RAMAIAH
Institute of Technology

BASICIS OF CIVIL ENGINEERING & MECHANICS

Course code:CV14/CV24

Credits:3:0:0

WATER MANAGEMENT- TRADITIONAL AND FUTURISTIC SYSTEMS

- Water scarcity is being driven by two converging phenomena: growing freshwater use and depletion of usable freshwater resources.
- At the global level, 31 countries are already short of water and by 2025 there will be 48 countries facing serious water shortages. Around 20 major cities in India face chronic or interrupted water shortages. There are 100 countries that share the waters of 13 large rivers and lakes.
- Water management, therefore, is the need of time. It is the management of water resources for the coming generations. It involves the activity of planning, developing, distributing and managing the optimum use of water resources.

- Water management is a process of developing, optimizing and planning of water resources via many practices which are defined by many policies and regulations.
- We observe that some amount of water is wasted through leakage of pipe and many other reasons.
- Proper water management is necessary for the conservation of water. Thus, it is important for civic authorities to take care of these issues while supplying water to our homes.

TYPES OF WATER MANAGEMENT

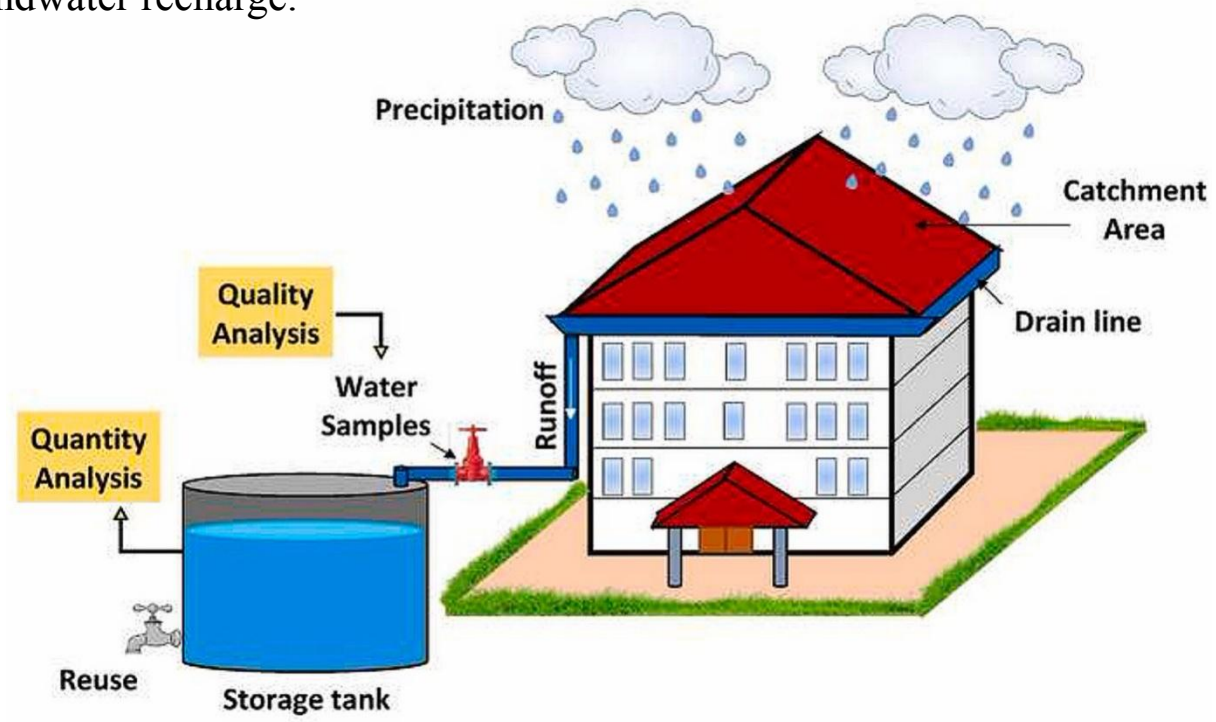
Water resource management traditionally involves managing water storage and water flows.

There are different methods through which water management and conservation can be done, some of them are explained below.

1. **Rainwater harvesting**
2. **Groundwater recharge**
3. **Artificial groundwater recharge**
4. **Drip irrigation**
5. **Greywater management**
6. **Sewage water treatment**
7. **Conjunctive use**
8. **Aquifer storage and recovery**
9. **Desalination**

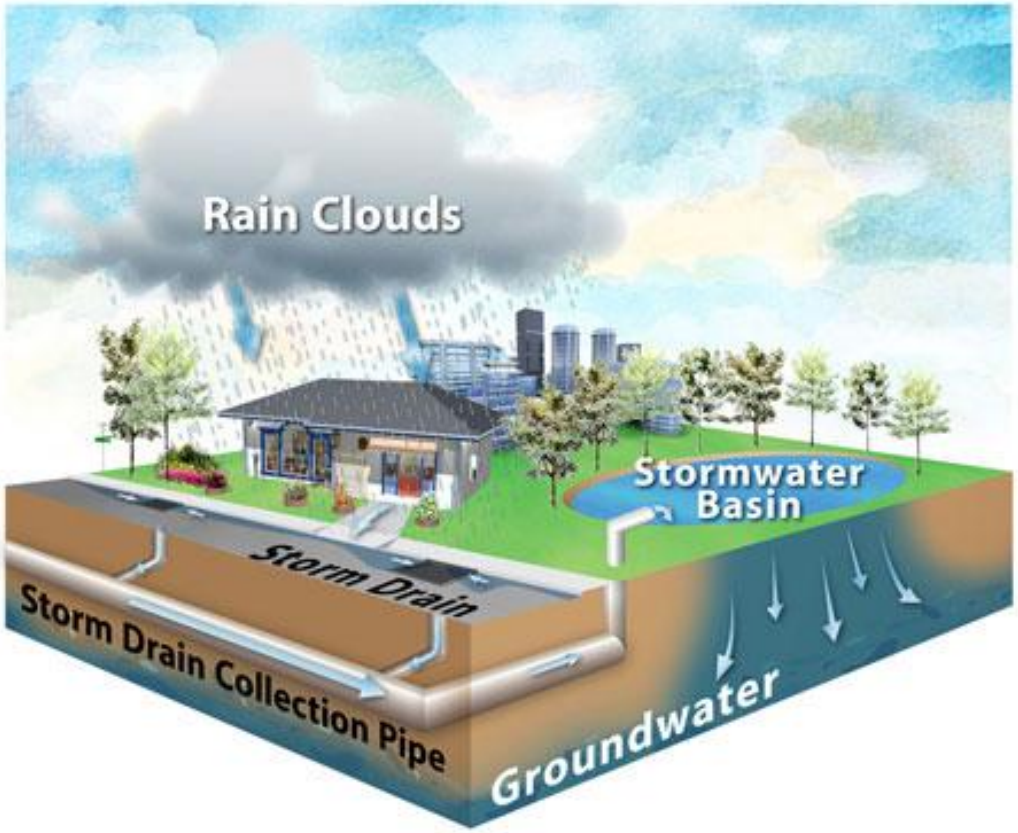
1. RAINWATER HARVESTING

- Rainwater harvesting (RWH) is the collection and storage of rain, rather than allowing it to run off. Rainwater is collected from a roof-like surface and redirected to a tank.
- Rainwater harvesting differs from storm water harvesting as the runoff is collected from roofs, rather than creeks, drains, roads, or any other land surfaces. Its uses include watering gardens, livestock, irrigation, domestic use with proper treatment, and domestic heating. The harvested water can also be committed to longer-term storage or groundwater recharge.



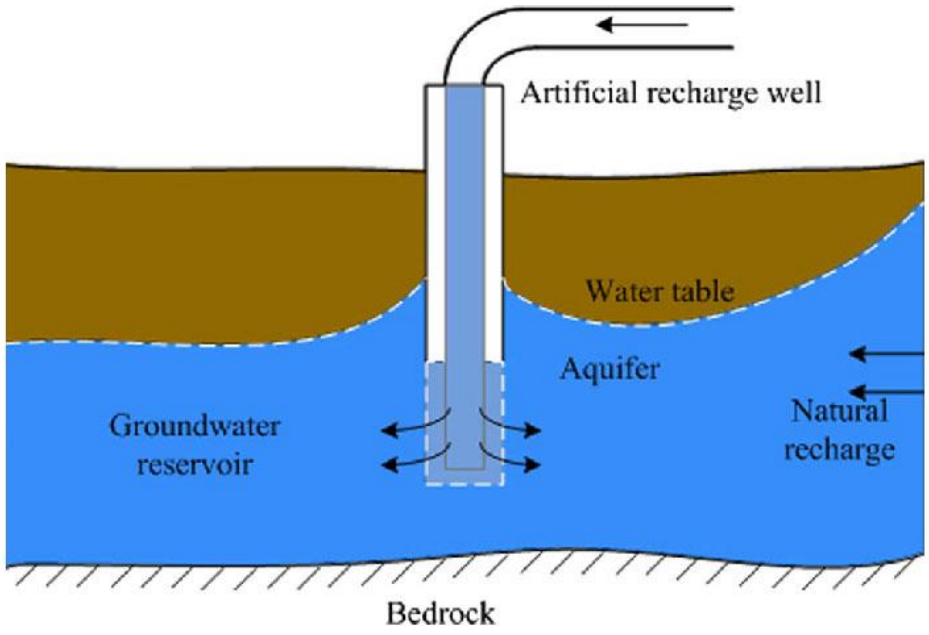
2. GROUNDWATER RECHARGE

- Groundwater recharge is the enhancement of natural groundwater supplies using man-made conveyances such as infiltration basins, trenches, dams, or injection wells.
- Aquifer storage and recovery (ASR) is a specific type of groundwater recharge practiced with the purpose of both augmenting groundwater resources and recovering the water in the future for various uses.
- The use of groundwater, especially for irrigation, may also lower the water tables. Groundwater recharge is an important process for sustainable groundwater management
- Flooding temporarily increases river bed permeability by moving clay soils downstream, and this increases aquifer recharge.



3. ARTIFICIAL GROUNDWATER RECHARGE

- Artificial recharge is the practice of increasing the amount of water that enters an aquifer through human-controlled means.
- For example, groundwater can be artificially recharged by redirecting water across the land surface through canals, infiltration basins, or ponds; adding irrigation furrows or sprinkler systems; or simply injecting water directly into the subsurface through injection wells.
- Artificial groundwater recharge is becoming increasingly important in India, where the over-pumping of groundwater by farmers has led to underground resources becoming depleted.



4. DRIP IRRIGATION

- Drip irrigation is a type of micro-irrigation system that has the potential to save water and nutrients by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface.
- The goal is to place water directly into the root zone and minimize evaporation.
- Drip irrigation systems distribute water through a network of valves, pipes, tubing, and emitters. Depending on how well designed, installed, maintained, and operated it is, a drip irrigation system can be more efficient than other types of irrigation systems, such as surface irrigation or sprinkler irrigation.

5. GREY WATER MANAGEMENT

Greywater is gently used water from our bathroom sinks, showers, tubs, and washing machines. It is not water that has come into contact with faeces, either from the toilet or from washing diapers.

Greywater may contain traces of dirt, food, grease, hair, and certain household cleaning products. While greywater may look “dirty,” it is a safe and even beneficial source of irrigation water in a yard.

The greywater is held briefly in the tank before being discharged to an irrigation or treatment system. The greywater can be diverted either by gravity or by using a pump. The surge tank can be any type of container that is suitable for holding (but not storing) the initial surge of water. The surge tank must be emptied completely each time greywater is dispersed to the irrigation or treatment system – greywater must not sit for extended periods of time in the tank. A gravity system can only be used when there is sufficient fall from the laundry/bathroom drain to the surge tank.

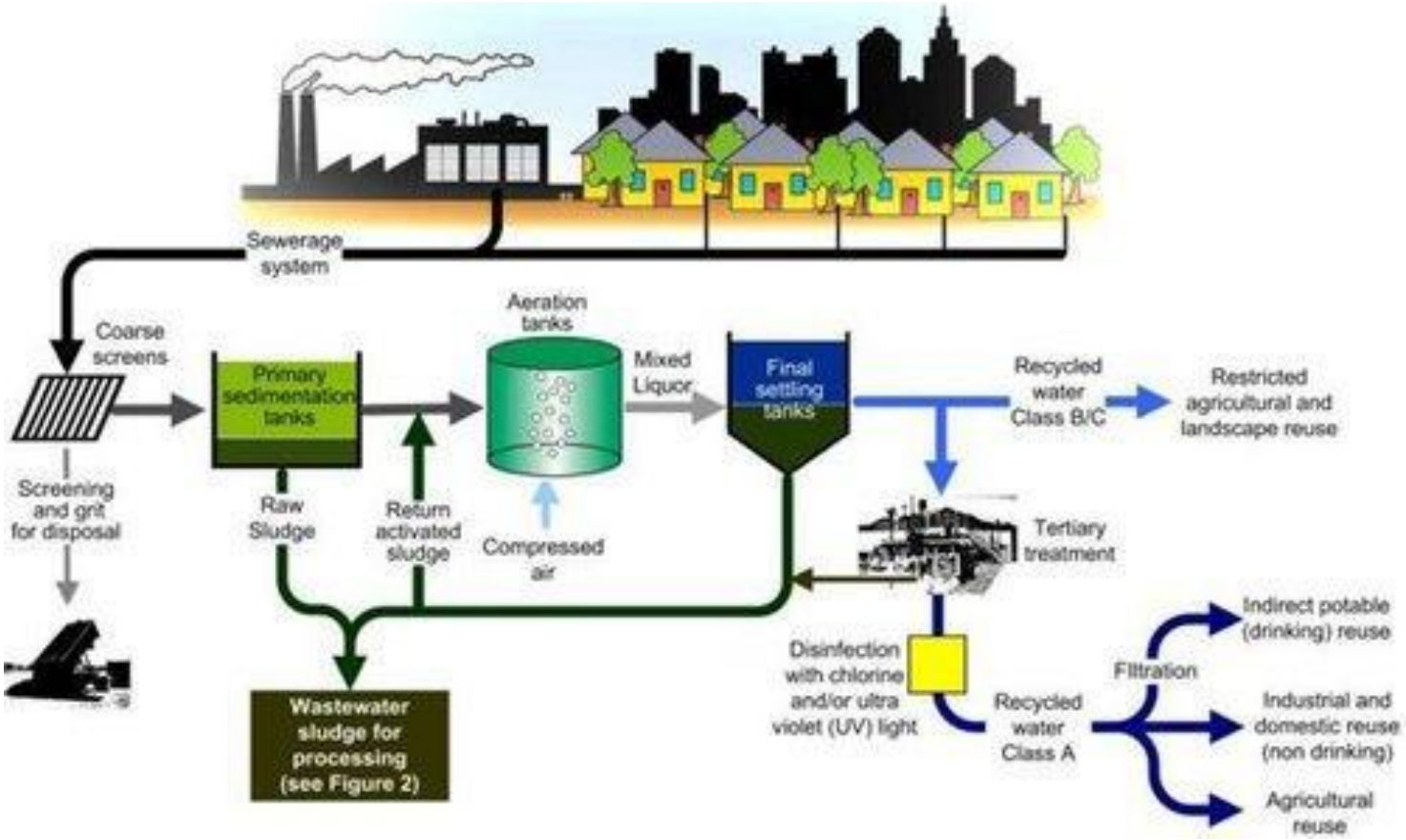
6. Sewage water treatment

Sewage treatment is the process of removing contaminants from municipal wastewater, containing mainly household sewage plus some industrial wastewater.

Physical, chemical, and biological processes are used to remove contaminants and produce treated wastewater (or treated effluent) that is safe enough for release into the environment.

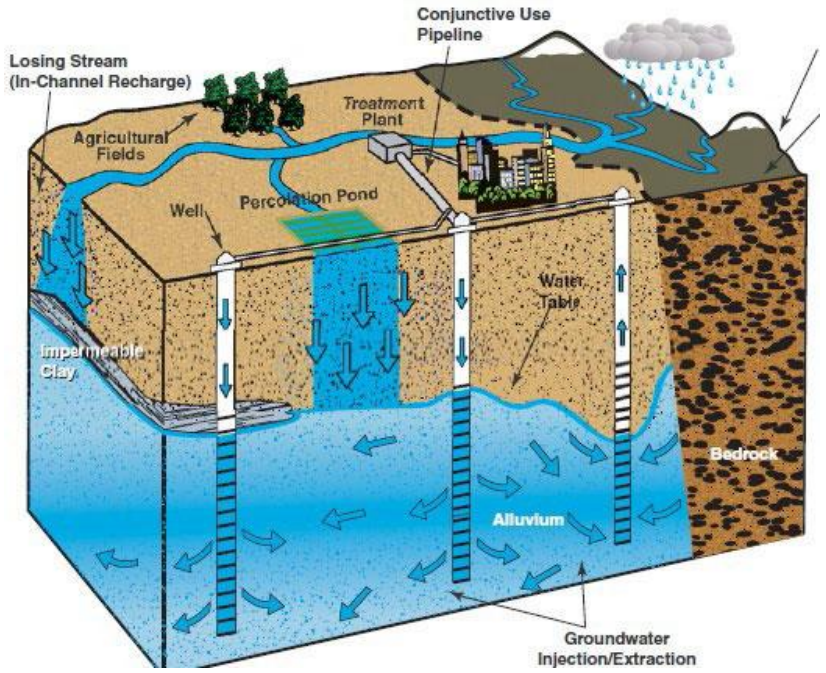
A by-product of sewage treatment is a semi-solid waste or slurry, called sewage sludge. The sludge has to undergo further treatment before being suitable for disposal or application to land.

Sewage water treatment



7. Conjunctive use

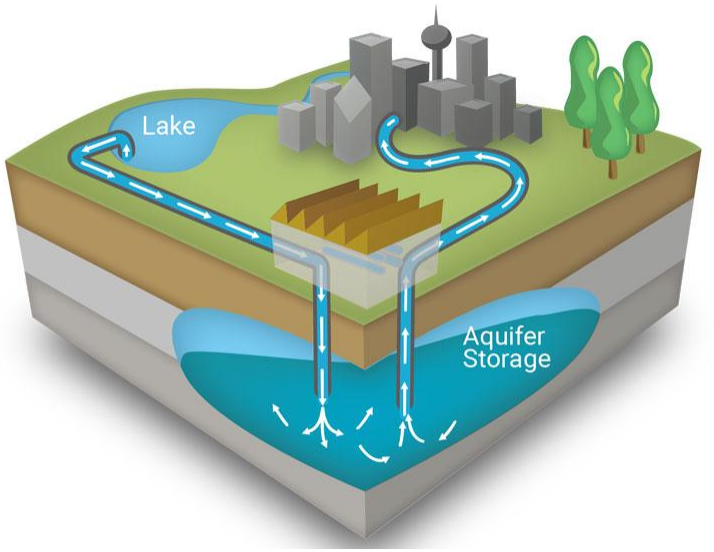
- Conjunctive use is a catch-phrase for co-ordinated use of surface water and groundwater— literally going with the flow to maximize sufficient yield.
- Conjunctive use in an irrigation setting is the process of using water from the two different sources for consumptive purposes.



8. Aquifer storage and recovery

Aquifer storage and recovery (ASR) is the direct injection of surface water supplies such as potable water, reclaimed water (i.e. rainwater), or river water into an aquifer for later recovery and use.

The injection and extraction is often done by means of a well. In areas where the rainwater cannot percolate the soil or where it is not capable of percolating it fast enough (i.e. urban areas) and where the rainwater is thus diverted to rivers, rainwater ASR could help to keep the rainwater within an area. ASR is used for municipal, industrial and agricultural purposes.



Desalination

- Desalination is a process that takes away mineral components from saline water.
- Saltwater is desalinated to produce water suitable for human consumption or irrigation. The by-product of the desalination process is brine.
- Most of the modern interest in desalination is focused on the cost-effective provision of freshwater for human use. Along with recycled wastewater, it is one of the few rainfall-independent water sources.
- As such, the technology is energy intensive and research is continually evolving to improve efficiency and reduce energy consumption.

Source:
https://www.constrofacilitator.com/different-types-of-water-management-methods/

FLOOD CONTROL

- A flood is an unusually high stage in a river, normally the level at which the river overflows its banks and inundates the adjoining area.
- The damages caused by floods in terms of loss of life, property and economic loss due to disruption of economic activity are all well known.
- Thousands of crores of rupees are spent every year in flood control and flood forecasting.
- The country may have to look for international assistance to supply food and materials to clean and rebuild its infrastructure. While some countries will support voluntarily, other will charge for their efforts, putting the assisted country in debt and at an economic loss.

Causes and consequences of floods

- Flooding may be caused by many factors such as intense rainfall, strong winds over water, unusual high tides, tsunamis or failure of dams, elevation of retention pond levels or other structures that contain water. Periodic flooding occurs in many rivers, forming a surrounding region known as an alluvial plain.
- **Flooding causes many impacts.**
  - They damage property and endanger the lives of humans and other living things.
  - Rapid water runoff causes soil erosion and concomitant deposition of sediment at various locations, as well as fish spawning sites and other wildlife habitats, which may become polluted or completely destroyed.
  - Some high and prolonged floods can compromise vehicle traffic in areas that do not have elevated roads.
  - Flooding can interfere with drainage and economic land use, as well as with agriculture.
  - Structural damage can occur in bridge pillars, sewage systems and other structures in the area of floods.
  - Water navigation and hydroelectric power are often hampered.
  - An important impact resulting from the sudden flood is the landslide. A landslide is a geological and climatologically phenomenon that includes a broad spectrum of soil movements, such as rock falls, landslide in depth and surface streams of debris

Flood control and flood management

Flood control refers to all methods used to reduce or prevent the damaging effects of flood waters. Some of the common techniques used for flood control are the installation of rock beams, rock rip-raps, sand bags, maintenance of normal slopes with vegetation or application of soil cements on steeper slopes and construction or expansion of drainage. Other methods include dykes, dams, retention basins or detention.

The engineering works that can prevent and mitigate the effects of floods are as follows:

1) On highways, the implantation of steel pipes should take water by gravity away from the road from catchment basins;

2) construction of great swimming pools that are large underground water tanks to store the waters;

3) Mandatory placement of permeable drainage floors in huge courtyards of parking lots in malls, supermarkets and cinemas, to allow the water infiltration in part of the ground, being the same for monuments and spaces around buildings;

4) using drains and gutters around all houses to divert rainwater to a reservoir or disposal area;

5) Maintenance, whenever possible, of some green areas so that the water is reabsorbed by the soil;

6) Rectification of rivers and streams, construction of dams and canals in large rivers that extend their containment basins.


ONE WAY
NOTICE
DOGS
MUST BE
LEASHED

Flood control and flood management

Caring to avoid flooding in urban areas is, as follows:

1) keeping streets and sidewalks always clean; cleaning and unclogging manhole and storm drain;

2) keeping in the houses the channels and other channels of rainfall free of branches and leaves of trees to avoid clogging and, consequently, return of water;

3) putting garbage bags on the sidewalks only near the time the garbage collection truck will come, preventing them from being drawn into the manhole when it rains;

4) having a drain pump on hand if flooding cannot be avoided; and

5) using Dutch and British flood proof technology as a floating amphibian house that allows buildings to float in the same way as a boat.

Hydrological experts recommend that, in order to avoid flooding in urban areas, the following measures should be adopted:

1) Combating erosion by minimizing sedimentation of natural drainage and built up through rigorous and extensive soil erosion control and irregular disposition of urban garbage and construction rubble , as well as the expansion of the river gutters;
2) Combating waterproofing with the creation of domestic and business reservoirs, as well as the expansion of green areas;
3) Forbidding traffic on high traffic avenues when nearby rivers overflow;
4) Implantation of avenues covered by vegetation that, in cases of overflowing rivers or streams, water would be absorbed by the pavement free soil;
5) Constructing great swimming pools to receive rainwater and mini swimming pools in houses and buildings;
6) Investing in small and large streams of the urban center to support the increase of water and act as containment barriers;
7) Review of occupied areas – continuous planning and land-use planning; and
8) Action and planning – preparation of a plan to deal with the occurrence of floods as well as extreme climatic variations, and construction of reservoirs capable of storing billions of cubic meters of water and their use for non-potable purposes

Flood Management

- In order to deal with flood risks, it is essential that prevention and precaution measures are adopted to avoid catastrophic events.
- The Preliminary Environmental Impact Assessment of Floods is an important instrument for the formulation of civil defence plans as it is used to assess, predict and prevent further economic and social damages resulting from floods.
- It should be noted that preventive or precautionary measures should be based on risk management policies and, above all, be present in the proposals and actions of the Civil Defence in dealing with the floods.
- Big Data enables the analysis of a huge amount of information to show patterns and correlations, in many cases totally unknown. Big Data opens up a wider range of possibilities that can turn into paths to innovation.

Flood Management

It should be noted that decision-making is a process of analysis and choice of several alternatives available, of the course of action to be followed. The decision-making process consists of 6 steps:

1) Perception of the situation;
2) Analysis and definition of the problem;
3) Definition of objectives;
4) Search for solution alternatives;
5) Evaluation and comparison of these alternatives;
6) Choice of the most appropriate alternative.

Floods in India

Floods are recurrent phenomena in India. Due to different climatic and rainfall patterns in different regions, it has been the experience that, while some parts are suffering devastating floods, another part is suffering drought at the same time. With the increase in population and development activity, there has been a tendency to occupy the floodplains, which has resulted in damage of a more serious nature over the years.

Damage from floods

	Maximum	Average
Area affected	17.5 million ha (1978)	7.63 million ha
Crop area affected	10.15 million ha (1988)	3.56 million ha
Population affected	70.45 million (1978)	32.92 Million
Houses damaged	3 507 542 (1978)	1 234 616
Heads of cattle lost	618 248 (1979)	91 242
Human lives lost	1 1316 (1977)	1 560
Damage to public utilities	US$ 705 million (1998)	US$ 126 million
Total damage	US$ 1 255 million (1998)	US$ 307 million

Heavy flood damage was inflicted during the monsoon of 1955, 1971, 1973, 1977, 1978, 1980, 1984, 1988, 1989, 1998, 2001 and 2004. Highlights of the damage are given below:

Approach to flood management

Approaches to dealing with floods may be any one or a combination of the following available options:

- Attempts to modify the flood
- Attempts to modify the susceptibility to flood damage
- Attempts to modify the loss burden
- Bearing the loss.

Structural measures	Non-structural measures
• Embankments, flood walls, sea walls • Dams and reservoirs • Natural detention basins • Channel improvement • Drainage improvement Diversion of flood waters.	• Flood forecasting and warning centres • Floodplain zoning • Flood fighting • Flood proofing • Flood insurance

BEST PRACTICES

It is necessary to distinguish between different kinds of flooding and the environmental conditions that contribute to the problem.

Therefore, the effectiveness of the best practices described depends on among other hydrological and environmental circumstances.

- Integrated river basin approach
- Public awareness, public participation and insurance
- Research, education and exchange of knowledge
- Retention of water and non-structural measures
- Land use, zoning and risk assessment
- Structural measures and their impact
- Flood emergency
- Prevention of pollution

Source:
https://www.heraldopenaccess.us/article_pdf/15/flood-control-and-its-management.pdf
https://public.wmo.int/en/bulletin/flood-and-drought-management-through-water-resources-development-india
https://ec.europa.eu/environment/water/flood_risk/pdf/flooding_bestpractice.pdf