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In situ rainwater harvesting using dead level contours in semi-arid southern Zimbabwe: Insights on the role of socio-economic factors on performance and effectiveness in Gwanda District

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ABSTRACT

Droughts and dry spells which have characterised the past decade in Zimbabwe have seen a marked increase in the promotion and use of *in situ* rainwater harvesting technologies (RWHTs) as a drought mitigating strategy. A number of these technologies have been tried in recent years which include dead level contours with infiltration pits and deepened contours. Although *in situ* RWHTs are known to increase food security in drought prone areas, the role of socio-economic factors on their performance in terms of crop yield and scaling out is still not well understood. This study sought to investigate the socio-economic factors which influence the effectiveness of dead level contours for *in situ* rainwater harvesting and consequently on crop yield. The study involved 14 key informants interviews and questionnaire administration to a total of 55 respondent farmers practising *in situ* rainwater harvesting with dead level contours. A statistical package (Statistical Package for Social Scientists, SPSS) was used to analyse relationships between performance of RWHTs and attributes such as labour, resources, gender, experience and education. The results show a strong correlation between performance and resource status ($p = 0.004$). For example, within the wealthy category, 42.1% were successful, while 14.3% and 13.8% were average and poor performers respectively. Thus within the successful category, 42.1% were wealthy, while 42.1% and 15.8% were medium-rich and resource-constrained respectively. Performance rating was also significantly correlated ($p = 0.007$) to gender of household head e.g., within the most successful group 94.7% were men compared to 5.3% women. There was also a significant correlation between resource status and gender ($p = 0.039$) such that within the wealthy category, 69.2% of the respondents were men compared to 30.8% women. Labour was found to have no significance on performance ($p > 0.05$) even though the majority of key informants (93%) alluded that the more labour resources at one's disposal, the higher their chances of success. This is so because RWHTs are time-consuming and labour intensive. Education level and number of years using water harvesting technologies did not have a significant bearing on performance ($p > 0.05$). The paper concludes that resource ownership could be a key factor in farmers' ability to scale out RWHTs since performance was significantly linked to resource status. Women headed households were performing rather poorly in RWHTs suggesting the need for special attention to gender in the promotion of RWHTs.

1. Introduction

Africa has, in the past been hit by a barrage of climate related natural disasters. These catastrophes have had adverse effects on communities, development efforts and national economies as well as on critical human, natural and other material resources. Zimbabwe has not been spared as evidenced by a marked increase in droughts and dry spells. For smallholder rain-fed systems, these occurrences have severely undermined food security. Crop productivity in small-scale/subsistence farming is not as high as that in large-scale/commercial farming because under the latter farming systems, there are larger inputs of irrigation water and chemical fertilizer (Tsumbo and Walker, 2007). In addition, the majority of affected small-scale farmers are located in less favoured agro-ecological conditions, with poor soils, and low and erratic rainfall where periodic droughts and dry spells result in complete crop failure, water scarcity and livestock deaths. In order to improve the effectiveness of crop production in these marginal rainfall regions,

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cultural practices which conserve and extend the period of water availability to the crop are essential (Gollifer, 1993; Twomlow and Bruneau, 2000).

In order to mitigate effects of droughts a number of *in situ* rainwater harvesting technologies (RWHTs) have been introduced and are being implemented in many semi-arid areas of Zimbabwe. *In situ* RWHTs refers to all interventions that collect and conserve rainwater thereby prolonging the time of soil water availability to crops. A range of *in situ* RWHTs exist and are currently being tested. These include infiltration pits (Maseko, 1995); cross-tied graded contours, deepened contours and fanya juus (Hagmann, 1994). Extensive research efforts have been put to *in situ* RWHTs in Zimbabwe and success stories have been documented (Nyagumbo, 1999; Twomlow and Bruneau, 2000; Rusike and Heinrich, 2002; Motsi et al.2004; Mugabe, 2004).

However, even though rainwater harvesting is a proven technology to increase food security in drought prone areas (Li et al., 1999; FAO/AGL, 2000; Xiaolong et al., 2008), the conditions under which these technologies perform well has not been fully explored. This had led to indiscriminate recommendations of the rainwater harvesting technologies without considering the prevailing socio-economic conditions of targeted households. It is hypothesised that socio-economic aspects affect the performance of RWHTs despite good techniques and design. In view of the importance of the subject and lack of knowledge with regards to the influence of socio-economic factors on crop yield performance of dead level contours, it was seen crucial to undertake a study to establish the key socio-economic factors affecting the performance and scaling out of *in situ* RWHTs. This will help in refining recommendations for their use and improve farmers' capacity to adapt to climate change induced droughts. The objective of the study therefore was to identify and evaluate the socio-economic factors which affect performance of dead level contours. The phrase *in situ* RWHT will be used to refer to dead level contours. The socio-economic factors hypothesised to have a bearing on success or failure of RWHTs are; labour availability, resource endowment (implements, draft power and land), gender, education and number of years (experience) using RWHTs. These were chosen based on their effect on general smallholder farming system. It has been found that agricultural production relies on a set of basic inputs (Willcocks and Twomlow, 1993; FAO, 2008; Mazvimavi and Twomlow, 2009) which include the stated socio-economic factors.

Performance of dead level contours in this paper is used to relate to effectiveness of dead level contours towards crop yield improvement based on farmers' perceptions and recall. Thus success is continued use of RWHT to an extent translating to crop yield benefits based on perceptions of locals.

2. Methodology

2.1. Study area

The farmers targeted by the research were smallholder farmers involved in crop production using dead level contours with infiltration pits in Wards 17 and 18 of Gwanda District lying within the Mzingwane Catchment. Mzingwane Catchment, which is part of the Limpopo river basin, is divided into four sub-catchments, namely, Shashe, Upper Mzingwane, Lower Mzingwane, and Mwenezi (Fig. 1). The rainfall is between 450 and 600 mm rainfall per year and this is subject to frequent seasonal droughts.

Gwanda District is flooded by numerous types of RWHTs because of its semi-aridity as farmers try to overcome the effects of seasonal droughts and ensure food security. These techniques include dead level contours with infiltration pits, conservation basins, contour strips, storage tanks, dam construction and ripping. A number of organisations mainly non-governmental organisations (NGOs) have been promoting the various technologies in Gwanda District. Some of the NGOS are Practical Action, the International Crops Research Institute for the Semi-arid Tropics (ICRISAT), World Vision, and the government extension department, Agricultural Technical and Extension Services (Agritex). Although some of these programmes started as early as the pre-independence era (before 1980), intensive advocacy of the technologies started in earnest with the coming of the new millennium.

Practical Action introduced the dead level contours in Gwanda following their successful implementation in Chivi, a semi-arid district in Masvingo province of Zimbabwe. However, the proponent of these mechanical structures is said to be Zephania Phiri, a successful farmer in Zvishavane area of Zimbabwe (Maseko, 1995). When deal level contours were introduced in Gwanda, the promoter, Practical Action, encouraged farmers to work in groups. This was done to reduce work load as well as help those households which were more vulnerable and did not have sufficient labour (like HIV/AIDS affected and infected and orphans). Food incentives (type was the same but quantity depended on size of household) were given to households in both wards as a way of encouraging them to implement the technology. In addition, farmers were also provided with appropriate extension support. However, the NGO has since stopped the programme but some farmers are still practising RWHT.

2.2. Data collection

The methods used to collect data for this study included a questionnaire survey, key informant interviews, focus group discussions and field observations. Questionnaires were administered to a total of 55 farmers from Ward 17 and Ward 18. The majority of the respondents were males 69% compared to 31% females. The female respondents were either divorced or widowed or had never been married according to the information obtained from focus group discussions. These respondent farmers were selected during two community meetings held in each ward. The farmers were put into three groups (successful, average performers, poor performers) according to their performance (as evaluated by farmers themselves) with dead level contours. It was from these groups that the 55 farmers were randomly selected. Furthermore, farmers were classified into three resource categories (wealthy, medium-rich and resource-constrained).

The meetings provided a platform for sensitizing the community and creating awareness about the study as well as to get their views and opinions on the various research questions. Key informant interviews were done with an additional 14 informants (10 males, 4 females) who were not part of the 55 questionnaire respondents and constituted kraal heads, councillors, RWHT coordinators and extension agents. Direct observation was also used as a crosscutting method throughout the fieldwork as it helped to capture some salient issues which did not necessarily feature during discussions.

2.3. Peer categorisation of farmers into performance classes

In categorising the farmers into successful, average and poor performers, participant farmers were looking at those farmers who have continued to use dead levels from the time they were introduced translating to some crop harvest in the different cropping seasons (Table 1).

Even though yield was a better indicator for performance there were a number of challenges which made it scientifically unsound to use yield figures. For instance, the farmers did not record their yield as a result figures given were not reliable. In addition yield was given for different seasons making a comparative analysis difficult.