

3RD SADC GROUND WATER CONFERENCE

SUB-THEME 1: Sustainable Groundwater Use for a Food Secure SADC Region

Review of comparative studies on estimating groundwater recharge under conservation agriculture versus conventional tillage

D. Mudimbu^{1*}, K. Banda², S. Mabvuso³, W. Namaona⁴, R. Owen⁵, B. Brauns⁶, D. J. Lapworth⁷, A. M. MacDonald⁸

Affiliations

¹ Geology Department, Faculty of Science, University of Zimbabwe, Harare, Zimbabwe

² Department of Geology, School of Mines, University of Zambia, P.O. Box 32379, Lusaka, Zambia

³ Department of Soil Science, School of Agricultural Sciences, University of Zambia, P.O. Box 32379, Lusaka, Zambia

⁴ Lilongwe University of Agriculture and Natural Resources, Malawi

⁵ Department of Civil Engineering, School of Engineering, University of Zimbabwe, Harare, Zimbabwe

⁶ British Geological Survey, Keyworth, NG12 5GG, UK

⁷ British Geological Survey, Wallingford, OX10 8BB, UK

⁸ British Geological Survey, Edinburgh, EH14 4AP, UK

Corresponding Author:

Daina Mudimbu
University of Zimbabwe
Faculty of Science
Geology Department
Harare, Zimbabwe
Email: deemudimbu@gmail.com

ABSTRACT

Along with the expansion of groundwater-irrigated agriculture, conservation agriculture (CA) is one of the key policies promoted in the SADC region to safeguard and enhance agricultural production because of its positive effects on water conservation and soil fertility. The effects of CA on groundwater recharge however are not clearly understood, and there is a lack of systematic evaluation of research studies that have investigated this topic. To fill this gap, we have undertaken a literature review on comparative groundwater recharge studies on CA versus conventional tillage (CT). Specific attention was given to the methods used for soil water measurements or groundwater fluxes. Infiltration, deep drainage and percolation were used as proxy indicators of potential groundwater recharge where actual recharge estimates were not calculated.

The study yielded 34 manuscripts (22 sites and 12 reviews), and in 55% of the studies, potential groundwater recharge was higher under CA compared to 32% of the studies in which it was higher under CT. 14% of the studies concluded that there was no difference between CA and CT practices. Except for two of the site studies, all reviewed research was based on data collected in the unsaturated zone, combined with a calculation of infiltration rates. This indirect monitoring can lead to an estimation of “potential” recharge to the groundwater rather than “actual” recharge. The review also revealed that results of soil water fluxes in CA treatments are greatly influenced by a number of factors such as the specific combination and degree of the applied CA principles, timing of the data collection, and underlying soil type and climatic conditions. This compounded the challenges of comparing the results of the studies. The key conclusion of our review is that there is a research gap on the influence of CA on groundwater recharge derived from direct monitoring methods.

Keywords: Conservation agriculture, Conventional tillage, Groundwater recharge, Africa, Literature review