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DEVELOPING SOIL AND WATER MANAGEMENT TECHNOLOGIES FOR SMALL-SCALE FARMERS IN THE SEMI-ARID AREAS: METHODOLOGICAL CONCERNS FOR PARTICIPATORY RESEARCH

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Introduction

In many countries, the semiarid areas constitute a significant percentage of the total area, and a considerable number of people live and farm in these areas. For example, in Zimbabwe, 83% of the country lies in the semiarid natural agroecological Regions III, IV and V. These regions are characterized by unreliable rainfall with an annual average of about 600 mm. Drought-induced crop failures occur in one out of every four years. Although the mean annual rainfall is low, the intensity is very high and exceeds infiltration, resulting in high water losses due to surface runoff, estimated in Zimbabwe to be up to 30% of total rainfall. Also, the high-intensity early rains normally fall when the ground is totally bare, thus resulting in high soil losses. Annual losses of up to 50 - 100 tons/ha have been estimated. The soils are sandy and inherently infertile. The resource-poor farmer who operates under these conditions is highly resource constrained. Arable land holdings are of subeconomic size and the farmer can hardly risk investing resources in technologies developed under research station conditions which are not guaranteed to work under his conditions. Soil and water management technologies should aim to address all these constraints of the small-scale farmer in the semiarid areas. Soil management technologies include soil erosion control methods, water harvesting techniques and physical and chemical soil improvement practices. This paper raises three major issues that are pertinent in research-driven farmer participatory research for technology development in the semi-arid areas. The questions raised are based on the authors' experiences in the research and development of soil and water conservation technologies in Zimbabwe.

Key Methodological Issues and Questions

The following issues are crucial in the development of soil technologies:

Benefits of soil management technologies are long term and depend on other agronomic activities (farmer management skills)

The impact of soil management technologies, particularly soil erosion control techniques, tend to be long term. This was confirmed in an experiment to evaluate four conservation tillage systems in southern Zimbabwe. The conservation impact of the best system only became apparent in the sixth year (Chuma & Hagmann 1995). Thus, in the first five years, the benefits of conservation tillage were not apparent. Also, the benefits of soil management technologies, particularly in terms of crop performance, are masked by other agronomic activities and the impact tends to be farmer and site specific. This can also be illustrated by the results of on-farm evaluation of a conservation system in Zimbabwe. Yields on farmers fields were highly variable between farmers and seasons. In 1992/93, grain yield on sandy sites was 6% higher on ridges than on conventional flat. In the same year, grain yield on periodically water-logged sites was 22% more on the new technique (tied ridging). In 1993/94, tied ridges on waterlogged sites yielded 66% more than the conventional technique and, on upland soils, ridges yielded only 16% more than on the conventional technique.

Methodologically, the question here is how to separate the impacts of soil management technologies from the effect of other agronomic practices and farmers' management skills? Researchers are looking for quantitative results, while the high degree of variability of yields of the same technology from farmer to farmer is a reality. Highly sophisticated research designs, however, would compromise farmer participation. Another important question is how to reconcile long-term objectives of soil management with the short-term requirements of crop production.

A possible solution is to apply a land husbandry approach which implies the care, management and improvement of land resources as a positive approach, and where soil management technologies are applied as an integral component of land management this, however, requires addressing several problems/issues at the same. The question here is whether it is possible to address all the important issues from different disciplines simultaneously, for example, when applying research funds? Maybe prioritizing the issues could help in the initiation of a land husbandry approach, but again the question is, how to get the right priority for farmers and the soil.

Dynamism of the Social Environment and Production Constraints

Farmer circumstances tend to be dynamic which makes the understanding of farmers' social environment rather difficult. The importance of understanding farmers' circumstances and their decision-making criteria is crucial in technology development on how to extract the impacts of soil management technologies from the effects of other agronomic practices. A combination of evaluation methods that includes formal surveys, informal discussions and technical measurements has been recommended to help researchers understand farmers' social environment, particularly the decision making process (Chuma 1994). Our work in Zimbabwe has shown the importance of incorporating gender as an integral part in the technology development process (Hagmann *et al* 1996), however, it also clearly revealed that the social environment is highly dynamic. For example, household headship can change from male de facto to de jure in a year. Considering the long-term nature of experiments on the development of soil technologies, an experiment started under the circumstances of a male-headed household ends up under different conditions and might have to be changed.

Related to this issue is the dynamic nature of production constraints particularly in the semiarid areas. For example, in a drought year, water harvesting techniques are a key to soil management, whereas, in a wet year, water harvesting becomes totally irrelevant and waterlogging becomes a problem. The challenge for the development of soil technologies here is to build in flexibility during implementation while maintaining scientific quantitative results. The development and application of the appropriate monitoring of diversity is a key challenge in participatory research.

How To Deal with Diversity of Soil Management Problems?

Problems to be addressed with soil management technologies tend to be diverse and the objectives depend on the scale of operation. For an individual farmer, the objective to achieve appropriate land management is at the field level, and for a community the scale is at the catchment level. The objectives of the individual and those of the community are not necessarily always equal, but the effectiveness of individual efforts in conservation can only be successful if farmers in a community or watershed are co-operating. Now, whose objective (community or individual) should be addressed by farmer participatory research? Who is putting up the research agenda? Who is the driving force? Who owns the research? Also, the criteria for the evaluation of technologies differ depending on degree of market orientation, gender, wealth, etc. Whose criteria are to be used for evaluation? Farmers' perceptions of problems is highly diverse. For example, some farmers attribute low soil fertility to spiritual effects, while others believe in casual-rational terms, etc. The overall question is how to take these issues on board in participatory research.

Conclusion

This paper only shows a limited number of methodological concerns in farmer participatory research on soil technologies. These concerns apply when utilizing a research approach based on positivistic science, which is often the case in classical farmer participatory research. However, if take farmers' reality as a starting point in technology development, and do not seek for quantitative data but more for a learning process, the methodological concerns are different. In our work in Zimbabwe, we tried to combine a learning process and simple quantitative research. The methodology and the results have been documented (see references).

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