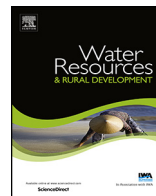




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Rainwater harvesting and conservation tillage increase maize yields in South Africa



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ABSTRACT

Poverty and food insecurity are common amongst rural communities in the sub-Saharan African region. The rural population of South Africa is not excluded from poverty. With normal conventional tillage practices, crop failures are common on marginal soils in semi-arid areas with low and erratic rainfall. Therefore, selected rural communities in the Eastern Cape, Limpopo and Free State Provinces of South Africa were introduced to appropriate rainwater harvesting and conservation agricultural techniques to contribute towards the reduction of food insecurity through improved maize yields. Conventional tillage, no-till, minimum tillage, mechanized basins, in-field rainwater harvesting and the Daling plough were tested in on-station and on-farm field experiments over three to five maize growing seasons (2008/09–2011/13). The rainwater harvesting (in-field rainwater harvesting and Daling plough) and conservation (mechanized basins, no-till and minimum tillage) techniques resulted in slightly higher yields than conventional tillage due to their potential to conserve rainwater better and to harvest additional rainwater. Conventional tillage, no-till and minimum tillage had lower grain yields because they lost on average 18% of the total rainfall to ex-field runoff. The rainwater productivity of the Daling plough treatment was very similar to that of in-field rainwater harvesting, followed by mechanized basins, conventional tillage and no-till or minimum tillage.

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1. Introduction

Poverty and food insecurity are common amongst rural communities of poor countries in the sub-Saharan African region. People in these areas usually depend on rainfed agriculture and the use of natural resources for household consumption and income generation. Most of these areas lack industries to provide alternative employment opportunities and are often marginal for crop production due to low and unreliable rainfall, high evaporation rates and poor soils. In South Africa, about two-thirds of the poor and food insecure people live in rural areas where they rely mostly on rainfed agriculture (NDA, 1998, 2001; Ngwane et al., 2001; Ortmann and Machethe, 2003).

In 2010 about 22% of South African households faced inadequate or severely inadequate access to food (Statistics South Africa, 2011). In the Free State, Limpopo and Eastern Cape, 24%, 21% and 20% of households, respectively, reported that they had inadequate food. That being the case, only 22% of South African households were involved in agricultural production, mostly in the production of food and grains (43%), fruit and vegetables (30%), poultry (44%) and livestock (49%), with most of the crop production (approximately 88%) taking place in homestead gardens. Most rural households mostly produce for own home consumption.

The major constraint to agricultural production in the rural areas of South Africa is low and erratic rainfall, and the resultant lack of water has prevented many people from growing crops on their premises (Backeberg and Sanewe, 2010). Generally, only a small portion of the land in these areas is under some form of irrigation (Vink and Kirsten, 2003). Thus, rainfed agriculture is the main source of food for the people in these areas (FAO, 1990; Parr et al., 1990). Improvement of agricultural productivity in the rainfed system is thus critical for improving food security of rural populations (Wiebe, 2001; Ortmann and Machethe, 2003).

We examine the potential increase in cropland productivity and maize yields by applying appropriate rainwater harvesting and conservation techniques in semi-arid areas.

2. Literature review

As land pressure rises, more and more marginal areas in the world are being used for agriculture. Much of this land is located in the arid or semi-arid areas where rainfall is low and erratic where much of the water is soon lost as surface runoff. Recent droughts have highlighted the risks to human beings and livestock, which occur when rains falter or fail. There is now increasing interest in a low cost alternative generally referred to as rainwater harvesting. Rainwater harvesting is the collection of runoff for productive purposes. Instead of runoff being left to cause erosion, it is harvested and utilized (Oweis et al., 2001). In the semi-arid drought-prone areas where it is already practised, rainwater harvesting is a directly productive form of soil and water conservation. Both yields and reliability of production can be improved significantly with this method (Kronen, 1994). Rainwater harvesting can be considered as a rudimentary form of irrigation, but the difference is that with rainwater harvesting the farmer has no control over timing. Farmers can control the timing of irrigation if they collect rainfall in a pond and then apply it when they wish. Runoff can only be harvested when it rains. In regions where crops are entirely rainfed, a reduction of 50% in the seasonal rainfall, for example, may result in a total crop failure. If, however, the available rain can be concentrated on a smaller area, reasonable yields will still be obtained (Botha, 2006). Of course, in a year of severe drought, there may be no runoff to collect but an efficient rainwater harvesting system will improve plant growth in most years. This depends on the amount and frequency of rainfall. Therefore, the application of appropriate rainwater harvesting and conservation techniques on croplands in selected rural villages in the Eastern Cape, Limpopo and Free State Provinces of South Africa could empower community members to produce their own crops using the land in their croplands more productively, hence contributing towards the reduction of household food insecurity.

Efficient water harvesting and conservation techniques for smallholder crop production can aid in alleviating poverty and helping farmers to become self-sufficient. The lack of such techniques is a pressing problem for agriculture in semi-arid areas. Water harvesting can aid the smallholder crop farmers in utilizing their low and erratic rainfall in order to grow a sufficient crop to sustain their livelihoods

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