

# Quantifying rainfall-runoff relationships on the Mieso Hypo Calcic Vertisol ecotope in Ethiopia

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## Abstract

Droughts are common in the semi-arid areas of Ethiopia and adversely influence the wellbeing of many of the 80% of the population involved in agriculture. The introduction of any strategy that could increase crop yields would therefore be advantageous. The objective of the study was to attempt to assess the benefit that the in-field rainwater harvesting (IRWH) crop production technique would have, compared to conventional tillage, on increasing soil water, and therefore the yield of a crop, on a semi-arid ecotope at Mieso.

The mean annual rainfall at Mieso is 738 mm. The soil is a Hypo Calcic Vertisol with a high clay and silt content and is very susceptible to crusting. To achieve the objective of the study, rainfall-runoff measurements were made during 2003 and 2004 on 2 m x 2 m plots provided with a runoff measuring system, and replicated 3 times for each treatment. There were 2 treatments: conventional tillage (CT) that simulated the normal local CT; and a flat surface simulating the no-till IRWH technique (NT). Rainfall intensity was measured at 1-min intervals and runoff was measured after each storm. The Morin and Cluff runoff model was calibrated and validated using measured rainfall-runoff data. Appropriate values for final infiltration rate ( $I_f$ ), surface storage ( $SD$ ) and the crusting parameter ( $\gamma$ ) were found to be: 10 mm·hr<sup>-1</sup>; 2 mm for NT and 5 mm for CT; 0.4 mm<sup>-1</sup>; respectively. The runoff ( $R$ )/rainfall ( $P$ ) ratio ( $R/P$ ) gave values of 0.43 and 0.34 for the NT and CT treatments, respectively. There was a statistical difference between the runoff on the 2 treatments. The first estimated yield benefit of IRWH compared to CT is 455 kg·ha<sup>-1</sup>. Based on the average long-term maize yield of 2 000 kg·ha<sup>-1</sup> at Melkassa, this is an estimated yield increase of 23%.

**Keywords:** In-field rainwater harvesting, maize, yield increase, rainfall intensity, Rift Valley