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Field based measurement approaches to better understand soil moisture dynamics in rainfed smallholder systems in Sub-Saharan Africa

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The common goal to attain food security suffers many challenges especially in Sub-Saharan countries where increasing food demands, erratic climatic conditions and rapidly degrading soils combine to reduce further the poor yields obtained in smallholder rainfed systems. This paper presents work conducted in semi-arid northern Tanzania where, even with two rainfall seasons in a year, the total annual rainfall of less than 500 mm a-1 is insufficient to support most crop water requirements.

The study aims to better understand soil water partitioning at field scale in rainfed systems through the measurement of water balance components such as rainfall, runoff, and soil moisture over the growing season. Soil moisture fluctuations have been monitored using a combination of Time Domain Reflectory (TDR) methods, Electrical Resistivity Tomography (ERT) methods as well as tensiometry using watermark sensors in cropped plots. Comparison is made between soil moisture dynamics under traditional tillage practices and in trial plots where improved simple farming techniques such as storm water diversion and construction of retention trenches and bunds (fanya juus) have been introduced. The results show an increase in soil moisture retention of up to 50% in areas where improved techniques exist while maize yields more than doubled in some cases through the introduction of more efficient tillage practices. A relationship between soil moisture and soil moisture tension has been established for each site. ERT and TDR results also confirm the relationship between the constructed

improved techniques and soil moisture retention and distribution.

Conclusions from the research are that, in areas where water resources are limited, there is scope for improving yield levels even in the absence of formal irrigation schemes through a shift to localized micro-irrigation methods which concentrate available storm-flow into the root zone. It is also concluded that crop yields are more a function of the tillage techniques employed than the actual rainfall received on site. However, more research is needed to establish the impact of the success of these improved techniques on the sharing of the available water to “blue” and “green” water balances.

Keywords: rainfed, water balance, partitioning, soil moisture, smallholder