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Rain Water Harvesting

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Abstract : *The technology of rain water harvesting is as old as the civilization of the mankind and is a useful techonology for enhancing productor from the rainfed lands. In this paper, steps for rain water management, water harvesting Rchnignes, and probling & lemitations in N.W. Himalayan region have been foceused.*

Introduction

India's total gegraphic area of 328 million ha. comprises of approximately 74 per cent under rainfed farming. The contribution to the national food basket from this huge area is only 42 per cent. The main reason for low level of production from these area is the traditional conventional agricultural practices adopted by the farmers. Irrigation is one of the vital means to overcome climatic extremes for increasing agricultural production. Efforts are, therefore, being made to bring maximum cultivated area under irrigation by the turn of the century. Even after harnessing all the water resources available in the country, the irrigated area can not be increased beyond half the total cultivated area. Hence, the remaining fifty per cent land will still depend on the vagaries of the weather. There is a vast variation in the rainfall of the country, one area having drought and excessive rains causing floods elsewhere. It is, therefore essential to intercept the scanty rainfall through *insitu* moisture conservation, harvesting excess runoff and recycling it for increased production.

About 50 per cent of the geographical area of the country receives rainfall ranging from 40 - 120 cm annually. In India, under the rainfed conditions approximately 78 per cent cotton, 82 per cent of oil seeds, 96 per cent of sorghum, 98 per cent of millets, 62 per cent of rice and 38 per cent of wheat, is grown (Venkateswarlu, 1983).

The technology of rain water harvesting is as old as the civilization of the mankind. However, the use of the term water harvesting is of rather recent origin. The practice of rain water harvesting starts right from the moment the rain drops reach the ground and are conserved *insitu*. The surplus rain water is collected in the form of runoff in tanks, drought ponds as well as behind the earthen and masonry dams. Runoff from slopes can be harvested from slopes into small basins or micro catchments. This technique can be adopted in areas receiving rainfall as low as 500 to 800 mm on an average.

In our country, where the problems of drought, water logging, soil salinity, soil erosion and deforestation are widespread, the rain water conservation could make considerable contribution to the problem of water scarcity as well as reduce soil erosion and flooding.

It is very essential to collect and conserve the rain water at the earliest opportunity in the hydrologic cycle in order to ensure the best use of rainfall, before the water runs into rivers or percolates into the ground water or else disappears as evaporation. It is essential to

ensure that there is a proper relationship between catchment and size of storage based on average expected volume of runoff (Singh et al. 1990).

Steps for Rain Water Management

For developing a viable water harvesting project, the data on rainfall - catchment area - runoff - capacity of farm pond, play an important role. The various steps to be considered comprise of :

(1) Collection of part of the portion of rainfall in the cropped land till such time and extent that it may not be harmful to the crops.

(2) Diverting of excess water on satisfaction of the first step into farm pond. The stored water is utilized for providing supplemental irrigation in the lands situated in the vicinity during late onset, long breaks (dry spells) and early withdrawal of the monsoon rains.

(3) The remaining excess water is surplussed into the natural drainage system.

Problems and Limitations in North-Western Himalayan Region

The rainfall in this region exhibits vide variations in time and space. The undependable and erratic rainfall introduces element of risk, uncertainity and instability in crop production. There are several features that distinguish the rainfed agriculture in the tropics.

(1) The rainy season is short (2-4 months) and is followed by dry season. The monsoon rains are inadequate to meet demands erratic and uncertain, the lower the mean annual rainfall, the greater is the variation and less dependability.

(2) In the semi arid tropics, the rains are of high intensity and the soils lack in organic matter like black soils of India, resulting in excess runoff.

(3) In the tropics, the rainfall effectiveness is reduced by the prevailing high temperature resulting in enhanced evaporation alongwith shallow and light soils caused by erosion.

Uneven and erratic rainfall normally occurs with high intensity for a short duration resulting in high runoff events and poor soil moisture storage. Several storage sites are available in these tracts and it is not only possible to conserve the runoff water and provide supplemental irrigation in the drought prone areas but also to conserve the soil. Storage of harvested water is the most important part of rain water harvesting system. The dugout ponds or embankment type storage structure or combination of both may constitute a storage structure. Earth work to storage ratio should be kept as minimum as possible. Construction of the pond at the lowest end of the waterway can reduce the ratio of earthwork to storage. It should be preferred to choose a site where irrigation water may be conveyed through gravity, in order to avoid installation and costs of pumping

Storage capacity of tank is decided on the basis of available volume of runoff, economic height of embankment, expected storage losses and area to be irrigated. The progressive loss of storage volume due to sedimentation must be taken into account while designing a water storage structure (Sastry et al. 1981).

Water harvesting techniques

Rainfall data analysis : The rainfall data for the research farm of Central Soil and Water Conservation Research and Training Institute, Dehra Dun was analysed for understanding the rainfall distribution, the magnitude of storm rainfall and length of dry spells of different return periods.

The probability of occurrence of different amounts of rainfall in any 5 day period and different amounts of cumulative rainfall on different dates during June - September period has been carried out. It has been inferred that

rainfall of 50 mm is assured throughout July and August in any 5-day period.

About 50 per cent and 75 per cent of mean monsoon rainfall (1400 mm) is received, by the first 5-day period of August and September respectively at 80 percent probability. The threshold rainfall for initiating the process of runoff in the region is about 20 mm.

The water yield data and overflow indicate that about 15 to 20 per cent of rainfall occur as runoff from agricultural watersheds treated with graded bunds. It has been estimated that the farm pond gets filled to F.S.L. earliest by 2nd week of July and the latest by 1st week of August and about 45 per cent of season's rainfall is needed to bring the farm pond to the first F.S.L.

Water thus collected can be utilized for providing supplemental irrigation to winter crops which suffer due to acute moisture stress.

Water Available for Supplemental Irrigation

The water available in the storage structure decreases exponentially and shows that only 50 per cent of storage capacity is available after 50 days of cessation of monsoon (1st week of September) for applying supplemental irrigation during the first week of November at presowing stage of wheat crop. At this stage about 13 ha (80 per cent of watershed area) can be applied with 5 cm of water only. 30 per cent of storage capacity is available after 80 days in order to apply 5 cm of water to 8 ha (50 per cent of watershed area) which coincides with the crown root initiation stage. Irrigation to both the stages (5 cm each, totalling 10 cm) could be affected to 4 ha (25 per cent of watershed area. (Sastry et al, 1981).

Soil Moisture Status in Winter

Data on winter rains were analysed (Gupta et al. 1975) and it was found that at 80 per cent probability about 200 mm of rain with low intensity is assured. On account of low intensity major portion of winter rain gets infiltrated into soil and meet the evapotranspiration demands of winter crops.

Effect on Crop Production

There is a tremendous improvement in the yield of wheat crop as a result of supplemental irrigation. If only one presowing irrigation is applied 80 per cent of the catchment can be covered and an increase in yield to the tune of 82 per cent can be achieved. If the irrigation is deferred till crown root initiation stage the water may be sufficient to cover only 50 per cent area of the watershed and the increase in grain yield may be limited to 43 per cent. In case irrigation is applied at both of the stages the area of watershed covered further gets reduced to 25 per cent but the yield increases tremendously by 116 per cent i.e. more than double of what is obtained under rainfed conditions.

Irrigation when applied at presowing stage results in the highest yield of 3.10 tonnes/ha of watershed area when 5 cm irrigation is applied at presowing stage. Application of 10 cm water at presowing and crown root initiation stages yield of only 2.45 tonnes/ha of watershed area can be obtained which is the least economical proposition among the various alternatives.

Conclusions

Rain water harvesting is a viable technology for enhancing production from the rainfed lands. After *insitu* harvesting of directly received rainfall the excess runoff is collected in farm pond/ tanks/reservoirs. The stored water must be utilized at the earliest opportunity in order to minimise seepage and evaporation losses. If just two supplemental irrigations are applied at most critical stages of crops, the increase in yield to the tune of 100 to 200 per cent over the rainfed crops may be obtained.

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