Insitu soil moisture conservation - a review

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Abstract
To increase the moisture availability to the agricultural crops, it is necessary to adopt in-situ moisture conservation techniques in addition to the large scale soil and moisture conservation and water harvesting structures in the watershed. The principle behind the recommendation of different practices is to increase the infiltration by reducing the rate of runoff, temporarily impounding the water on the surface of the soil to increase the opportunity time for infiltration and modifying the land configuration for inter plot water harvesting. Earlier efforts for moisture conservation were concentrated upon construction of various types of bunds across the land slope to control erosion and conserve soil. All the erosion control measures however, led to accumulation of water against the structures rather than its proper and uniform distribution in the inter terraced area and at times led to reduction in crop yields. To overcome these problems the insitu moisture conservation techniques are recommended. Insitu soil moisture conservation can be done through various methods i.e., agronomical method, mechanical method etc. Agronomical method includes summer ploughing, contour ploughing, mulching etc,. Mechanical methods include bunding, broad bed furrow, basin listing, tie ridging etc, In general, it could be possible to reduce soil and water losses by adopting in-situ conservation practices. It was concluded that by adopting the in-situ soil moisture conservation 38-50% moisture can be conserved, it stabilizes the crop production and it also increases crop yield and in fodder crops it can increase the fodder yield by 40%.

Keywords: in-situ soil moisture, crop yield, erosion and crop production

Introduction

Out of the total geographical area of 328.73 m ha in India, only 141 m ha is under cultivation. India has about 47 m ha of dryland out of 108 m ha of total rainfed area. Dry lands contribute 42% of the total food grain production of the country. Out of 141 m ha 80 m ha is under dryland farming, which was 52% of the total cultivable land. Thus, dry farming is majorly practiced in state of Chhattisgarh, Uttar Pradesh, Tamil Nadu and Madhya Pradesh. In dryland areas, variation in amount and distribution of rainfall influences the crop production as well as socio-economic conditions of the farmers. The problems arise in the dryland farming are Inadequate soil moisture is the chief constraint in drylands where the annual rainfall is 500 mm to 1000 mm. It is not evenly distributed and highly variable and erratic. The soils are light/medium textured. Their water holding capacity are low. The lands are often having rolling topography. The rainwater runs off quickly, removes soil and fertilizers. Subsoil hard pan is formed due to continuous use of implements up to certain depths constantly, which in turn precipitate the clay in the subsoil horizon. While considerable importance has been given to increase the productivity of the irrigated lands under green revolution, much attention has not been given to increase the productivity of the rainfed areas. As the moisture is the limiting factor in the rainfed farming and the rainfall is the only source of water for these lands, it is necessary to conserve rain water and to maxi-mise the retention of moisture. Since the available land area is limited and finite, the necessity to improve the productivity of the land and to increase the income of the farmers have become important. It is therefore necessary to introduce technologies in dryland farming to increase production. To overcome these problems, it is necessary to adopt in situ soil moisture conservation methods. In situ soil moisture conservation defined as storage of rainfall in soil at the place where it falls. It aims at increasing infiltration of rainfall into the soil and reducing runoff loss of rainwater. It is the most efficient and cheapest method for conserving rainfall is to hold the water in-situ. Evaporation losses can also be greatly reduced if rainfall is stored in the soil rather than in a structure with a free water surface. Moreover, the water in the soil is readily available to plants whereas a large investment is necessary if water is collected elsewhere and brought in the use. To increase the moisture availability to the agricultural crops in the individual farmer's field and to increase the infiltration and percolation of rain water into the root profile, the in-situ moisture conservation techniques are recommended. It helps to intercept rain drops and reduce the splash effect, obtain a better intake of water by soil, through improving the contact of organic matter and soil structure. The principles involved in the mechanical methods of in-situ soil moisture conservation are shaping the land surface manually or with implements in such a way to reduce the velocity of runoff, to allow more time for rainfall to stand on soil surface and to facilitate more infiltration of rainfall into soil layers.

Agronomical/cultural methods

Contour ploughing

When ploughing is done along the contour it is termed as contour ploughing and is more helpful for in-situ moisture conservation. Plough furrows can hold water in the depressions and thereby increases the infiltration.

Cover cropping

Erosion can be reduced if the land surface is fully covered with foliage Eg- blackgram, greengram, groundnut, fodder grasses like *Cenchrus ciliaris*, *Cenchrus glaucus*, Diannath grass, Marvel grass. Cover cropping can be practiced when the slope is less than 2 percent.

Mulching

Mulching refers to covering the soil surface with crop stubbles, straw, coir pith, groundnut shell, husk etc. to conserve the moisture up to 40 – 60% and also prevent erosion.

Mechanical methods

Bunding

In dryland, well maintained bunds would hold water to decrease soil erosion and conserve the moisture. It is done in 2 different methods.

a) Contour bunding

The practice of arresting the soil loss and run-off involving construction of permanent bunds or other barriers along the contours is known as contour bunding. It is possible in the tropical regions. The distance between two contour bunds is generally 10-12m. It is suitable for deep red soil with slope less than 1%. It is not suitable for heavy black soil with low infiltration where bunds tend to develop cracks on drying. A successful sorghum crop has been achieved with 270 mm rainfall using this technology (Itabari and Wamuongo, 2003) [5].

b) Compartmental bunding

Small bunds of 15cm width and 15cm height are formed in both directions to divide the field into small basins or compartments of 40sq.m size. It is suitable for red soils and black soils with a slope 0.5 – 1%. The bunds can be formed before sowing or immediately after sowing with local wooden plough. It is highly suitable for broadcast sown crops.

Broad Bed Furrow (BBF)

The BBF system consists of broad beds separated by sunken furrows. Beds of 1.5 m width, 15 cm height and convenient length are formed, separated by furrows of 30 cm width and 15 cm depth. It can be prepared using a multiple tool 'Tropiculture'. It can be suitable for the land having 0.4 – 0.8%. Broad bed and furrows had significantly higher total soil moisture content upto 60 cm deep. Maurya and Devadattam (1987) [6] reported that the moisture availability, crop yield and costbenefit ratio were higher for the broad bed and furrow system than the flat bed system.

Tied Ridging

It is a modification system of ridges and furrows where in the ridges are connected or tied by a small bund at 2-3 m interval along the furrows. It should be practiced only in the well drained soils. Gichangi *et al*.'s (2007) [3] has reported that study on maize grain yields across various sites in semi-arid of eastern Kenya show that tied-ridging with manure, manure and fertilizer application can increased crop yields from 100 to 359%.

Basin listing

Formation of small depressions (basins) of 10-15 cm depth and 10-15 cm width at regular intervals using an implement called basin lister. The small basins collect rainfall and improves its storage. It is suitable for all soil types and crops. Elmaeni and Elsahookie (1987) [2] established the maize crop by sowing (a) on ridges with basin listing (b) in the furrows and (c) on the ridges and concluded that sowing on ridger with basin listing out yielded other treatments producing grain yields of 7.37 and 11.9 t/ha from spring and autumn sowings respectively.

Bench terracing

In general, arable land can be increased by 20%–40% through the conversion of slope land into terraced fields, which is significant to increase grain yield (about 20%–40%) (Hu *et al*., 2005) [4]. The construction of bench terrace involves converting the ground surface into step like fields. The riser is vulnerable to erosion and it's protected by vegetation cover and sometimes faced with stones or concretes.

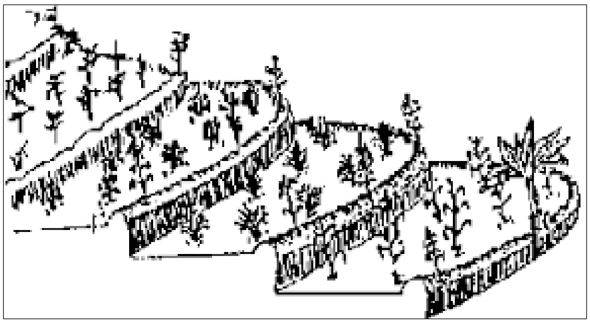

Fig 1

Conclusion

The problem under dryland agriculture is that of low yield and unstable production. Despite the realization that it is much difficult to increase the production from drylands, it cannot be neglected, as a large number of farmers with more than two-thirds of the cultivated area of the country is involved. Generally, there are many technologies for in-situ rain water harvesting and their impact is enhanced by combining these technologies with integrated soil fertility improvement. The in-situ rainwater harvesting technologies have potential to increase crops and fodder productivity and are viable for farmer adoption.

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