

# METHODS OF COLLECTING AND STORING RAINWATER

## METHODES DE COLLECTE ET DE STOCKAGE DES EAUX DE PLUIE

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### ABSTRACT

*Population growth along with unscientific water resources use causes reduction of available fresh water volume. Rainwater is the primary and most important renewable fresh water resource. So, collection and preservation of rainwater, even at low amounts, can prove beneficial for the arable lands in arid and semi-arid regions. Rainwater collection has a very old historical background. The most important purpose of using collection and preservation of rainwater is supplying the required water for agriculture in dry regions.*

*Although the amount of rainwater in arid and semi-arid regions is low, but even a 10 mm of rainfall produces 100000 liters of water per hectare. Collection and use of this water can support agriculture over a part of this 1 ha area, which has not been developed so far and can produce food grain if water is available. In addition to rainwater collection, new practices such as banquette, hay banquette, and non intrusion slots can be used to preserve water in the low rainfall season. This paper reviews the methods used to collect rainfall water.*

**Key words:** *Rain water harvesting, arid and semi-arid regions, groundwater recharge, terraces and banquettes.*

### RESUME

*La croissance démographique ainsi que l'usage non scientifique cause la réduction de volume disponible d'eau douce. L'eau de pluie est la ressource principale et importante des ressources renouvelables d'eau douce. Ainsi, la collecte et la conservation des eaux de pluie, même aux quantités basses, peuvent prouver avantageux aux terres arables dans des régions arides et semi-arides. La collecte des eaux de pluie a un très vieux contexte*

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*historique. La collecte et la conservation des eaux de pluie visent à fournir l'eau exigée à l'agriculture des régions sèches.*

*Bien que la quantité d'eau de pluie dans des régions arides et semi-arides soit basse, même 10 mm de précipitation produise 100000 litres d'eau par hectare. La collecte et l'utilisation de cette quantité d'eau peuvent soutenir l'agriculture sur une superficie de 1 ha de terre de cette région qui n'a pas été développée jusqu'ici et peut produire le grain alimentaire si l'eau est disponible. En plus de la collecte des eaux de pluie, les nouvelles pratiques telles que « banquette, hay banquette, and non intrusion slots » peuvent être utilisées pour conserver l'eau dans la saison de basse précipitation. Ce rapport passe en revue les méthodes utilisées pour collecter les eaux de pluie.*

**Mots clés :** *Collecte des eaux de pluie, régions arides et semi-arides, recharge des eaux souterraine, terrasses et banquettes.*

## 1. INTRODUCTION

Population growth along with unscientific water use has caused stress on the availability of fresh water giving rise to local, regional and international conflicts in harnessing water resources. Researchers are trying to address this issue and are suggesting measures such as rationing of water, re-using waste water after treatment, optimum use of water resources and adopting rain water conservation methods. Rain water harvesting is performed for different aims. Its main objective is optimization and management of water use based on availability and consumption. Since rainfall does not occur on demand, it implies that the undesirable runoff loss in wet season is to be stored for its use in the dry season.

Rain water conservation helps in other ways also such as reducing soil erosion, controlling river flows, minimizing flood hazards at the downstream, etc. The other objectives of water harvesting are its use in artificial recharge of ground water aquifers, springs and Ghanat. For this purpose, several small dams can be constructed across a stream to increase infiltration (Krishna et al., 1996).

In arid and semi-arid regions, land area is not the constraint. The conserved or stored rainwater does not have to be conveyed over long distances to reach the agricultural lands. These two facts motivate the farmers for adopting rain water harvesting in such areas (Orisakwe and Frazzoli, 2010).

## 2. METHODS OF RAIN WATER HARVESTING

Rain water harvesting is the collection of surface runoff caused by rainfall in banquette, terraces and water storage ponds for different uses (UNCHS, 2004). For rain water harvesting, the following points should be considered: seasonal rainfall distribution, soil hydraulic conditions and plant biological characteristics. It is also to be noted that the harvested rain water can at the most permit a few supplemental irrigation to the crop. Hence, crop characteristics as to which may be the best time to apply supplemental irrigation must also be known.

## Execution methods of rain water harvesting

Harvesting and storage methods of rain water for creation and enhancement of vegetation are: Terraces, Banquette, Furrowing, Turk nest and Ponds. Each method may have several types, which are executed in different situations.

**Terraces:** A terrace is a sloping land with step-wise plots in which plants are cultivated. Each terrace is a nearly flat land but may be with varying dimensions. In areas with low average rainfall, by converting a sloping land into terraces, almost all rain temporarily accumulated on the terrace surface is infiltrated. Depending on the quantity, the infiltrated water may be stored in the soil pores, or flow towards the downstream terraces and may also join the groundwater reservoir. Parts of all these waters are usable later by the plants. To make the Terrace, vertical or sloping walls are built between two consecutive terraces, these walls are built of stone or even by using soil if it is not too light in texture and does not cave in or collapse. The inside of each berm is made soft and level with soil for plant cultivation. This causes rain water to spread on the level part of berms, because the height of wall downstream and upstream of the berm is 20 to 40 cm higher than berms bottom and at least 10-11 cm rain water is collected in it (CGWB, 2000).

The main purpose of terrace construction is reducing runoff loss and prevention of soil erosion, and simultaneously facilitate water storage. Terracing helps soil conservation and erosion control by two means namely, it reduces the general slope of the land and reduces water flow velocity (Tahmasbi, 2005).

Although the cost of terrace construction is high and needs a lot of work, they are constructed because they permit using agriculture machines whereas, the other options such as contour furrowing or banquette do not support as much mechanization as the terraces do. Since, mechanized cultivation generally gives higher crop yield, the cost of terrace construction can be recovered.

### Types of Terraces

Terraces are divided into following types, based on the objectives of construction:

- 1) Bench terrace: In these terraces, the stone walls are constructed on contour lines and water of each terrace enters the next terrace through spillways or pipes. Bench terrace is suitable for land slopes of 6 to 8 %.
- 2) Irrigation terrace: In these terraces, irrigated farming is performed. It is constructed in a way that irrigation flow does not cause soil erosion. These terraces are recommended for land slopes of 2 to 6 %. In these terraces, due to low width of terrace, possibility of adopting mechanized farming is slim and so the farmers are not keen in adopting irrigation terraces.
- 3) Runoff retention terrace: These are like obstacles, constructed along the contours. They are called flood control terrace. In the past, their width was small, but recently they have larger width to allow mechanized farming.
- 4) Slope or channel terrace: the objective of this terrace is translocation of high amount of water through a route with minimum soil erosion. These terraces minimize the damages from erosion by decreasing longitudinal slope and guiding the runoff flow.

- 5) **Level terrace or levees:** These terraces have two objectives: Soil moisture retention and soil erosion control. These terraces are constructed so that they decrease the runoff velocity and store a major part of it in the soil. In high rainfall areas, it may not be able to control runoff resulting in soil erosion and gully formation.

**Banquette:** Banquette are in the forms of streams or wide soil canals which are constructed on contour lines of sloppy areas to control runoff, infiltration and water storage for planting trees or annual crops and also water erosion control .their characteristics is that they exist in 23% slope also, and exist on lands with 60% slope if the soil depth is 50 cm (RCUES, 2006).

The distance between two consecutive banquettes may be 5-25 m based on natural land slope, rainfall, vegetation and objective. By considering rainfall amount and type of cultivated crop in banquette and its water requirement, sometimes, the distance between banquette are cleaned of gravel and vegetation, so that more runoff enters into banquette. In addition, even with good rainfall, the banquettes are built in the sloping lands for controlling runoff.

### Types of banquettes

Different banquettes are used for different texture and slope:

- 1) **Gradient:** gradients are small banquettes used mostly for forestry and are constructed in either of the two forms: A) gradient with V shape profile and B) gradient with natural profile. The former are economical, do not need much land leveling and may be used in lands with high slope. The latter have more stability with respect to natural gradient. These are in the form of small canals which retain more water in it.
- 2) **Banquette with natural profile:** These banquettes have large dimensions and can be constructed in lands with slopes of 20 to 50 per cent. Their functions are water harvesting, infiltration and cultivation.
- 3) **banquette used for cereal cultivation:** for cereal cultivation, usually 3 types of banquette are used: A) banquette with simple curve at slope of 12-20% and only the lower part of levee is lost, but it is not over 4 to 5% of total land; B) Banquette with two curves at slope of 6-12% the lower part of levee can be used and C) Banquette with 3 curves at slopes less than 6% and the constructed levees prevent flowing out of runoff.

**Pitting:** Pitting is creating a series of small pits on land surface to collect runoff from rainfall. The objective of this method is to store water around the plant root zone to be used by the plants in drought period. This method is used in rangeland of arid and semi-arid regions with medium to somewhat light textured soil. In heavy soil, infiltration decrease, water evaporates and water goes out of reach of plant (Sharma, 2006). The pits are 15-20 cm deep, 15-20 cm wide and about 1 m length (straight or curved) laid on contour and the pit rows are 0.8 to 1 m apart.

**Furrowing:** Furrowing is an agricultural system that is used in low rainfall area for maximum water conservation in the soil and control soil erosion (Boers and Ben-Asher, 1982). This system needs little soil displacement as compared to terracing, are less expensive and are

efficient due to which the farmers in low rainfall regions prefer them. In this method, plants are cultivated between two consecutive furrows or on the furrows and the distance between two furrows is used for water harvesting. The design of this system is like bench terracing which has the objective of water harvesting and improvement of soil moisture status.

**Turk nest:** Turk nest is a reservoir, which is used in low slope areas for storage and harvesting flood water. The stored water is for irrigation, animal water use, accumulation of sediment and reduction of runoff velocity (Cluff, 1979). To determine the dimensions of Turk nest one should consider rainfall features such as its intensity and return period, soil type, water transmission property of the soil and depth to groundwater table. While constructing Turk nest, one should keep in mind that:

- 1) Chanel and floodway should not be over 7%.
- 2) Type of soil is sandy clay and should not be very hard.
- 3) The most suitable places for Turk nest is between gully and watershed.
- 4) As far as possible, the Turk nest should be close to farms.
- 5) For better efficiency and operation, Turk nest should be constructed in the upstream of mother wall of Ghanat and deep wells.

### 3. CONCLUSIONS

Due to increasing importance of rainwater, several types of executions are made for harvesting and storage rainwater. The few methods described above are for agricultural and animal husbandry purposes in Iran. These two sectors are most important for supplying food. For development and improvement of rainwater harvesting more research are underway to use the fresh water more efficiently.

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