Catchment management in semi-arid area of central South Africa: Strategy for improving water productivity

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Abstract

In the semi-arid part of central South Africa, population growth and industrial development are the driving forces for an increased demand for water. This accentuates the need for wise decisions by catchment management agencies (CMAs), especially in water-scarce semi-arid areas. These decisions become more and more complex as the range of demands widens over the spectrum of water consumers, i.e. municipal, industrial, irrigation and rain-fed farming. A study was conducted in the Upper Modder River catchment, which is situated in the semi-arid area of central South Africa, where crop production in the catchment using conventional production technique is currently not suitable due to marginal and erratic rainfall. Moreover, the area is characterised by low precipitation use efficiency because of large runoff and evaporation losses on clay and duplex soils. A labour intensive in-field rainwater harvesting (IRWH) technique recently introduced into a part of the basin occupied by communal farmers has been shown to increase maize and sunflower yields by 30 to 50% compared to conventional tillage, making it a feasible option for the subsistence farmers in the catchment. The area of land suitable for the IRWH located in the communal land is estimated to be 23 000 ha. Two catchment management options presented in this paper are:

- Option1: allowing the IRWH suitable land in the communal farming area to remain under grassland and utilising the runoff downstream for irrigating maize
- Option 2: utilising the IRWH suitable land for maize production in the basin, using the IRWH technique

Results showed that the expected maize production from Option 2 was higher than from Option 1. A financial analysis also showed that gross margin of option, expressed as R/ m^3 of rainwater utilised, was estimated to be between 0.0234 to 0.0254 under Option 1 and 0.0354 for Option 2. This clearly shows that use of rainwater where it falls has high socio-economic benefits for the communal farmers who are currently struggling to achieve sustainable livelihoods.

Keywords: catchment management, rainwater harvesting, water productivity, small-scale farmers

Introduction

In a new paradigm shift related to integrated water resources management in the context of a river basin, attention is being drawn to the upstream influences on the various water use entities, as well as the downstream impacts arising from them. Along the path of water flowing in a river basin are many water-related human interventions, such as water storage, diversion, regulation, pollution, purification, etc. and associated acts to modify the natural systems. All of these have one common effect, and that is that they impact on those who live downstream (Sunaryo, 2002).

In rain-fed agriculture water productivity will have to increase dramatically over the next generations if food production is to keep pace with human population growth (Rockström et al., 2002). In Sub-Saharan Africa, over 60% of the population depends on rain based rural economics, generating about 30 to 40% of the regions GDP (World Bank, 1997). However, in many parts of the water scarce countries, yields from rain-fed agriculture are low, oscillating around 1 t/ha (Rockström, 2001). Many researchers, however, suggest that the low productivity in rain-fed agriculture is more due to sub-optimal performance related to management aspects than to low physical potential. For instance, Bennie et al. (1994) reported that in arid and semi-arid areas between 60 and 85% of the rainfall evaporates from the soil surface without making any contribution to production.

In the semi-arid part of central South Africa, population growth and industrial development are the driving forces for an increased demand for water. This accentuates the need for wise decisions by catchment management agencies (CMAs), especially in water scarce semi-arid areas. These decisions become more and more complex as the range of demands widens over the spectrum of water consumers, i.e. municipal, industrial, irrigation and rain-fed farming. Due to its location, which is close to the relatively densely populated and industrialised greater Mangaung Municipal area that includes Bloemfontein, Botshabelo and Thaba Nchu, the Upper Modder River (UMR) catchment is of strategic importance, with the widest possible range of competing stakeholders. It is therefore important that the CMA's decision for this and other similar catchment be based on reliable information. The objective of this paper is to provide essential new information relevant to the rain-fed crop production by subsistence farmers in the UMR catchment.

The Upper Modder River catchment and subsistence agriculture

A detailed description of the UMR catchment is given by Woyessa et al. (2006). The area is 295 766 ha, mean annual pre-

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