Evaluating benefits of rainwater harvesting using infiltration pits for improved crop yield in rainfed cropping systems: The case of Rushinga District, Zimbabwe

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ABSTRACT

In-situ rainwater harvesting (RWH) bridges the gap between rainfall events by increasing plant available water through collecting runoff and allowing its infiltration into the soil. RWH is therefore a viable strategy for improving food security in semi-arid areas by mitigating dry spells. This study assessed the benefits of RWH using infiltration pits under *Zea mays* L. production. Field experiments were conducted at two sites in Rushinga District, Zimbabwe, located in a semi-arid area.

A split-plot design with two major plots distinguished by the presence/absence of infiltration pits in the contour ridge (CR) channel was used. CRs are hydraulic structures that consist of an upstream channel and downstream ridge constructed in a crossslope direction in order to safely discharge runoff. Minor plots were differentiated by the tillage method namely conventional tillage (CT) and planting pits (PP). Thus, four treatments were used namely: (1) infiltration pits plus conventional tillage (I+CT); (2) infiltration pits plus planting pits (I+PP); (3) PP only (PP) and (4) CT only (CT). Infiltration pits, 1m wide, 2m long and 0.75m deep were dug at 10-m intervals in the channel of a standard CR. CT entailed ploughing to of ±0.23m depth and opening planting furrows using the mouldboard plough. Furrows were spaced at 0.90m x 0.45m. PP measured 0.15m deep and 0.20m wide, and were spaced at 0.90m × 0.50m. Two pips were planted per station.

The experiment was laid out in three blocks per site, giving three replications. Soil moisture content was measured weekly in two treatments (I+CT and CT) at one site in one block during the 2010/11 rainy-season using the TDR method at 0.20-m depth intervals to 1.40m. .
Maize was harvested from 10m×10m net harvest plots. Weight of grain was adjusted to 12.5% moisture content. Harvest index was calculated as the ratio of grain yield to total above-ground biomass.

Soil moisture content graphic trends analyses were done using SPSS for Windows Version 17.0. Maize grain and stover yield data was subjected to ANOVA and the LSD test was performed to identify significantly different means using the same statistical package.

Results showed no significant grain and stover yield difference ($p>0.05$) in major treatments, but CT outperformed PP ($p<0.05$) at one experimental site. Although there was no significant difference ($p>0.05$) in maize yields for sections of the CR reinforced with infiltration pits and the unreinforced sections, soil moisture content increased in the reinforced sections up to a distance of 2m from the centre of the infiltration pit in the downslope direction. A cropping system that utilises soil moisture in the proximity of the CR is recommended. Perennial crops, as for example cassava planted close to the infiltration pits will make use of the heavy rains that fall in December when the maize crop is still at the initial stage and improve the overall water productivity. It was also noted that use of infiltration pits enhances environmental sustainability through reducing soil erosion and enhancing groundwater recharge. Thus, infiltration pits improve both crop water productivity and environmental sustainability.

Keywords: Rainwater harvesting, food security, soil moisture, maize, dry spell mitigation, infiltration pit