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FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

Rainfed Agriculture and Watershed Management

Lecture -9

Water harvesting and lifesaving irrigation

Introduction

Rainwater is the key input in dryland agriculture. In a tropical country such as India which experiences extreme variation in rainfall both in space and time, rain water management assumes vital importance in cutting down risks and stabilizing crop production in dry areas. When rains are received with an intensity far reaching infiltration rate, runoff is inevitable. It varies from 10 to 40% of total rainfall. Of this at least 30% can be harvestedinto water storage structures.

Water Harvesting:

- The process of runoff collection during periods of peak rainfall in storage tanks, ponds etc., is known **as water harvesting**. It is a process of collection of runoff water from treated or untreated land surfaces/ catchments or roof tops and storing it in an open farm pond or closed water tanks/reservoirs or in the soil itself (in situ moisture storage) for irrigation or drinking purposes.
- Runoff farming and rainwater harvesting agriculture are synonymous terms, which imply that farming is done in dry areas by means of runoff from a catchment. Runoff farming is basically a water harvesting system specially designed to provide supplemental or lifesaving irrigation to crops, especially during periods of soil moisture stress.
- Collecting and storing water for subsequent use is known as **water harvesting**. It is a method to induce, collect, store and conserve local surface runoff for agriculture in arid and semiarid regions.
- All water harvesting systems have **three components** viz., the catchment area, the storage facility and the command area. The catchment area is the part of the land that contributes the rain water. The storage facility is a place where the runoff water is stored from the time it is collected until it is used. The command area is where water is used.
- Water harvesting is done both in arid and semi-arid regions with certain differences. In arid regions, the collecting area or catchment area is substantially in higher proportion compared to command area. Actually, the runoff is induced in catchment area in arid lands whereas in semi-arid regions, runoff is not induced in catchment area, only the excess rainfall is collected and stored. However, several methods of water harvesting are used both in arid and semiarid regions.

Methods of Water Harvesting

The different methods of water harvesting that are followed in arid and semiarid regions are discussed separately.

Arid Regions

The catchment area should provide enough water to mature the crop, and the type of farming practiced must make the best use of water. In general, perennial crops are suitable as they have deep root systems that can use runoff water stored deep in the soil which is not lost through evaporation.

Water Spreading: In arid areas, the limited rainfall is received as short intense storms. Water

swiftly drains into gullies and then flows towards the sea. Water is lost to the region and floods caused by this sudden runoff can be devastating often to areas otherwise untouched by the storm. Water spreading is a simple irrigation method for use in such a situation. Flood waters are deliberately diverted from their natural courses and spread over adjacent plains. The 28 water is diverted or retarded by ditches, dikes, small dams or brush fences. The wet flood plains or valley floods are used to grow crops.

Micro catchments: A plant can grow in a region with too little rainfall for its survival if a rain water catchment basin is built around it. At the lowest point within each microcatchment, a basin is dug about 40 cm deep and a tree is planted in it. The basin stores the runoff from microcatchment.

Traditional water harvesting systems: Tanka, nadi, khadin are the important traditional water harvesting systems of Rajasthan.

Tanka is an **underground tank** or cistern constructed for collection and storage ofrunoff water from natural catchment or artificially prepared catchment or from a roof top. The vertical walls are lined with stone masonry or cement concrete and the base with 10 cm thick concrete. The capacity of the tank ranges from 1000 to 6,00,000 lt.

Nadi or village pond is constructed for storing water from natural catchments. The capacity of nadis ranges from 1200 m^3 to 15000 m^3

Khadin is unique land use system where in run off water from rocky catchments are collected in valley plains during rainy season. Crops are grown in the winter season after water is receded in shallow pond on the residual moisture.

Semiarid Regions

- Water harvesting techniques followed in semi-arid areas are numerous and also ancient.

Dug Wells: Hand dug wells have been used to collect and store underground water and this water is lifted for irrigation. The quality of water is generally poor due to dissolvedsalts.

Tanks: Runoff water from hill sides and forests is collected on the plains in tanks. Thetraditional tank system has following components viz., catchment area, storage tank, tank bund, sluice, spill way and command area. The runoff water from catchment area is collected and stored in storage tank on the plains with the help of a bund. To avoid the breaching of tank bund, **spillways** are provided at one or both the ends of the tank bund to **dispose of excess water**. The **sluice** is provided in the central area of the tank bund to allow **controlled flow** of water into the command area.

Percolation Tanks: Flowing rivulets or big gullies are obstructed and water is ponded. Water from the ponds percolates into the soil and raises the water table of the region. The improved water level in the wells lower down the percolation tanks are used for supplemental 29irrigation

Farm Ponds: These are small storage structures for collection and storage of runoff water. Depending upon their construction and suitability to different topographic conditions farm ponds are classified as

- Excavated farm ponds suitable for flat topography
- Embankment ponds for hilly terrains and
- Excavated cum Embankment ponds

There are three types of excavated farm ponds – square, rectangular and circular. Circular ponds have high water storage capacity. Farm ponds of size 100 to 300 m^3 may be dug to store 30 per cent of runoff. The problem associated with farm ponds in red soils is high seepage loss. This can be reduced by lining walls. Some of the traditional methods for seepage control are the use of bentonite, soil dispersants and soil-cement mixture.

- Bentonite has excellent sealing properties if kept continuously wet, but cracks develop when dried. Soil-cement mixture can be used. A soil-cement lining of 100 mm thickness reduces seepage losses up to 100 per cent. The pit lined continuously develops cracks but no cracks develop when applied in blocks. The other alternative sealant for alfisols is a mixture of red soil and black soil in the ratio of 1: 2.
- In arid and semi-arid regions, rains are sometimes received in heavy down pours resulting in runoff. The runoff event ranges from 4 to 8 during the rain season in arid and semi-arid region. The percentage of runoff ranges from 10 to 30% of total rainfall. The size of the farm pond depends on the rainfall, slope of the soil and catchment area.

Fig. 15.2 Farm Pond Lined with Kadapa Slabs

- The dimensions may be in the range of 10 m x 10 m x 2.5 m to 15 m x 15 m x 3.5 m. The side slope 1.5: 1 is considered sufficient. A silt trap is constructed with a width of slightly higher than the water course and depth of 0.5 to 1 m and with side slope of 1.5: 1.
- The different types of **lining materials** are soil-cement, red and black soils, cement-concrete, bricks, Kadapa slabs, stone pitching, polythene sheet etc., In alluvial sandy loam

to loamy sand soils of Gujarat and red sandy loams soils of Bangalore, a soil + cement (8 : 1) mixture is" the best lining material. At Anantapur (A.P.), soil without sieving and cement in 6:1 ratio is very effective and cheap lining material for red sandy loam soils. In laterite silty clay loam soils of Ooty, medium black soils of Kota, **bitumen was effective**. Water can be stored for two months in deep heavy soils with out lining at Nandyal (AP).

Fig .15.3 Farm Pond lined with Cement Bricks

Fig. 15.4 Farm Pond Lined with Fire Bricks

- Clay soils linings are generally the most economical. **Evaporation losses** can be reduced in farm ponds especially in arid regions by **rubber or plastic floats**. White plastic sheet is economical and easily available. Farm pond technology is economically viable.

Fig: 15.5 Farm Pond lined with soil + cement (6:1 ratio)