas for agriculture.

2. "**Rooftop rainwater harvesting**" is commonly practised to store drinking water, particularly in Rajasthan.

3. In the flood plains of Bengal, people developed inundation channels to irrigate their

fields.

4. In arid and semi-arid regions, agricultural fields were converted into rain-fed storage structures that allowed the water to stand and moisten the soil such as 'khadins' in Jaisalmer and 'Johads' in other parts of Rajasthan.

5. The **tankas** are part of the well-developed rooftop rainwater harvesting system and are built inside the main house or the courtyard. This is mainly practised in Rajasthan, particularly in Bikaner, Phalodi and Barmer areas for saving the rainwater. Many houses constructed underground rooms adjoining the 'tanka' to beat the summer heat as it would keep the room cool.

Tamil Nadu is the first state in India which has made rooftop rainwater harvesting structure compulsory to all the houses across the state. There are legal provisions to punish the defaulters.







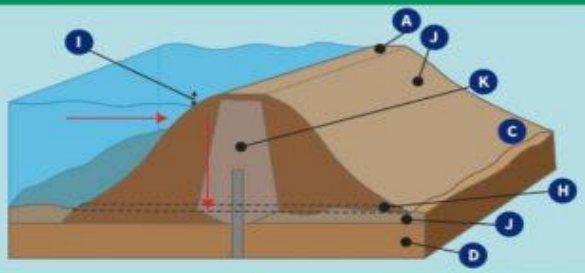

IMPORTANT FOR MAPSKILL EVALUATION

Dams: a. Salal b. Bhakra Nangal c. Tehri d. Rana Pratap Sagar e. Sardar Sarovar

f. Hirakud g. Nagarjuna Sagar h. Tungabhadra

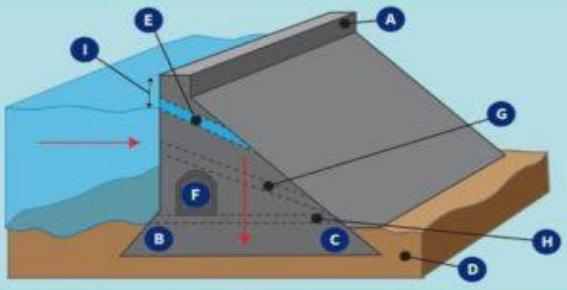
River	Dams constructed	State/place
Mahanadi	Hirakud Dam	Odisha
Satluj	Bhakhra Nangal Dam	Himachal Pradesh in northern India
Krishna	Nagarjuna Sagar Dam	Nalgonda District, Telangana State.
Chenab	Salal Dam*	Jammu and Kashmir.
Narmada	Sardar Sarovar Project*	Gujarat
Bhagirathi	Tehri Dam	Uttarakhand
Ganges	Naraura dam	Uttar Pradesh
Chambal River	Rana Pratap Sagar Dam	Rajasthan
Chambal	Gandhi Sagar Dam	Madhya Pradesh

TYPES OF DAMS



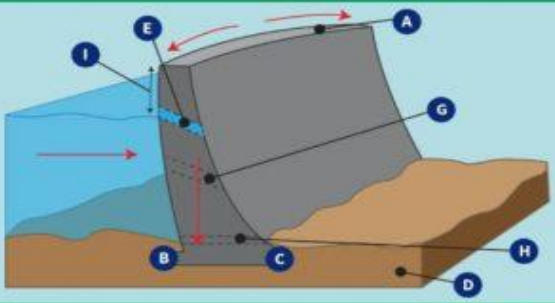
EMBANKMENT

- Constructed from compacted soil ("earthfill") or rock ("rockfill") with an impervious core
- Designed to transfer the entire water load downward
- 80% of all large dams in the U.S. are embankment dams
- Used to retain water across wide river valleys or for flood control
- Typically shorter and wider than other types of dams



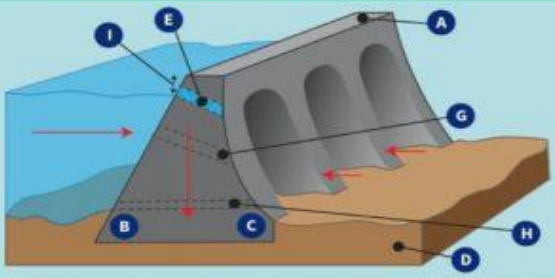
GRAVITY

- Constructed of concrete or stone masonry
- Designed to transfer the entire water load downward
- Typically span narrow river valleys with bedrock abutments and foundations
- Retain water by utilizing the weight of the dam to resist the horizontal water load pushing against it
- Each section of the dam is independently stable



ARCH

- Constructed of concrete
- Designed to transfer water loads to the adjacent rock formations
- Constructed only in canyons with solid rock walls that are able to resist the pressure of the dam
- Because the canyon walls bear the bulk of the load, arch dams are thinly constructed, requiring less material than other types of dams



BUTTRESS

- Constructed of reinforced concrete
- Designed to transfer the water load both downward and to the buttresses
- Hollow gravity dams with a solid upstream face and a buttressed downstream side
- Buttresses are supports that transmit the water force to a bedrock foundation

A **Crest:** The top of the dam, in some cases used to provide a roadway or walkway over the dam

B **Heel:** The part of the dam in contact with ground on the upstream side

C **Toe:** The part of the dam in contact with the ground on the downstream side

D **Foundation:** Excavated surface or undisturbed material

E **Spillway:** Structure that provides for controlled conveyance of water flows downstream of the dam

F **Gallery:** Small room within large dams used to monitor the performance of the dam, with a drain on the floor for water seepage

G **Outlet:** Also called sluiceway, used to release water from the reservoir for water supply, irrigation, and hydro power

H **Blowoff:** Opening within the dam near the base to drain the reservoir

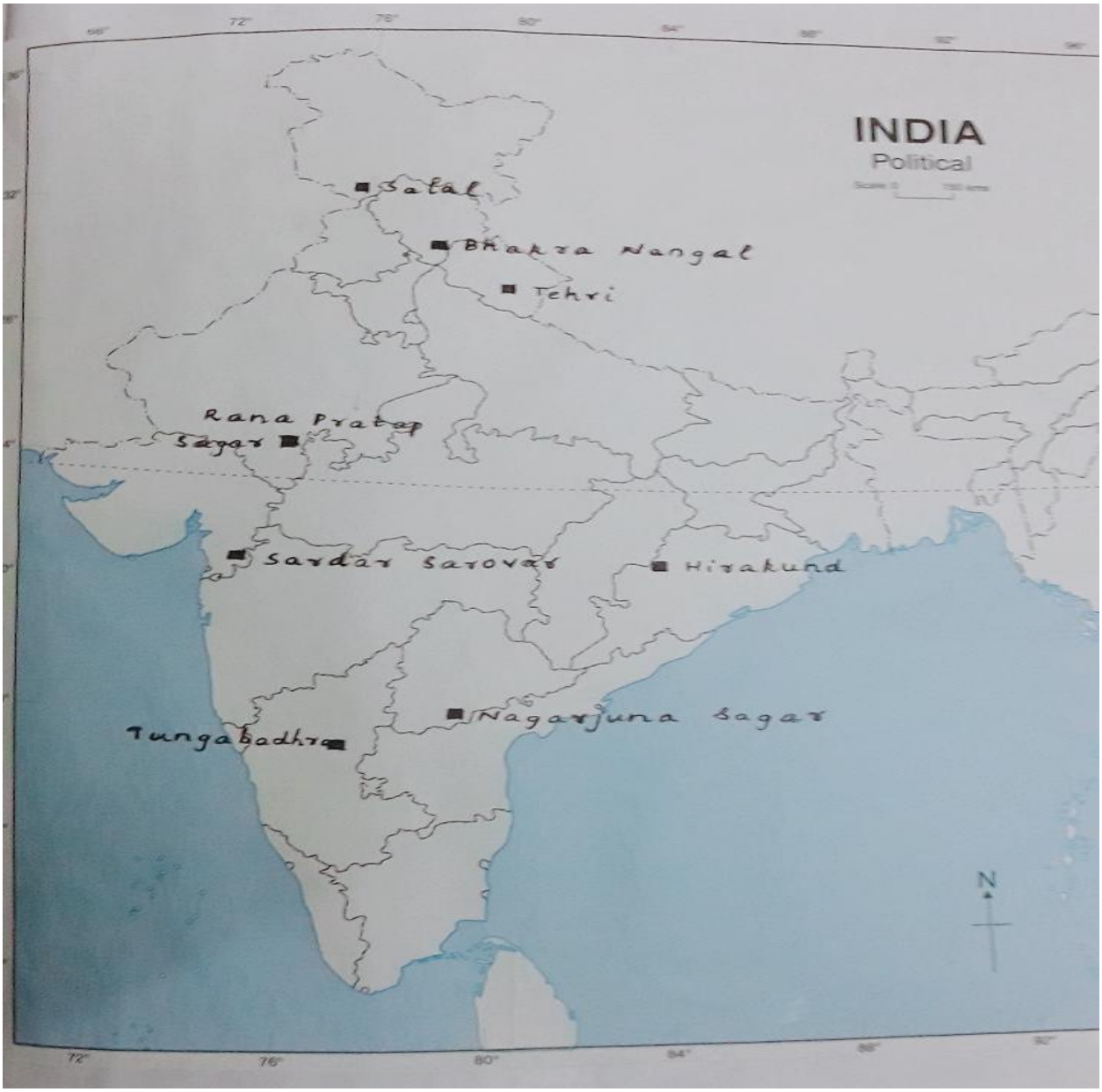
I **Freeboard:** Vertical distance between the spillway level and the crest of the dam

J **Pervious Material:** Substances that allow water to pass through

K **Impervious Material:** Substances that do not allow water to pass through

TATA & HOWARD

Unsurpassed Solutions in the Water Environment



Salal Hydroelectric Power Station

- A run-of-the-river hydropower project on the Chenab River in the Reasi district of the Jammu and Kashmir.
- It was the first hydropower project built by India in Jammu and Kashmir under the Indus Water Treaty regime.

Bhakra Dam is a concrete gravity dam on the Sutlej River in Bilaspur, Himachal Pradesh in northern India.

- The dam forms the Gobind Sagar reservoir.
- In terms of quantity of water, it is the third largest reservoir in India, the first being Indira Sagar dam in Madhya Pradesh with capacity of 12.22 billion cu m and second Nagarjunasagar Dam.

The **Tehri Dam** is the highest dam in India.

- One of the highest in the world.
- It is a multi-purpose rock and earth-fill embankment dam on the Bhagirathi River near Tehri in Uttarakhand, India.

The **Ranapratap Sagar Dam** is a gravity masonry dam of 53.8 meters (177 ft) height built on the Chambal River at Rawatbhata in Rajasthan in India.

The **Sardar Sarovar Dam** is a concrete gravity dam on the Narmada river in Kevadiya near Navagam, Gujarat in India.

- Four Indian states, Gujarat, Madhya Pradesh, Maharashtra and Rajasthan, receive water and electricity supplied from the dam.

Hirakud Dam is built across the Mahanadi River, about 15 kilometers (9 mi) from Sambalpur in the state of Odisha in India.

- Behind the dam extends a lake, Hirakud Reservoir, 55 km (34 mi) long.
- It is one of the first major multipurpose river valley projects started after India's independence.

Nagarjuna Sagar Dam is a masonry dam across the Krishna River at Nagarjuna Sagar which straddles the border between Guntur district, Andhra Pradesh and Nalgonda district, Telangana.

- Nagarjuna Sagar Dam was the earliest in a series of large infrastructure projects termed as "modern temples" initiated for achieving the Green Revolution in India. It is also one of the earliest multi-purpose irrigation and hydroelectric projects in India.

The **Tungabhadra Dam** also known as **Pampa Sagar** is constructed across the Tungabhadra River, a tributary of the Krishna River.

- The dam is in Hosapete, Ballari district of Karnataka. It is a multipurpose dam serving irrigation, electricity generation, flood control, etc.

You can visit following link for further clarity: -

Water Resources https://www.youtube.com/watch?v=42E0792pnqA

Hydraulic Structures from Ancient India:- https://www.youtube.com/watch?v=ZMhvzMc0CjI