




Watershed Hydrology

Flood and Drought Management

What is Flood ?

-  Floods are an excess of water that covers land that is normally dry
-  According to the India National Commission on Irrigation and Drainage (INCID), 'Flood' is defined as a relatively high flow or stage in a river, marked by higher than the usual, causing inundation of low land or a body of water, rising, swelling and overflowing land that is not normally covered under water.
-  Flooding is caused by the inadequate capacity within the banks of the rivers to contain the high flows brought down from the upper catchment due to heavy rainfall. Areas having poor drainage characteristics get flooded by accumulation of water from heavy rainfall.

The Two Main Floods

- **Flash floods** occur when heavy rainfall persists for only a short time period (usually only a few hours), yet can cause major damage and death due to their sudden arrival.
- Flash floods can also be caused by dam bursts or overflows.
- **Riverine floods** occur when water rises above its natural banks, often caused by snowmelts in combination with prolonged and heavy precipitation.
- Riverine floods take days, weeks, or months to rise to its max and return to normal, much longer than it takes a flash flood to.



Floods



Hazards of Floods

- ❖ There are 6 categories to measure the flood severity in a region-
 - ❖ depth of water,
 - ❖ duration,
 - ❖ velocity,
 - ❖ rate of rise,
 - ❖ frequency, and
 - ❖ seasonality.
- ❖ Depth is simply how deep the water is.
- ❖ Duration is how long the water lasts for.
- ❖ Velocity is how quick the water is moving; the faster it moves the more damage done.
- ❖ Rate of rise is how quickly the depth of the water increases.
(important when giving warnings to evacuate areas)
- ❖ Frequency is how often floods occur in an area, which depends greatly on the topography and climate.

Flood Management

Structural measures	Non-structural measures
<ul style="list-style-type: none">i. Floodwalls & flood embankmentsii. Flood storages in reservoir / Damiii. Channel Improvementsiv. De-silting and Dredging of Riversv. Drainage Improvementvi. Diversion of floodwatervii. Catchment area treatmentviii. Sea Walls / Coastal Protection Works	<ul style="list-style-type: none">i. Reservoir operation for flood managementii. Flood forecasting and warningiii. Floodplain zoningiv. Flood proofingv. Flood insurance

Flood wall and Flood embankment



Reservoir or Dam



Channel improvement



De-silting and Dredging of river



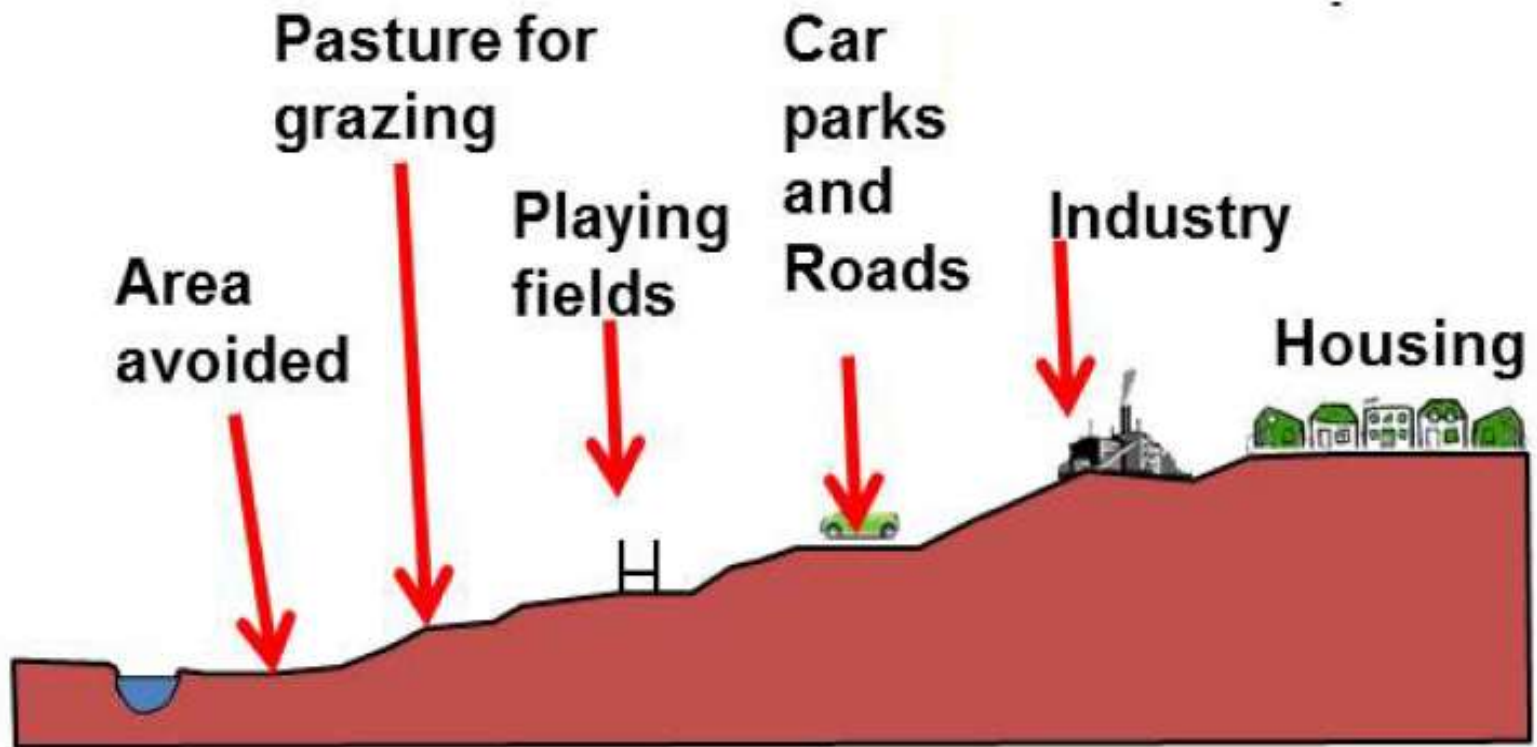


Drainage improvement



**Sea wall / Coastal
Protection work**

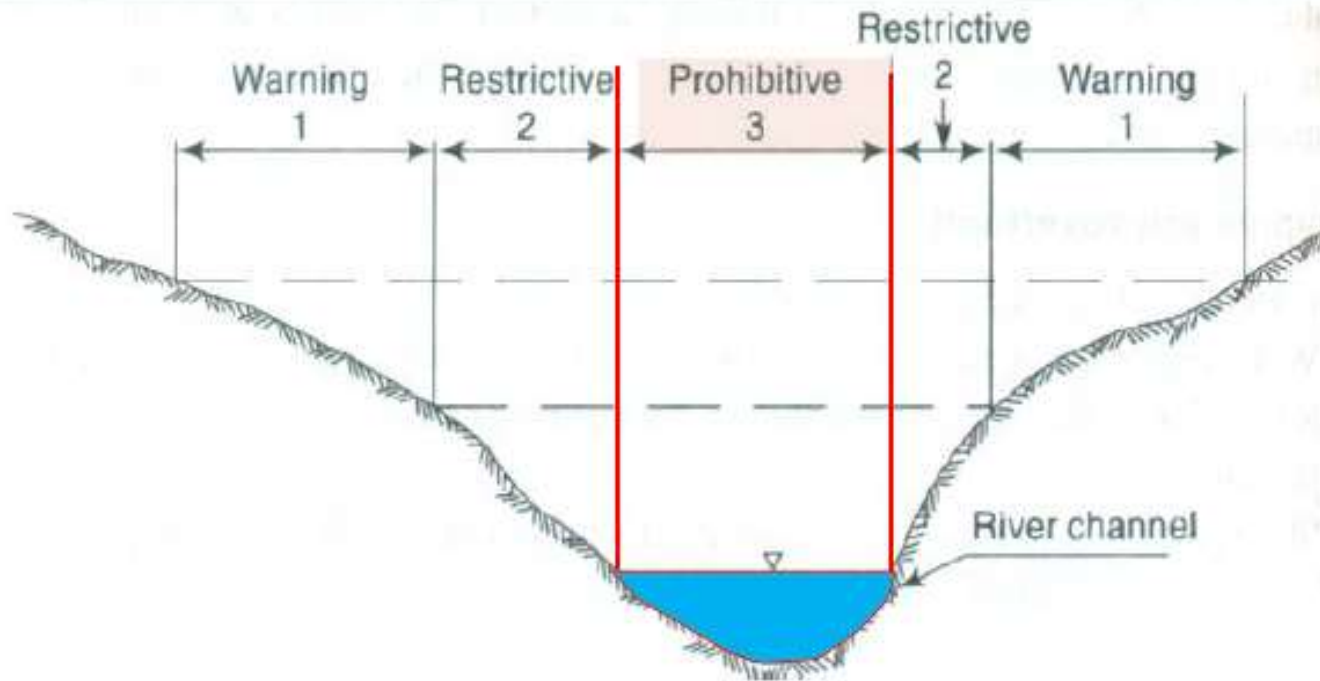
floodplain zoning



Land uses increase in value as distance from river increases

Floodplain zones

Zone	Flood Return Period	Example of Uses
1	100 Years	Residential houses, Offices, Factories, etc.
2	25 Years	Parks
3	Frequent	No construction/Encroachments



What is flood forecasting (FF)?

Flood forecasting is the **prediction of streamflow rates and water levels** for periods ranging from **a few hours to days ahead**, depending on the size of the river basin.

Utility:

- Flood disaster management
- Optimal reservoir operation



Floodplain (inundation) mapping



Water depth maps of FEMA 100 year flood event.

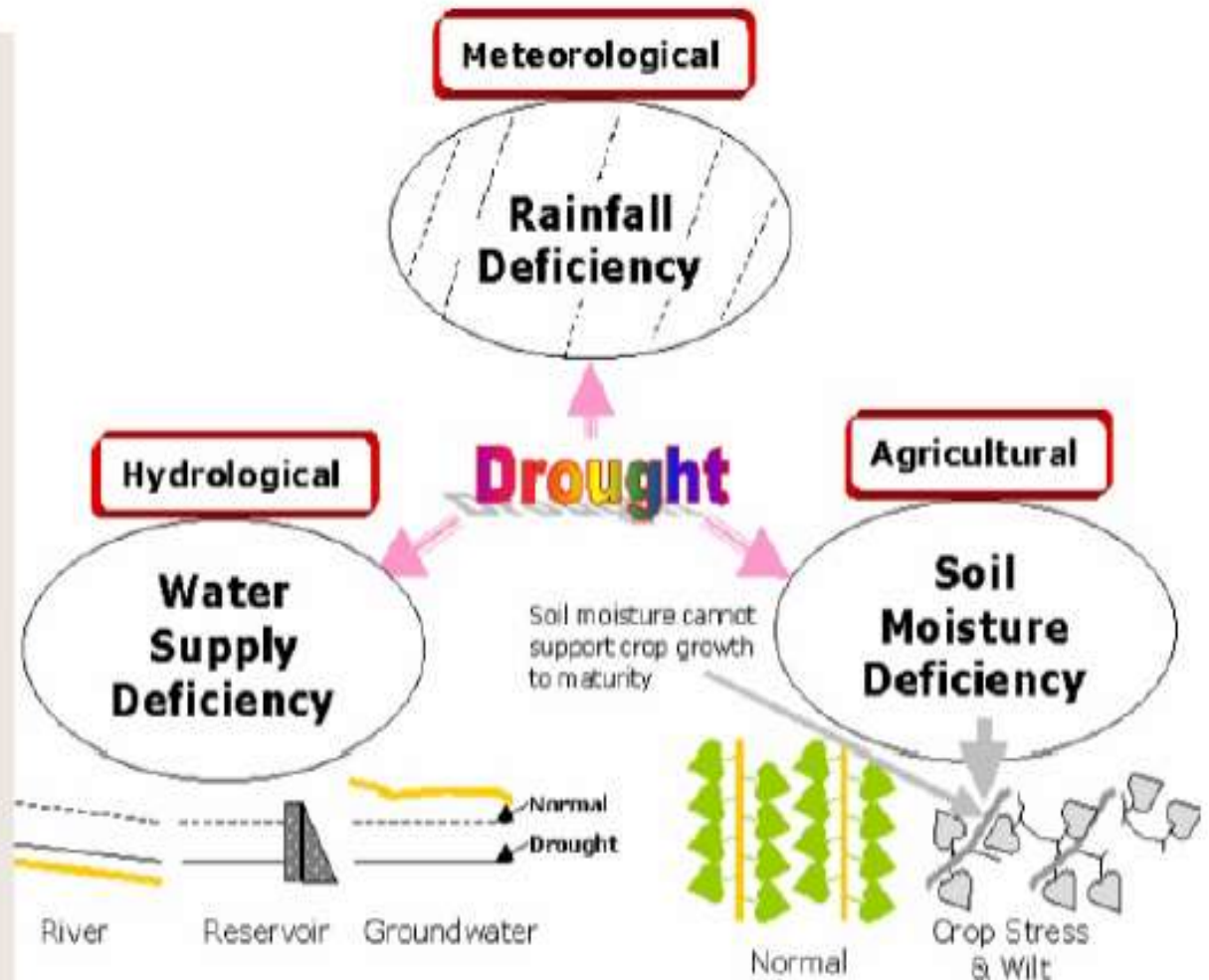
What is Drought?

- Droughts are considered **natural phenomena** and represent a relevant **temporary decrease of the average water availability**.
- Drought events have regularly occurred **producing severe socioeconomic and environmental impacts**, and have increased considerably over the past 30 years.
- Occurrence of droughts may not be controlled. However, the **resulting impacts can be mitigated**, by appropriate surveillance and management strategies (Drought Management plan).
- 16% of country's total area is drought prone and 68% of total sown area can be drought affected.
- 50 million people are expected to be annually affected.



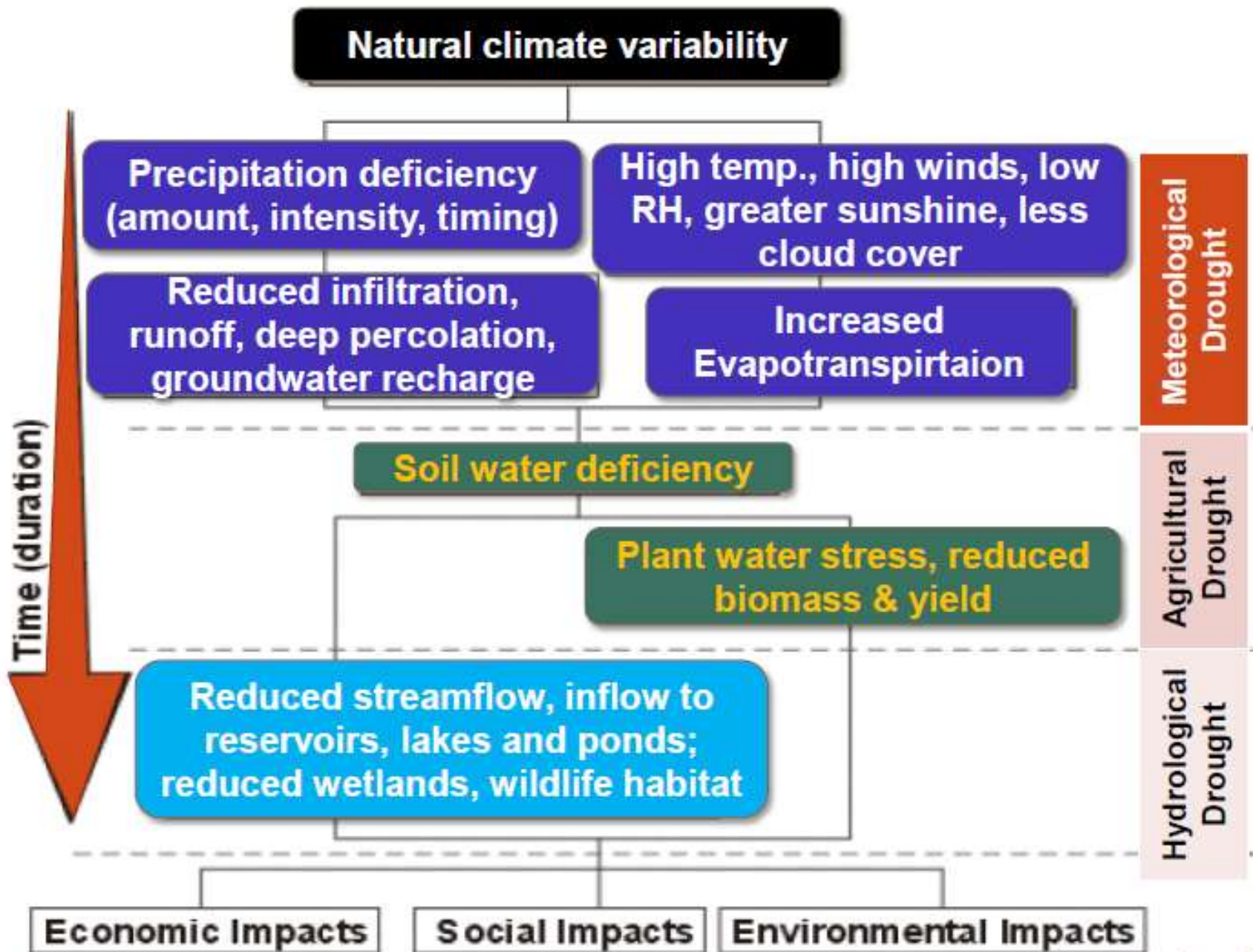
Classification of drought

1. Meteorological drought
2. Hydrological drought
3. Agricultural drought
4. Socio-economic drought



Drought - Types

- ❖ **Meteorological Drought:** Reduction in rainfall for a specified period (summer, winter, monsoon).
- ❖ **Hydrological Drought:** Depletion of water resources, stream flows, ground water, underground aquifers, etc.
- ❖ **Agricultural drought:** Impact of meteorological or hydrological drought on crop yields.
- ❖ **Famine drought:** Extreme form of agricultural drought, which destroys food security to maintain as active healthy life.
- ❖ **(Socio-Economic Drought)**



Causes of Drought

- ❖ Deficiency of Rain water.
- ❖ Dependency on rain-fed agriculture.
- ❖ Human Causes:
 - ✓ Over exploitation of ground water resource
 - ✓ Land use leading desertification
 - ✓ Deforestation
 - ✓ Over-cultivation
 - ✓ Overgrazing

Drought in India



Hydrological Drought

From a hydrologist's point of view, drought means below average values of **streamflow**, reduced **storages in tanks & reservoirs**, **groundwater** and **soil moisture**.

Four components of hydrological drought:

- i. Magnitude (= amount of deficiency)**
- ii. Duration**
- iii. Severity (= cumulative amount of deficiency)**
- iv. Frequency of occurrence**

Meteorological Drought

It is the situation where there is **more than 25%** decrease in precipitation from normal over an area.

In India, the meteorological drought is in general related to the **onset, breaks** and **withdrawal** times of **monsoon** in the region.

Types:

- 1. Normal drought:** Total seasonal **rainfall <75%** of normal value
- 2. Moderate drought:** 50% of normal value < Total seasonal rainfall <75% of normal value
- 3. Severe drought:** Total seasonal rainfall **<50%** of normal value

SOCIO-ECONOMIC Drought

It is the **situation** when the demand for an economic good exceeds the supply as a result of a weather-related shortfall in water supply (e.g., **reduced** hydroelectric power, migration, increased price of commodities etc.).

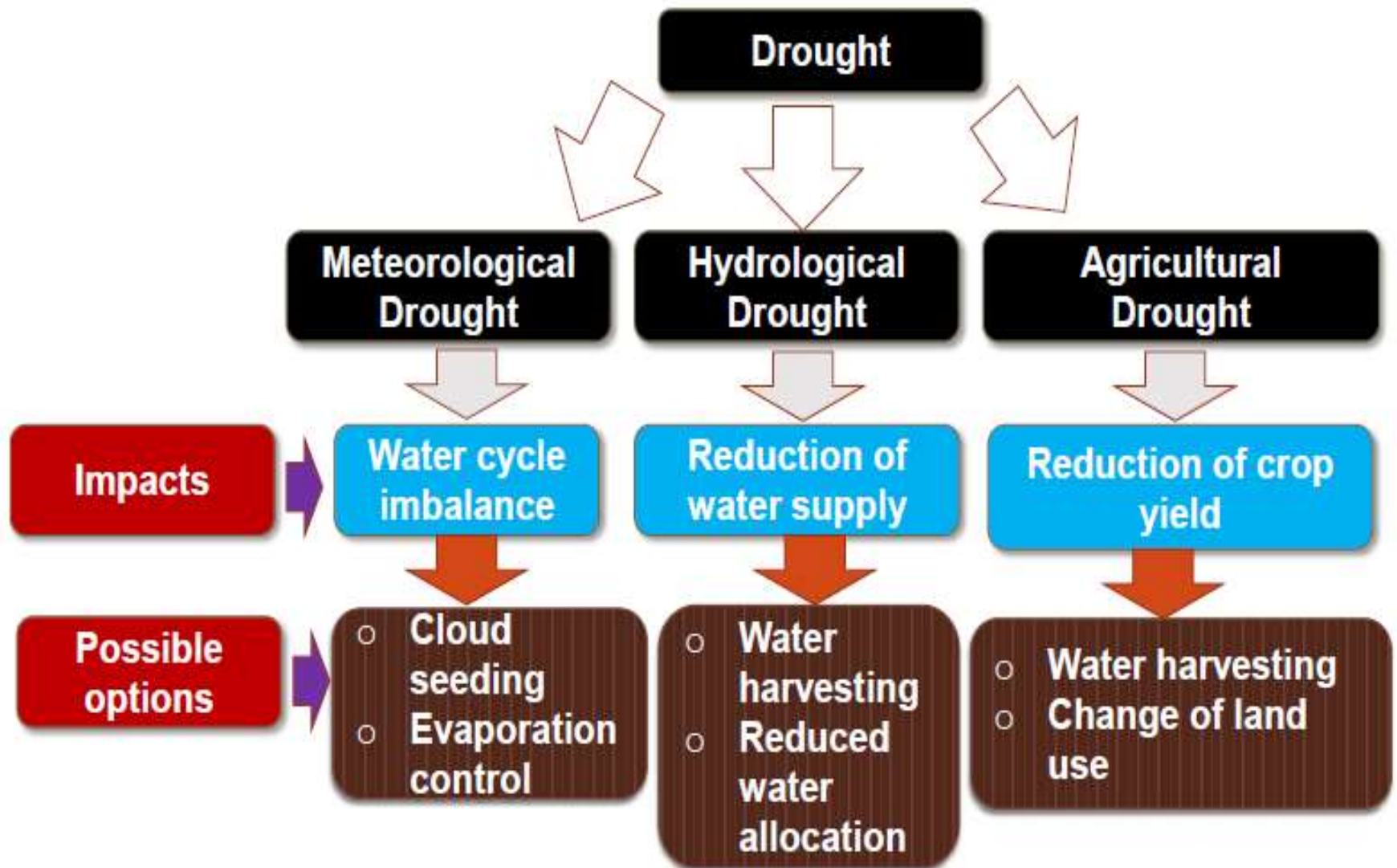


Agricultural Drought

It is the situation when soil moisture & rainfall are inadequate during the crop growing season to support healthy crop growth to maturity causing **extreme crop stress** and **wilt** conditions.



Drought Management Options



Drought Proofing Techniques

Creation of **water storages** through appropriate water resources development

Inter-basin transfer of surface waters from surplus areas to drought - prone areas

Development & management of **groundwater** potential

Development of appropriate **water-harvesting** practices

In-situ soil **moisture conservation** measures

Economic use of water through **drip, sprinkler irrigation**, etc.

Reduction of evaporation from soil & water surfaces: **mulching, ground cover**

Development of **afforestation**, agro-forestry and agro-horticulture practices



