Course Code:MCC102A
Course Title:Environmental Studies

Lecture No: 4

Title: Water resources

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Topics

Water resources: Use and over -utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems

Intended Learning Outcomes

At the end of this lecture, students will be able to

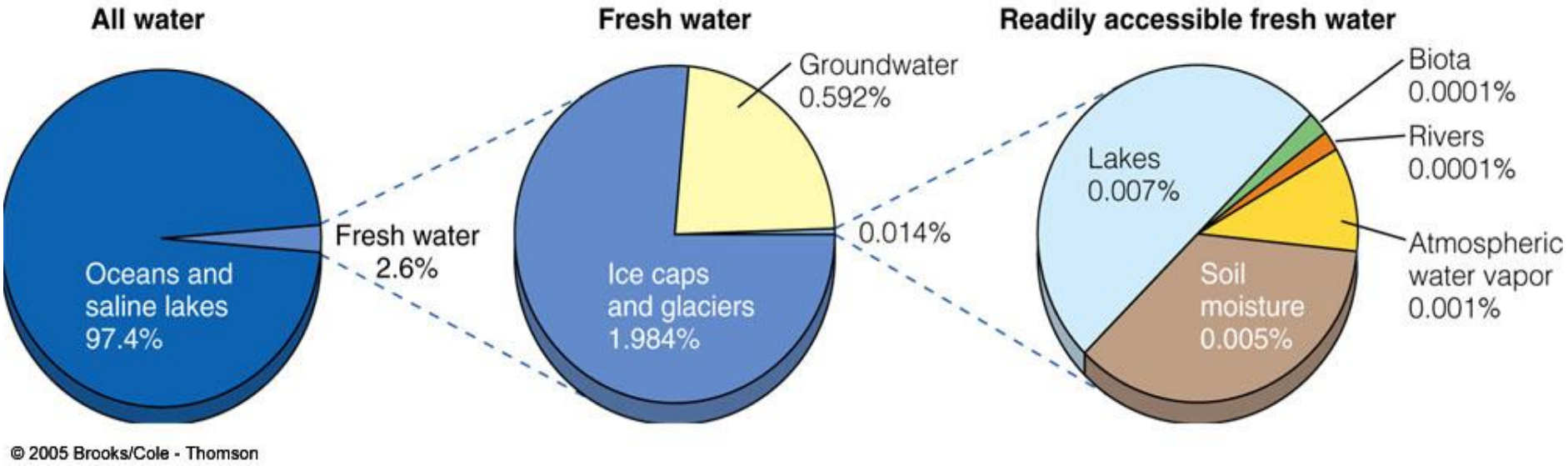
- Explain different water resources
- Relate Flooding and Deforestation
- Explain the measures for sustainable water use

Water Resources

Water

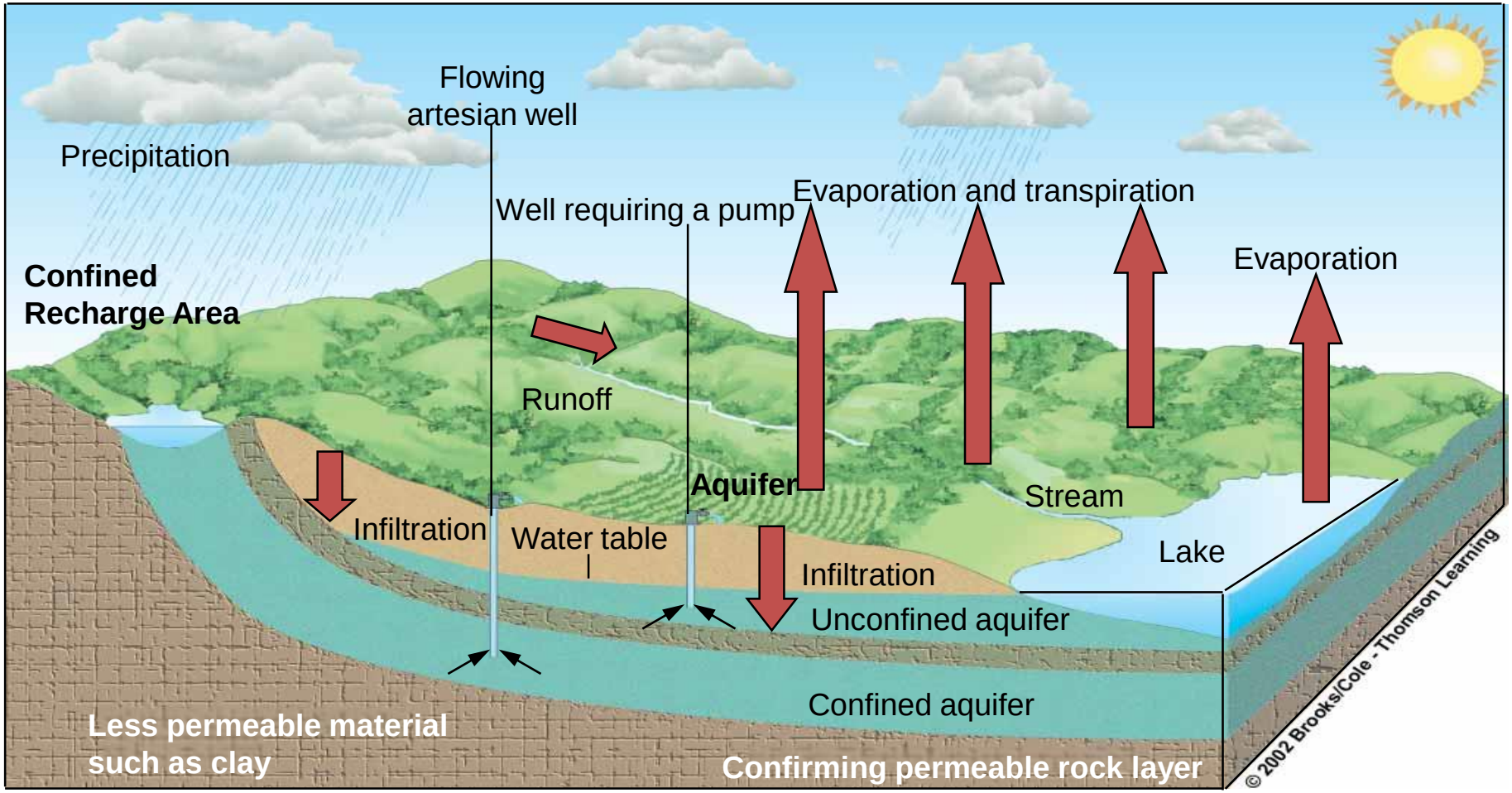
- Earth's surface is covered by 71% water
- Essential for life – can survive only a few days without water

Supply of Water Resources



Water Cycle

Continuously collected, purified, recycled and distributed



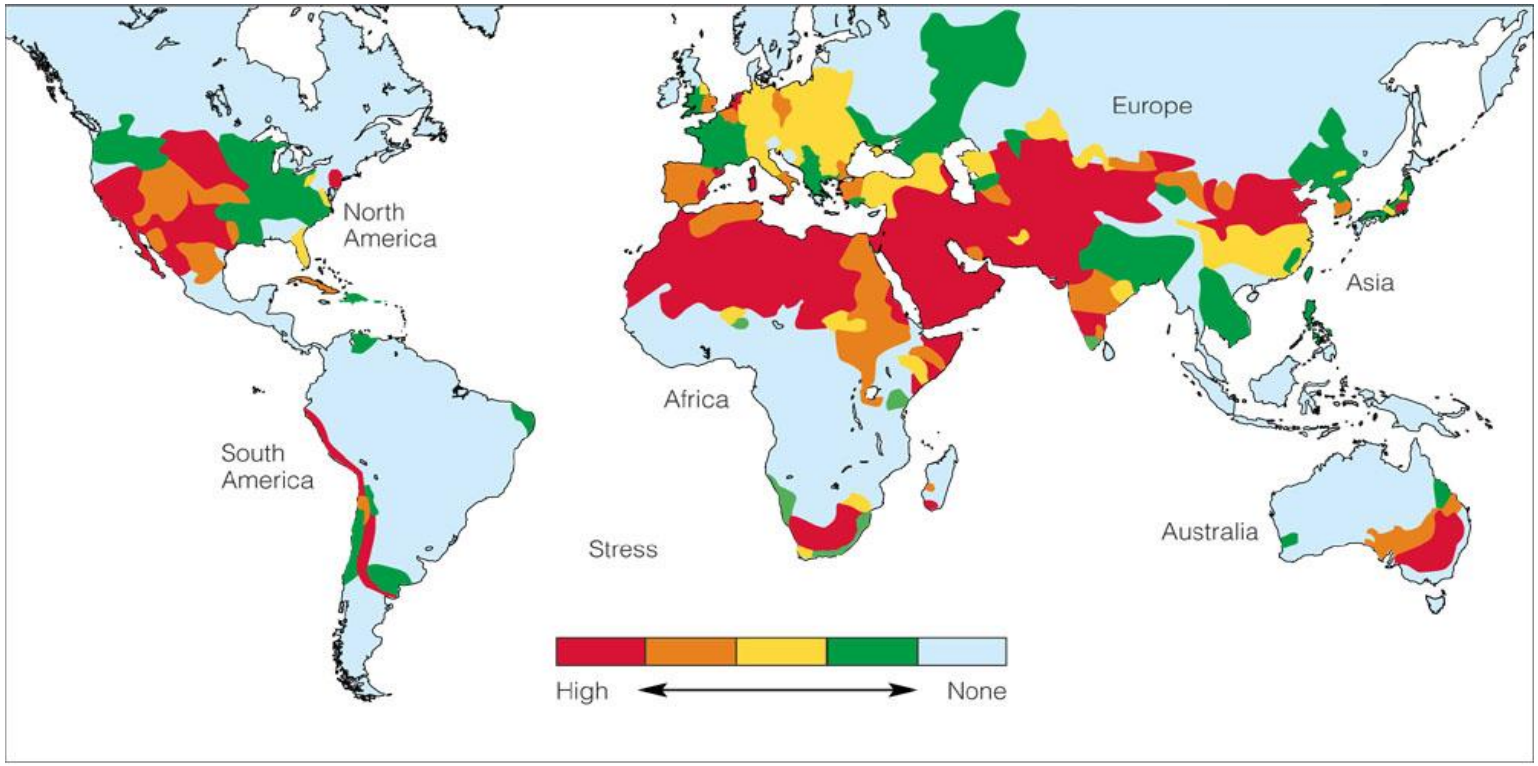
Water Resources

- Surface runoff – 2/3 lost to floods and not available for human use.
- Reliable runoff = one third
  - Amount of runoff that we can count on year to year
- Groundwater
- Zone of saturation
- Water table – top of zone of saturation
- Aquifer – water saturated layers of sand, gravel or bedrock through which groundwater flows.
- Recharge slow ~ 1 meter per year

Use of Water Resources

- Humans directly or indirectly use about 54% of reliable runoff
- Withdraw 34% of reliable runoff for:
- Agriculture – 70%
- Industry – 20%
- Domestic – 10%
- Leave 20% of runoff in streams for human use:
  - Transport goods, dilute pollution, sustain fisheries
- Could use up to 70-90% of the reliable runoff by 2025

Water conflicts: Global



Two main factors for water shortage: dry climate and too many people. Many people live in hydro poverty – can't afford clean water.

Sources of freshwater for humans

- Two major sources:
  - Surface water
  - Groundwater
- Surface water is the water that has not yet soaked into the ground or gone into the sea
- Untreated sources of surface water are streams, rivers, springs, (collectively called runoff) lakes, reservoirs, harvested rain water.
- Groundwater is water stored below the earth surface in spaces between certain rocks.
- Untreated source of groundwater is water drawn from aquifers using wells and pumps.

Utilization of Water Resources

- Only 30% of the runoff can be utilized as the remaining quantity is mostly in the form of floods. The usable runoff is called reliable runoff.
- Humans directly or indirectly use about 54% of reliable runoff
- Withdraw 34% of reliable runoff for:
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Over utilization of Water Resources

- The natural tendency to exploit a natural resource
- Over exploitation (OE) of water resources leads to “water stress”
- OE of **surface water** is mainly misuse leading to degradation of both quality and quantity.
- Dumping industrial and sewage waste into rivers gives rise to environmental, ecological and health problems.
- Population growth and associated rapid urbanization increases use of available water in a particular area
- Climate change has been found to have significant impact on surface water in the recent past.

Over utilization of Water Resources

Effects:

- Pollutants released in the river by industries flow downstream of the river invariantly affects people utilizing that water.
- Untreated sewage released into water also affects people in the downstream
- Aquatic ecosystem is affected leading to loss of aquatic life
- Construction of dams for water supply and power generation alter the natural course of river and disturbs the ecology
- Climate change impacts may result in dry rivers and shortage of surface water or adversely increase flooding.

Over utilization of Water Resources

- Over Exploitation of **groundwater** is also misuse leading to degradation of both quality and quantity.
- In most arid and semi arid countries, groundwater contributes significantly to water supply and irrigation
- Unscientific usage of groundwater leads to the depletion of groundwater level
- Industries discharging waste into the ground adds to the pollutants and results in significant increase in groundwater pollution

Over utilization of Water Resources

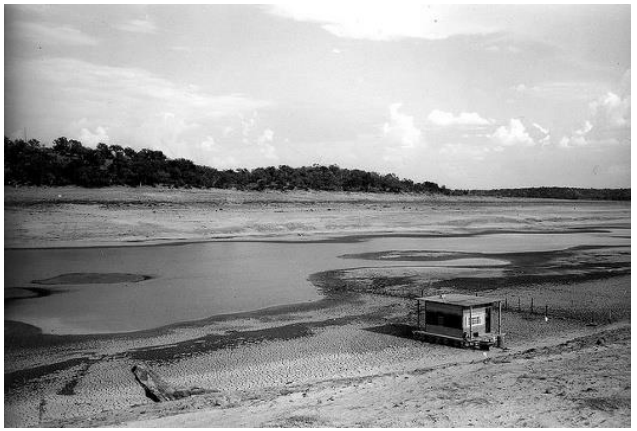
Effects:

- Continuous lowering of water levels. (Both pre-monsoon and post-monsoon)
- Lowering of pump sets, causing low efficiency, higher cost of operation
- Reduction of yields of wells, well interference due to close spacing of wells, severe drinking water scarcity in summer months.
- Deepening of wells, mining of groundwater from deeper aquifers
- Increase in cost of groundwater extraction, cost benefit affected
- Total collapse of operation & management system of groundwater resource of the basin or watershed and disturbed planned and sustained development and regulatory system in the area.

The extremes in nature

- Two most significant extremes in nature related to water resources are
  - Floods
  - Droughts
- Two ends of the spectrum, one signifies excess water in a short time (Floods) and the other water deficit for a long time (droughts).

Flooding in Alaknanda river destroys buildings in Govindghat town of Uttarakhand



1960s Northeast Drought lasted almost 5years and stretched across NE-USA.

Floods

- Natural phenomena
- Aggravated by human activities
  - Rain on snow Living on floodplains
  - Impervious surfaces
  - Removal of vegetation
  - Draining wetlands

Floods

- **Definition**
  - A general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters from the unusual and rapid accumulation or runoff of surface waters from any source.
- Floods could be caused due to natural causes, or, human activities, or, a combination of both.
  - Very heavy rainfall (say: due to cyclones, typhoons etc.) in a short span of time.
  - Breach in levy, dams etc. due to structural failure
  - Release of water from dams to accommodate increasing flow into them.

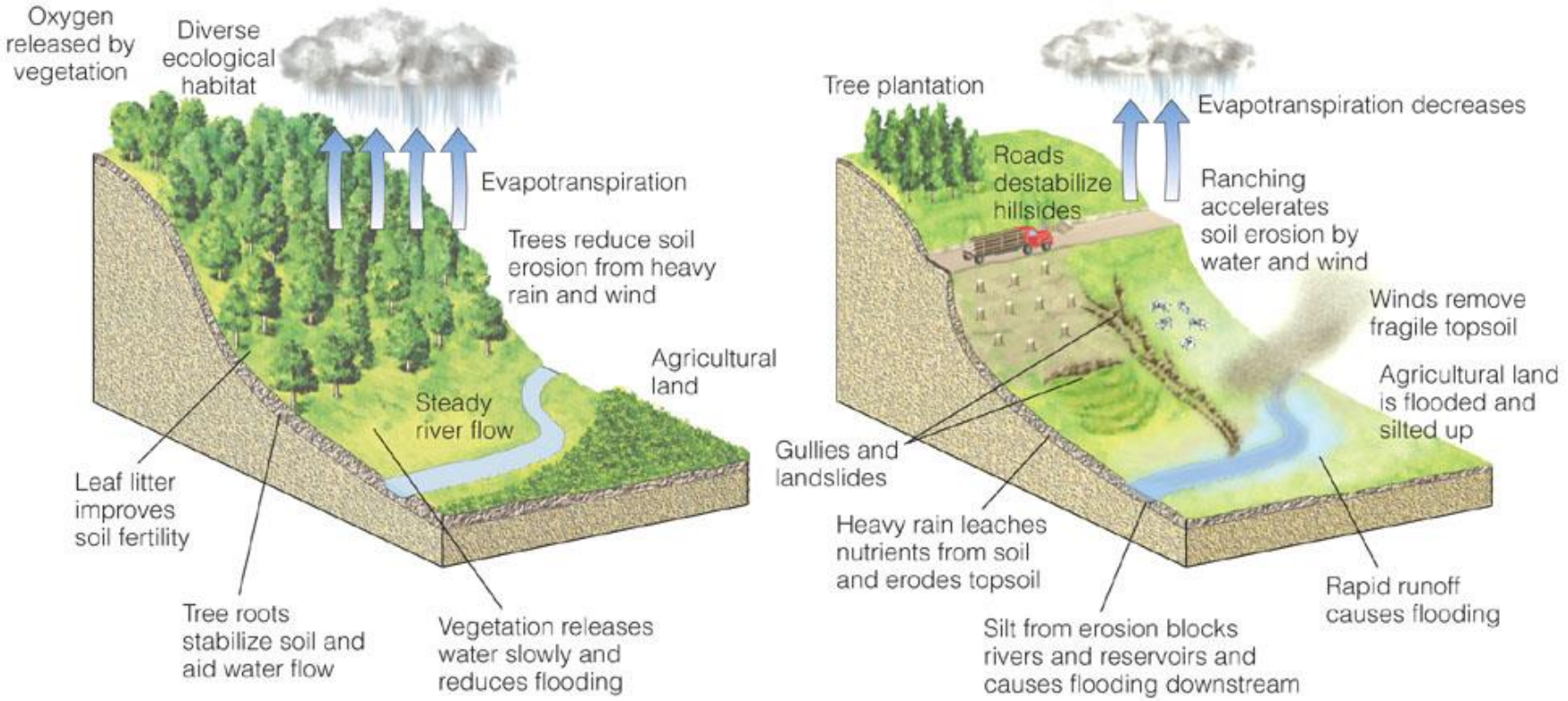
Floods

- Flooding impacts a large area, wherein entire district or states might be flooded.
- The areas, which are prone to flood-risks are:
  - Places, which have a history of flooding (most important)
  - Area receiving heavy rainfall, with not much naturally sloping landscape
  - Areas at the lower levels of naturally sloping landscape – where, the higher areas are receiving heavy rainfall
  - Areas around sea-coasts, or, river banks
  - Areas downstream of dams etc.

Floods: Prevention

- Keep the drainage system clean. This allows water to be carried down very fast.
- Desilting of drains to accommodate increase in their flow capacity
- Regular inspection and repair of dams, levees, embankments etc.
- Afforestation in the upstream of rivers
- Construct flood diversion measures for major cities.

Deforestation and flooding



What is drought?

- **One definition:**

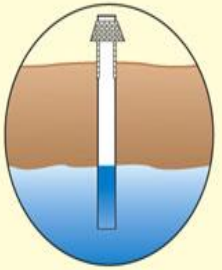
A deficiency of precipitation over an extended period that causes water shortage for some group or activity.

- **Elements of the definition:**
  - deficiency of precipitation
  - extended period (how long is "extended"?)
  - water shortage for some user ("group or activity")

Solutions for Sustainable Water Use

- Preserving ecological health of aquatic systems
- Integrated watershed management
- Agreements among regions and countries sharing surface water resources
- Outside party mediation of water disputes between nations
- Marketing of water rights
- Decreasing government subsides for supplying water
- Increasing government subsides for reducing water waste

Not depleting aquifers



Slowing population growth

Wasting less water

Preserving water quality

Solutions

Reducing Flood Damage

Prevention

Preserve forests on watersheds

Preserve and restore wetlands in floodplains

Use floodplains primarily for recharging aquifers, sustainable agriculture and forestry

Control

Straighten and deepen streams (channelization)

Build levees or floodwalls along streams

Build dams

Fig. 13-27, p. 342

Case Studies

A half constructed catchment pond at Maharashtra

A lake in Velladi where ash from power plants is released

Major Inter-state River Conflicts in India

Rivers	States concerned	Date of reference to the tribunal	Decision of the tribunal
Krishna	Maharashtra, Andhra Pradesh, Karnataka	April 1969	May 1976
Godavari	Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh and Orissa	April 1969	July 1980
Narmada	Rajasthan, Madhya Pradesh, Gujarat, Maharashtra	October 1969	December 1979
Ravi and Beas	Punjab, Haryana and Rajasthan	April 1986	–
Cauvery	Kerala, Karnataka, Tamil Nadu and Puducherry	June 1990	–
Krishna	Karnataka, Andhra Pradesh and Maharashtra	June 1990April 2004	–
Madel/Mandovi/ Mahadayi	Goa, Karnataka and Maharashtra	November 2010	–
Vamasadhara	Andhra Pradesh and Orissa	February 2010	–
Periyar[10]	Tamil Nadu and Kerala	–	–
Godavari (Bhabli Barrage)	Maharashtra and Andhra Pradesh	–	–

Lake Mead Facts

- Lake Mead was formed in Black Canyon when the Hoover Dam was finished in 1935.
- Water source for over 22 million people.
- Lake Mead supplies water to:
  - Las Vegas
    - 90% of the supply comes from Lake Mead
  - Los Angeles
  - San Diego
  - Southern California Agriculture
- Extends 110 miles behind the dam
- Capacity is 28.5 million acre-feet
  - Saylorville = 641,000 acre-feet

Lake Running Dry? The Causes

- Colorado River system is seeing a deficit of

  1 million acre-feet of water per year
  - This amount can supply 8 million people for 1 year.
- The water supply is not being replenished
  - 8 years of continued drought in the region
  - Below average snowfall within the Colorado River watershed
- Human factors
  - Human demand has increased as populations in the southwest have exploded.
  - Increased evaporation off the lake
  - Human induced climate change

A Comparison

Lake Mead has dropped over 100 feet in the last 10 years to its lowest level since the 1960s.

September 1998

June 2008

A Comparison

The same view behind the dam in June 2008.

1998 flood at the dam - water topped the spillways for 4 days.

8 years of drought and over-use of water

May 1998 Las Vegas flood and above average snowfall

Summary

- Only 30% of the runoff can be utilized as the remaining quantity is mostly in the form of floods. The usable runoff is called reliable runoff.

- Humans directly or indirectly use about 54% of reliable runoff

- Two main factors for water shortage: dry climate and too many people. Many people live in hydro poverty – can't afford clean water.

Summary

- Over exploitation of surface water and ground water and their misuse leading to degradation of both quality and quantity

- Dumping industrial and sewage waste into rivers gives rise to environmental, ecological and health problems

- Two most significant extremes in nature related to water resources are
  - Floods
  - Droughts