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Impact of different treatments on soil loss from small watershed

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Abstract
An investigation was carried out to study the effect of various treatments on runoff and soil loss from Model Watershed of Agro-Ecology and Environment Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The data viz. Rainfall, runoff, soil loss and meteorology for 2002-14 was collected for four treatments *viz*., along the slope cultivation with opening of tied furrows (T1), contour cultivation with opening of alternative furrows (T2), contour cultivation with opening of furrows (T3), across the slope cultivation with opening of furrows (T4) undertaken at watershed. The runoff was found maximum for treatment T1 where as it was minimum for treatment T4. Treatment T3 and T4 were observed to be more effective in conserving the soil. Treatment T4 was found as the most effective treatment as there was no soil loss from study area during the year 2002 to 2014 while other treatments are contributing to the soil loss.

Keywords: Runoff, Cultivation, Soil loss, Rainfall, Treatment

1. Introduction
Land degradation and runoff plays an important role, particularly soil degradation in form of soil erosion, deforestation and overgrazing remains a major constraint to increasing food production. Soil erosion rates are partially controlled by soil and water conservation structures such as lynchets and stone bunds, which are installed along the contour. Sediment accumulates behind these structures, which results in the development of progressive terraces. 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 interterraced area and at times led to reduction in crop yields. To overcome these problems the in-situ moisture conservation techniques are recommended. Among the effects of soil degradation include nutrient depletion, soil compaction and reduced water infiltration into the soil. These effects combined with poor soil management practices are responsible for agricultural drought and low crop yields, especially in developing countries. The situation is aggravated by increasing negative impact of climate change, in which drought and floods are frequent events (FAO, 2009a) [2].
Although principles of runoff reducing techniques are well-known, there is a need for research into the effects of surface treatments on runoff processes for efficient and appropriate application of effective measures in the correct circumstances (Wallace, 2000) [9].

Methodology
The study area was Agroecology and Environment centre (AEEC) watershed, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola located in western Vidarbha region of Maharashtra state. It is located at 22º41’ N latitude and 77°22’ E longitude. The study was conducted to evaluate the ruoff and soil loss effect based on various treatments.

Table 1: Details of plot size of treatments

Sr. No	Description of treatment	Plot size (m x m)	Area of plot (ha)
T1	along the slope cultivation with opening of tied furrows	129×28	0.36
T2	contour cultivation with opening of alternative furrows	126×28	0.36
T3	contour cultivation with opening of furrows	124.49×28	0.35
T4	across the slope cultivation with opening of furrows	122.25×28	0.34

Runoff Sample Collection and Analysis

The runoff from each plot concentrated at the outlet of runoff plot was measured by H-flume of 0.30 m depth installed as a runoff measuring device. The float type automatic stage level recorder was installed at the outlet of each gauging site. The runoff chart obtained from Stage Level Recorder gives a continuous record of depth of flow over the flume with respect to time. This stage graph will subsequently process to obtain the runoff rates and Peak rate of runoff volumes which will later use for further analysis.

Soil Loss

The runoff samples from treatments T1, T2, T3 and T4 were collected for each runoff events during thirteen years. The samples were analyzed for determination of soil loss.

The soil samples from the run-off were collected during the season. After each storm the run-off samples were collected manually. Stirred 100 ml run-off water each from individual sample was taken into aluminium box. The weight dry soil from 100 ml run-off water was determined by weighing. The soil loss in total run-off volume was expressed in kg ha^{-1}.

Results and Discussion

Runoff analysis

Runoff generally depends on rainfall intensity, duration of rainfall, rainfall distribution, direction of prevailing wind etc. The effect of runoff on various treatments was analysed. It was found that for treatment T1 the runoff was maximum whereas runoff is minimum for treatment T4. The runoff amount along the slope cultivation with opening of tied furrows (T1) varies from 0.236 mm to 286.57 mm, while for contour cultivation with opening of alternative furrows (T2) the runoff amount varies from 0 mm to 139.72 mm, whereas for contour cultivation with opening of furrows (T3) and across the slope cultivation with opening of furrows (T4), the runoff amount varies from 0 mm to 47.97 mm and 0 mm to 22.4 mm respectively. The variation of runoff according to different treatments are depicted in Fig. 1.

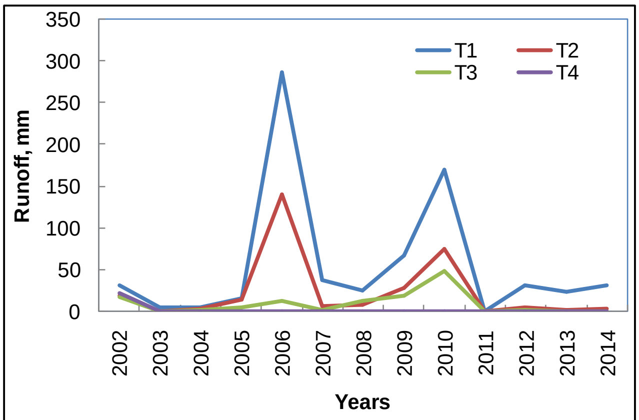
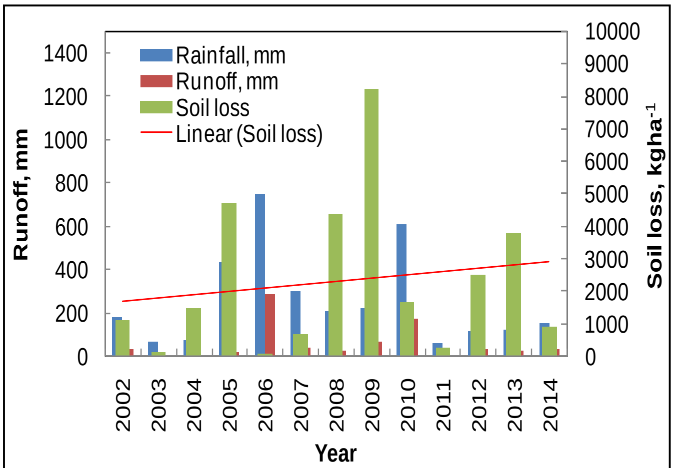


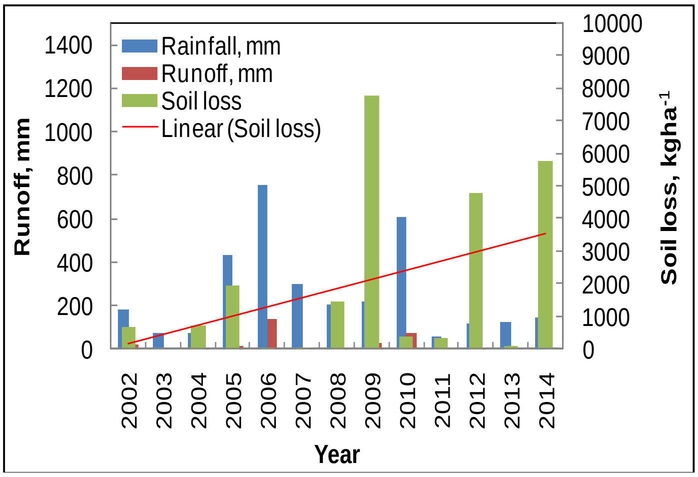
Fig 1. Effect of runoff on various treatments

Soil loss analysis

Treatment wise soil loss was analyzed for AEEC watershed. Annual soil loss along the slope cultivation with opening of tied furrows (T1) was observed to be varying between 110 kgha^{-1} to 8220 kgha^{-1}, for contour cultivation with opening of alternative furrows (T2) it was observed 0 kgha^{-1} to 7800 kgha^{-1}, for contour cultivation with opening of furrows (T3) it was observed 0 kgha^{-1} to 920 kgha^{-1}, whereas across the slope cultivation with opening of furrows (T4) it was observed between 0 kgha^{-1} to 910 kgha^{-1}. The variation of annual soil loss along with rainfall and runoff for the years *i.e.* 2002 to 2014 for the treatments T1, T2, T3 and T4 are depicted in Fig. 2.



Treatment T1



Treatment T2

Fig 2: Effect of soil loss on various treatments

It is seen from the Fig. 2, the soil loss is showing increasing trend in case of treatment T1 for the year 2002 to 2014. In case of treatment T2, the soil loss is showing increasing trend. The soil loss was increased from 700 kgha^{-1} (year 2002) to 5774 kgha^{-1} (year 2014). Treatment T3 show decreasing trend for soil loss. In this case, the soil loss was decreased from 590 kgha^{-1} (year 2002) to 122 kgha^{-1} (year 2014). Treatment T4 also show decreasing trend for soil loss. In this case, the soil loss was decreased from 910 kgha^{-1} (year 2002) to no soil loss (year 2014).

Thus, except treatment T1 and T2 all other treatments were observed to be effective in conserving the soil. Treatment T4 was found as the most effective treatment as there was no soil loss from study area during the year 2003 to 2014 while other treatments are contributing to the soil loss.

It is also concluded that over the years T1 is having more soil loss followed by T2, T3 and T4. Hence, it can be concluded that for control of soil erosion only T2 *i.e.* contour cultivation with opening of alternative furrows is not sufficient, we have to go for treatment T3 *i.e.* contour cultivation with opening of furrows and T4 *i.e.* across the slope cultivation with opening of furrows.

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