

Flood control by Reservoirs:

- The purpose of flood control reservoir is to temporarily store the portion of flood so that the flood peaks are flattened out.
- The “reservoir Location” may be ideally suited immediately upstream side of the area to be protected and the water discharged into the channel downstream at its safe capacity.
- All the inflow into the reservoir in excess of the safe channel capacity is stored until the inflow drops below the channel capacity and the stored water is released to recover the storage capacity for the next flood
- If there is some distance between the reservoir and the protected area but no local inflow between these points, the reservoir operation is similar to the above but the peak will further be reduced due to storage in the reach downstream from the reservoir .

Types of flood control Reservoirs

- Detention Reservoirs
- Retarding Reservoirs

A Detention Reservoir is provided with sluice gate and sluice ways which can be operated by manual. The Detention Reservoir is similar to an ordinary conservation reservoir except that the former has a comparatively larger sluice way capacity. It permits rapid drawdown in advance of flood and just after it.

Retention Reservoir is provided with ungated spill way which automatically regulate the flood flow from the dam depending upon the water level in the reservoir. The arrangement usually consist of a large ungated spill way or one or more ungated sluice ways. This type of sluice selected for a particular reservoir depends upon the storage characteristics and nature of the flood problems.

DROUGHT:

Drought is a normal, recurrent feature of climate, although it is erroneously considered as a rare and random event. It differs from aridity, which is restricted to

low rainfall regions and is a permanent feature of climate. Drought should be considered relative to some long-term average conditions of the balance between precipitation and evapotranspiration (i.e., evaporation + transpiration) in a

particular area. It is also related to the timing (principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rains.

An operational definition of drought helps people to identify the beginning, end, and degree of severity of a drought. This definition is usually made by comparing the current situation to the historical average, often based on a 30-year period of record (according to World Meteorological Organization recommendations). The following categories of drought are usually considered:

- **Meteorological** Meteorological drought is usually defined on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period. Definitions of meteorological drought must be considered as specific to a region since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.
- **Agricultural** Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth.
- **Hydrological** Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale.
- **Hydrological with respect of the land use** Although climate is a primary contributor to hydrological drought, other factors such as changes in land use (e.g., deforestation), land degradation, and the construction of dams all affect the hydrological characteristics of the basin.

Drought is a natural hazard, it has a slow onset, and it evolves over months or even years. It may affect a large region and causes little structural damage. The impacts of drought can be reduced through preparedness and mitigation.

The components of a drought preparedness and mitigation plan are the following:

- Prediction
- Monitoring
- Impact assessment
- Response.

Prediction can benefit from climate studies which use coupled ocean/atmosphere models, survey of snow packs, anomalous circulation patterns in the ocean and atmosphere, soil moisture, assimilation of remotely sensed data into numerical prediction models, and knowledge of stored water available for domestic, stock, and irrigation uses.

Monitoring exists in countries which use ground-based information such as rainfall, weather, crop conditions and water availability. Satellite observations complement data collected by ground systems. Satellites are necessary for the provision of synoptic, wide-area coverage.

Impact assessment is carried out on the basis of land-use type, persistence of stressed conditions, demographics and existing infrastructure, intensity and areal extent, and its effect on agricultural yield, public health, water quantity and quality, and building subsidence.

Response includes improved drought monitoring, better water and crop management, augmentation of water supplies with groundwater, increased public awareness and education, intensified watershed and local planning, reduction in water demand, and water conservation.

Drought preparedness and mitigation can be accomplished with the following practices: (1) soil and water conservation, and (2) herd management.

1. Soil and Water Conservation

Conservation practices minimize the disruption of the soil's structure, composition and natural biodiversity, thereby reducing erosion and soil degradation, surface runoff, and water pollution. The following are established practices of soil and water conservation:

- Crop rotation
- Contoured rowcrops
- Terracing
- Tillage practices
- Erosion-control structures
- Water retention and detention structures
- Windbreaks and shelterbelts
- Litter management
- Reclamation of salt-affected soil.

Soil and water conservation can be approached through agronomic and engineering measures. Agronomic measures include contour farming, off-season tillage, deep tillage, mulching and providing vegetative barriers on the contour. These measures prevent soil erosion and increase soil moisture.

Engineering measures differ with location, slope of the land, soil type, and amount and intensity of rainfall. Measures commonly used are the following:

Contour bunds, trenches and stone walls

These features prevent soil erosion and obstruct the flow of runoff. The retained water increases soil moisture and recharges the groundwater.

Check dams and other gully-plugging structures

Check dams are temporary structures constructed with locally available materials. Types of check dams are the brush-wood dam, the loose-rock dam and the woven-wire dam.

Percolation ponds

These features store water for livestock and recharge the groundwater. They are constructed by excavating a depression to form a small reservoir, or by constructing an embankment in a natural ravine or gully to form an impoundment.

Water-supply projects can also be implemented for drought mitigation, with a view to strengthen drought preparedness. Activities such as water-use planning, rain-water harvesting, runoff collection using surface and underground structures, improved management of channels and wells, exploration of additional water resources through drilling and dam construction, are implemented as a part of a drought-mitigation plan.

To increase moisture availability, the following in-situ moisture-conservation practices can be adopted:

- For agricultural crops, measures include ridges and furrows, basins, and water spreading.
- For tree crops, measures include saucer basins (Fig. 3), semi-circular bunds, crescent-shaped bunds, catch pits and deep pitting.
- Rainwater harvesting collects rainfall or moisture for immediate or eventual use in irrigation or domestic supplies. Part of the rainwater collected from roofs can be stored in a cistern or tank for later use.
- Landscape contouring is used to direct runoff into areas planted with trees, shrubs, and turf.

2. Herd management

Herd management is an important strategy for drought mitigation. Factors to be considered include the expected drought duration, the current water and feed supplies, the composition and body condition of the herd, and the financial resources available.

Herd management practices include the following:

Reduction in herd numbers

When feed resources are getting short, one solution is to critically evaluate the members of the herd and eliminate those that are less useful. Sale or agistment (relocating herd to non-affected pastures) are the two options available to reduce stock numbers.

Strategic weaning of calves

During a drought, the production of milk rapidly depletes a cow's body reserves, while the calf derives little benefit. Weaning the calf gives the cow a better chance of survival. However, the decision to wean must be made in relation to the time of year and age of the calf. In normal years, the nutritive value of pasture falls towards the end of autumn, at which time, beef cows may be producing as little as 1 liter of milk per day. If the calf is 5 to 6 months of age, weaning by the end of autumn will maintain or improve the cow's condition.

In drought years, early weaning is recommended. However, calves should not be weaned before 3 months of age unless absolutely necessary. Young calves need to be fed some true protein meal or preferably milk powder. Most calves over three months of age will survive on grain and Lucerne hay or molasses and protein meal diets.

Herd segregation

Segregating animals into classes gives the herd a better chance of getting needed feed supplies. Segregation makes possible the preferential treatment of vulnerable classes. The older dry cows can be moved to the poorer forage fields. Pregnancy testing is a useful tool to identify heavily pregnant cows for special feeding, especially young cows that are pregnant for a second time.

Parasite control

Cattle under nutritional and other stresses are less resistant to parasites than in normal conditions. Worms can be a serious problem with young cattle. During drought conditions, all cattle under 18 months of age should be treated for worms.

Optimizing use of drought-affected paddock

Cattle do not graze well areas located far away from watering points. Use of a drought-affected paddock can be encouraged by providing local water facilities, with supplementary hand feeding as an attractant.

Attention to contaminated water supplies

Polluted surface waters represent a death trap for drought-weakened cattle. Fencing may be necessary to separate cattle from undesirable water holes.

Salinity may increase with the depletion of the water table, with the water becoming too salty for the herd. The upper limit of total soluble salts should not exceed 8500 ppm. In addition, the sum of chlorides and sulphates of calcium and magnesium should not exceed 1400 ppm.

Potential problems arising from drought conditions are:

- Use of salt to limit feed intake may increase water intake 50 to 75%, or approximately 50 gallons of additional water for each pound of salt. Water must not be limited in any way or salt toxicity may result.
- Over consumption of urea-containing supplements by cattle grazing on forage-scarce ranges can result in urea toxicity. Generally, performance of cattle on urea-type supplements is poor wherever forage is in short supply.
- Hay cut under moisture-stress conditions, especially sorghum-type hays, may contain high levels of nitrate. Tests for nitrate should be performed before feeding these hays, especially before feeding large amounts. Farmers who cut drought corn or sorghum for hay should check nitrate levels before feeding.
- Prussic acid or cyanide poisoning can be a problem in grazing drought-stunted plants such as Johnson grass, sorghum, sorghum hybrids, and sudan grass. Prussic acid is generally not a problem when forage for hay is allowed to sun cure for 3 to 5 days, in order to bleach out any bright green color.
- Cattle that graze short or drought-stunted pasture are more likely to consume toxic plants.

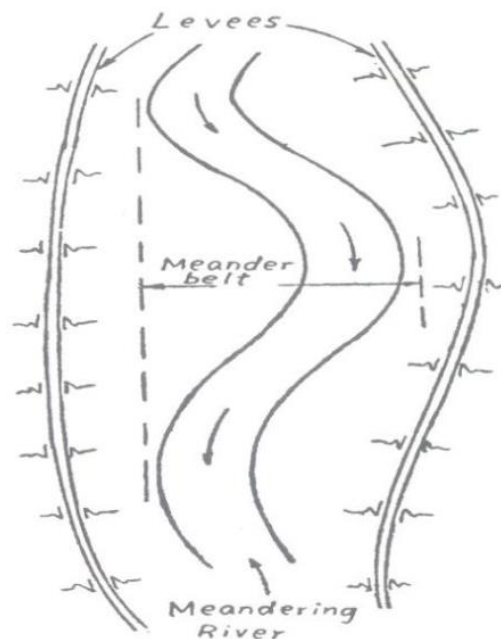
LEVEES:

It is one of the oldest and most widely used methods of protecting land from flood water is to erect a barrier preventing overflow. Levees are most frequently used for flood mitigation because they can be built at relatively low cost of materials available at the site. Levees are usually built of materials excavated from

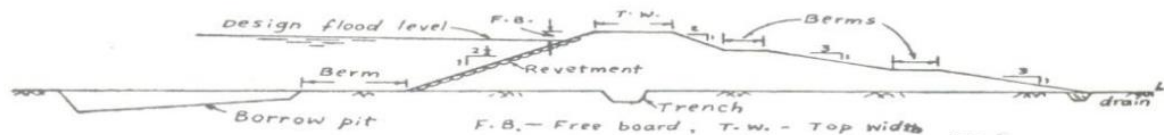
borrow pits paralleling the levee line. The material should be placed in layers and compacted with the least pervious materials along the river side of the levee.

The effects of levees on flood flow are

1. increase in the rate of flood flow
2. increase in the flood water elevation
3. increase in the carrying capacity of the channel
4. increase in the scouting action
5. decrease of surface slope of stream above the leveed section



(a) Levees along a meandering river



(b) Typical levee cross section

Fig. 8.8 Flood Control by Levees

FLOOD WALLS:

Due to flat side slope of levees, a levee of any considerable height requires a very large base width so that the land for earth dykes are not possible. In this case concrete flood walls are preferable. Flood walls are designed to withstand the

hydrostatic pressure exerted by the water when at the design flood level. If the wall is backed by an earth fill, it must also serve as a retaining wall against the earth pressure when stages are low.

CHANNEL IMPROVEMENT:

The reduction in stage at a specific point on a stream can often be achieved by merely improving the hydraulic capacity of the channel.

Removal of brush and snags, dredging of bars, straightening of bends and other devices can be effective, though care should not be taken to make the channel susceptible to bank erosion. The channels may be completely lined and straightened.

This may be achieved by,

- Decreasing the Manning's n for the reach
- Increasing the hydraulic radius by increasing the depth
- Increasing the channel slope by shortening the channel length.

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