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ScienceDirect
Physics and Chemistry of the Earth 31 (2006) 901–909
PHYSICS and CHEMISTRY of the EARTH
www.elsevier.com/locate/pce

Water productivity analysis for smallholder rainfed systems: A case study of Makanya catchment, Tanzania

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Abstract

Decreasing food security as a result of ever-increasing population, less water availability and soil degradation is common in countries in sub-Saharan Africa. While most of the developed fresh water resources are heavily committed to irrigation, about 90% of sub-Saharan populations rely solely on rainfed agriculture for their livelihoods. The majority of the population is therefore not directly benefiting from developed water resources but are, in fact, subsistence rainfed farmers. Thus, in sub-Saharan Africa, techniques which help to improve water productivity (WP) can assist in alleviating the impacts of water scarcity especially for crop production purposes.

A study was conducted in the semi-arid Makanya catchment in northern Tanzania where farmers depend on rainfed subsistence farming for their livelihoods. The objective of the study was to assess the effect of improved conservation agriculture techniques on WP of a maize crop. An assessment of the current WP in rainfed and partially supplementary irrigated agriculture was made. The crop water requirement for maize in the study area was found to be 508 mm/season by using the CROPWAT model compared to total received rainfall of up to 383.86 mm per study plot during the same period. An attempt was made to separate transpiration from evapotranspiration using a transpiration meter. Results indicate that, currently, WP for maize in the catchment is low (0.18–1.33 kg m^{-3}). Introduction of improved techniques increased WP by between 90% and 110%. Infiltration rates also increased from 6 to 26 cm/h.

The conclusion from the research is that, from a purely scientific view, there is room to significantly improve the water use techniques being applied for crop productivity through improving current smallholder farming practices A clear understanding and quantification of the water partitioning processes is required to maximise productive water use by the plant as transpiration and this is directly related to biomass production.

Keywords: Supplementary irrigation; Water productivity; Deep ripping; Rainfed

1. Introduction

Low crop yields have resulted in decreasing food security in many arid to semi-arid regions of the world, particularly in sub-Saharan Africa. This problem can largely be attributed to ever-increasing populations, reduced water availability for crop production purposes due to increased dry spells between growing seasons and during growing season, and increasing soil degradation. Whilst most of the developed fresh water resources are heavily committed to irrigation, about 90% of sub-Saharan populations rely solely on rainfed agriculture for their livelihoods (Rockstrom et al., 2003). In sub-Saharan Africa, techniques which help to improve water productivity (WP) can assist in alleviating the impacts of water scarcity for crop production purposes. There is presently an increase in water scarcity due to increased competition for the same water from non-agricultural sectors and, also from depletion of usable water due to pollution.

Improved water productivity can be achieved through improved soil, water and crop management (van Dam

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doi:10.1016/j.pce.2006.08.019

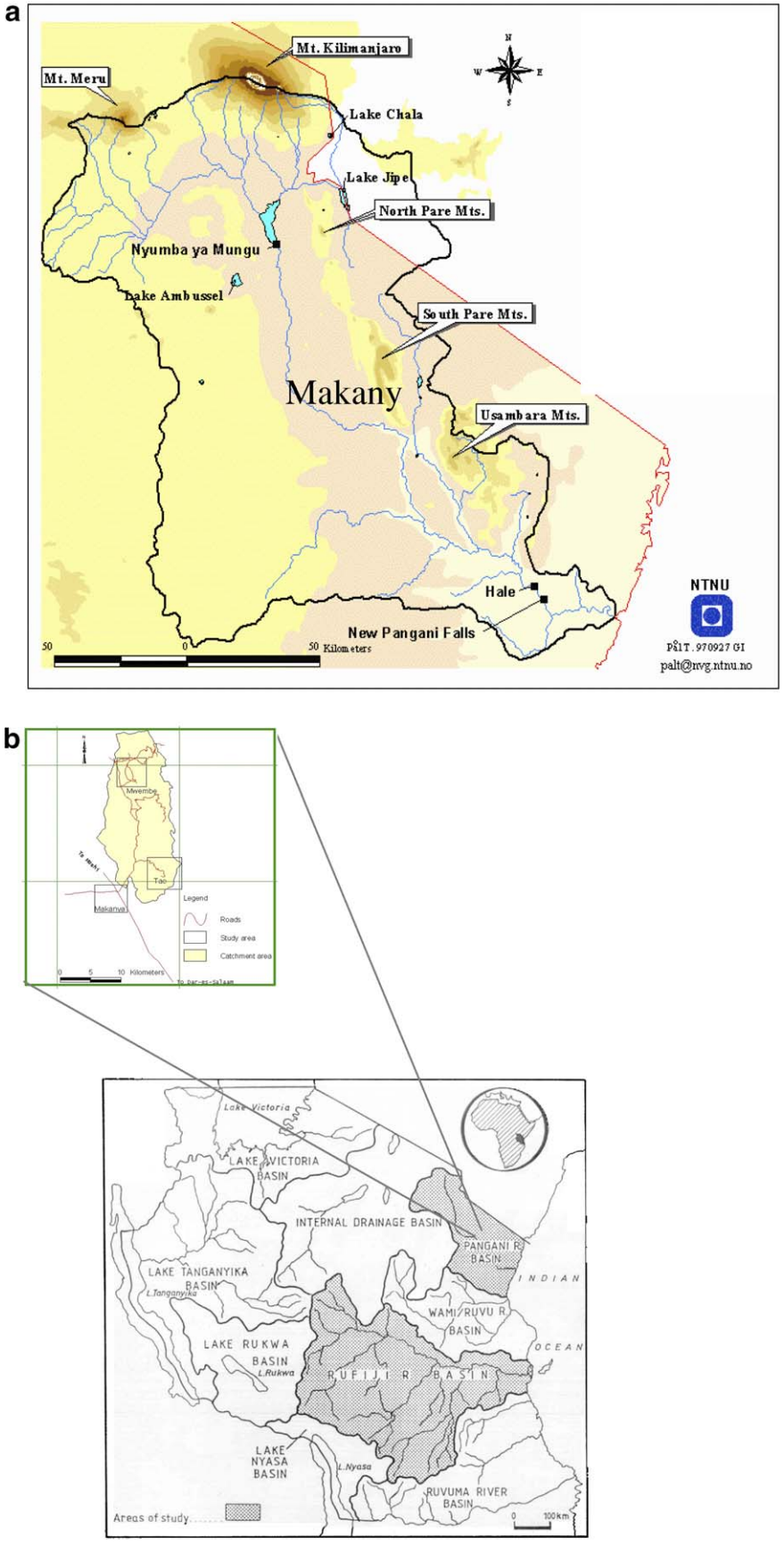

Fig. 1. Location of Makanya within northern Tanzania (a) and the location of the area in Tanzania (b) (*Source*: SSI first progress report).