Research Application Summary

Setting out to evaluate rain water harvesting (RWH) for crop production at Botswana College of Agriculture

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Abstract

This report is an account of an on-going study being carried out at Botswana College of Agriculture Farm to characterise soil surface conditions on runoff generation of micro-catchment RWH systems, and to appraise these micro-catchment RWH systems on crop performance. The characterisation undertaking involved a replicated runoff yield trial of two factors: size of catchment at three levels (5 x 5m, 5 x 10m and 5 x 20m) and four common soil surface conditions [ploughed surface (PS), harrowed surface (HS), managed crop (PM) and natural vegetation (NV)]. Trenching (for the installation of the runoff collection system at the bottom of each plot) was carried out. The appraisal of micro-catchment RWH systems on crop performance involved a replicated trial of two factors: catchment size at three levels and tillage treatment. Measurement of maize growth parameters and installation of runoff collection system which commenced in March 2012 were halted in mid-April 2012 due to an abrupt end of the rain season. No significant rain had fallen to initiate surface runoff for quantification. The study continues.

Key words: Botswana College of Agriculture, crop performance, micro-catchment RWH systems, runoff collection system, semi-arid areas, soil surface conditions

Résumé

Ce rapport entre en compte d'une étude en cours menée au sein de la ferme du Collège de sciences agronomiques au Botswana pour caractériser les conditions de surface du sol sur la production d'eaux de ruissellement des systèmes CEP dans le micro-bassin versant, et pour évaluer ces systèmes de CEP dans le micro-bassin versant sur le rendement des cultures. L'entreprise de la caractérisation a impliqué un essai répliqué de rendement de ruissellement de deux facteurs: la taille du bassin versant à trois niveaux (5 x 5m, 5 x 10m et 5 x 20m) et quatre conditions communes de surface du sol [surface labourée (PS), surface hersée (HS), cultures menées (PM) et végétation naturelle (NV)]. Le tranchage (pour l'installation du système

de collecte des eaux de ruissellement au fond de chaque parcelle) a été réalisé. L'évaluation des systèmes de CEP dans le micro-bassin sur le rendement des cultures a impliqué un essai répliqué de deux facteurs: la taille du bassin versant à trois niveaux et le traitement dû au labourage. La mesure des paramètres de croissance du maïs et l'installation du système de collecte des eaux de ruissellement qui ont débuté en Mars 2012, ont été arrêtés en mi-Avril 2012 suite à une brusque interruption de la saison des pluies. Aucune pluie significative n'est tombée afin d'amorcer le ruissellement de surface pour la quantification. L'étude se poursuit.

Mots clés: Collège des sciences agronomiques du Botswana, rendement des cultures, systèmes de CEP des micro-bassins versants, système de collecte des eaux de ruissellement, zones semi-arides, conditions de la surface du sol

Background

Agriculture plays a very important role in the economy of Botswana, where more than 80% of the population is involved. Botswana government considers arable farming as a key for employment creation and income generation for the majority of rural families. Climate is a key factor in determining crop production with rainfall and temperatures as main elements. Botswana is semi-arid with an average annual rainfall range of 250 - 650 mm. Further, rainfall is seasonal, unreliable and varies from year to year (Government of Botswana, 2000). Because of low and unreliable rainfall in much of the country, it is crucial that every effort be made to conserve and efficiently utilise the scarce rain water. This requires improved soil management techniques that maximise the holding of water into the soil, coupled with cultural practices that ensure the most optimum use of the available soil water by plant. Better management of rain-water, apart from enhancing plant production, is also necessary in the protection of the environment (Hatibu *et al.*, 2004). This is because poor management allows wasteful run-off to occur, causing erosion, downstream flooding and siltation. Therefore, rain water harvesting (RWH), is vital in enhancing plant production and protecting land against degradation caused by erosion especially in the semi-arid areas. The focus of the present study is to evaluate micro-catchment RWH systems for crop production in a semi-arid area.

Literature Summary

Rain-water harvesting is the process of interception and concentration of runoff and its subsequent storage either in the soil for direct use by plants or in reservoirs for later application

when needed to mitigate dry spells (Mzirai and Tumbo, 2010). It is a system that consists of a catchment area (the surface on which runoff is generated), command area (the area where runoff is utilised), runoff transfer infrastructure (channels, gullies, hard surface) or diversion method and storage structures. According to studies carried out by Mati *et al*. (2006), maize yield can be tripled with RWH through conservation agriculture through minimising the risk of crop failure during droughts, intra seasonal droughts and floods. RWH also reduces women's burden of collecting water for domestic use, gives opportunity for the girl child to attend school and provides a relatively safe and clean source of drinking water hence minimising incidences of water-borne diseases.

Study Description

The study commenced in January 2012 at the Botswana College of Agriculture Farm, located at Sebele (24^{o} 33' S, 25^{o} 54' E, 994 m above sea level), about 15 km northeast of Gaborone. Sebele is semi-arid with an average annual rainfall of 538 mm, most of it occurring in summer (late October - to March/ April). Prolonged dry spells during the rainy season are common and rainfall tends to be localised (Persaud *et al*., 1992). The soils are shallow, ferruginous tropical soils, mainly consisting of medium to coarse grain sands and loams with a low water holding capacity and subject to crusting after heavy rains.

A complete randomised block design trial of soil surface condition – catchment size combination was laid out at the experimental site. The soil surface condition treatments were (i) ploughed surface (PS), (ii) harrowed surface (HS), (iii) poorly managed crop (PM) and (iv) natural vegetation (NV). Micro-catchment sizes used included 5 x 5m, 5 x 10m and 5 x 20m. Trenching (for installation of the runoff collection system) has been completed (Plate 1). Installation of the runoff collection system commenced in March 2012. A complete randomised block trial involving the three micro-catchment sizes and tillage treatments was set up adjacent to the above-described runoff collection system. Maize was planted and data collection on growth parameters initiated, but was halted mid-April due to an abrupt end of the rain season (Plate 2). By this time, no significant rain had been received to initiate surface runoff for quantification.

Research Application

It has not been possible, for the season just ending, to either quantify runoff or appraise micro-catchment RWH systems on crop performance. The main reason for this being due to the

Plate 1. Trenching for runoffcollection system.

Plate 2. Layout of micro-catchment size versus tillage trial.

abrupt end of the rainy rainy season before the crop had significantly grown, and there was therefore no significant run-off to measure. Despite this, lessons have been learned on the technicalities of running field experiments of this nature in semi-arid environments, and on the need to prepare adequately for the next rainy season. Upcoming activities include completion of installation of the runoff collection system, data collection on runoff from various soil surface conditions, measurement of crop growth parameters and analysis of any collected runoff - crop growth data.

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