Institutional and policy support is essential to promote the adoption of soil fertility technologies on maize-based smallholder farms in Southern Africa

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Abstract

Smallholder farmers in southern Africa face acute food insecurity because the productive capacity of their soils has declined. These resource poor farmers increasingly cannot afford mineral fertilizers. Soil Fert Net researchers in southern Africa have developed and promoted a range of inorganic and organic "best-bet" soil fertility management technologies (SFMT) as options for farmers to improve soil fertility. This paper highlights recent financial, adoption, institutional and policy assessments on the use of SFMT by smallholders in southern Africa. Financial analysis of the SFMT 'best bets' indicates that (even with current unfavorable input and output prices) there are moderate positive payoffs to investing in some SFMTs, yet their rate of adoption is often slow. Because profitability analysis is sensitive to changes in maize grain price, crop yield and the cost of borrowing capital, policy interventions for better access to inputs, credit and an increased output price would create incentives to invest in soil fertility technologies and increase farmers' income. Institutional and political support for better market linkages, input availability and policy advocacy are found to be indispensable in southern Africa to scale up the diffusion of SFMTs.

Media summary

To adopt soil fertility technologies to improve crop productivity and sustainability, southern African farmers will need help from better input-supply and marketing policy.

Keywords

Policy briefs, Policy analysis matrix, markets, cropping systems, legumes, N fertilizer

Introduction

Southern Africa combines old soils with resource-poor smallholder farmers. The smallholder maize-based cropping systems of Southern Africa are characterized by persistent and recurring drought and widespread soil fertility decline resulting in stagnant or decreasing food production. Under smallholder production systems, yields of most staple food crops have been less than 1 tonne/hectare. Low soil fertility is now widely recognized as a major factor contributing to low productivity and non sustainability of existing production systems and long-term food insecurity in Southern and Eastern Africa (see Sanchez et al. 1997; 2002). As well as a direct contributor to reduced productivity, soil infertility is a major source of inefficiency in the returns to other inputs and management committed to smallholder farms, including N fertilizer, seed and labor (Mekuria and Waddington 2002). Thus, ways to reduce and manage soil infertility have received major attention from agricultural research and development agencies and donors in recent years (Sanchez et al. 2002).

This paper attempts to synthesize recent experience of an institutional network that has operated in Southern Africa, Soil Fert Net, in better addressing this constraint through the promotion of appropriate soil fertility technologies and identification of constraints to adoption. It draws lessons from those experiences to advocate institutional and policy support measures that are critical for the wider promotion and scaling up of soil fertility management options with smallholder farmers in Southern Africa.

Soil Fert Net and best bet soil fertility technology

An institutional innovation known as *Soil Fertility Management and Policy Network for the Maize-based Farming Systems of Southern Africa (Soil Fert Net)* operated from 1995 to 2003)[1] to deal with the challenges of developing and testing alternative soil fertility management technology options for smallholder farmers in the region. Soil Fert Net (coordinated by CIMMYT and financially supported by the Rockefeller Foundation) had a wide membership drawn from different institutions and agricultural science disciplines in Malawi, Zambia, Zimbabwe and Mozambique.

Soil Fert Net has cultivated networking in a region where human and financial resources for agricultural research and development are scarce. Networking helps use these resources efficiently to undertake collaborative research on high priority themes (e.g. on mixes of inputs external and within the farm, on ways to substitute for scarce N fertilizer by green manure and grain legumes), share available information and learn from each other. The Network has allocated small financial grants for network trials and start-up/top-up funding; supported and encouraged participatory technology testing; facilitated peer review of proposals; assisted members in sourcing of funds, helped with planning or priority setting; enabled information exchange and collective learning; organized conferences, training workshops and field tours; and produced a wide range of publications.

Soil Fert Net researchers developed, recommended and promoted what are known as “Best Bet” soil fertility management technologies (SFMT). The SFMTs have resulted from widespread participatory research and testing with the farmers on their farms in Malawi and Zimbabwe and recently in Zambia and Mozambique. They include a range of organic and mineral (inorganic) soil-fertility technology and cropping system options for smallholders in southern Africa (Mekuria and Waddington 2002). Most of the SFMTs provide some short-term soil fertility and crop productivity benefit, and several end uses, which makes them potentially attractive to farmers. They are compatible with farmer circumstances and effective within farmer resource constraints (cash, labor and land). These technologies offer farmers the “Best Bets” for improved productivity, sustainability, useful products and income[2]. Researchers in soil science, agronomy and socio economics have attempted to understand the benefits and uses of the SFMTs and the extent of their adoption.

Economic analysis and adoption of SFMTs

Financial analysis of velvet bean(*Mucuna*)green manure-maize rotations in Zimbabwe and Malawi (Mekuria and Siziba 2003a) revealed that pay-offs to investing in *Mucuna* as a green manure in both Zimbabwe and Malawi were positive but small for both land constrained and land adequate smallholder farmers. The risk of farmers suffering losses after investing in *Mucuna* was substantial for land constrained farmers who have to forgo one season of maize harvest to grow *Mucuna*. In Zimbabwe, SFMTs offer significant yield gains over current practice, but when combined with current farm management practices and current pricing policies the impact on income is very limited – except for soyabean.

Chilongo (2003) in Malawi used a Policy Analysis Matrix to compute the private and social profitability of several SFMT options (Table 1). It indicated that all the soil fertility technologies, except for undersown *Tephrosia*, did help build the fertility status of the soil better than modest rates of mineral fertilizer (69:21:0:4S), a current farmer practice. *Mucuna* fed the soil the best and gave the highest maize grain yield increase (of about 1.5 t/ha), but groundnut and pigeonpea had the highest net returns because they produced higher value and more marketable legume grains than did other legume grains. *Mucuna* had relatively poor net returns (US$19/ha), because currently the grain is of little economic importance to farmers. Chilongo (2003) showed that groundnut-maize rotations, pigeonpea/maize intercrop and soyabean-maize rotations are likely to be adopted (with marginal rates of return (MRR) of at least 100%). Though *Mucuna* had positive returns, it is unlikely to be taken up by farmers because of a low MRR. *Tephrosia,* with negative returns, is very unlikely to be adopted.

Studies have been conducted by Soil Fert Net’s Economics and Policy Working Group (EPWG) in Malawi (Phiri 2003), Zimbabwe (Gatsi et al. 2000; Mano and Rugube 2003), Zambia and Mozambique (Mekuria and Siziba 2003b) to understand the adoption benefits, constraints and challenges that farmers face. Table 2 shows highly variable use and use intensity for a range of SFMTs in northern Zimbabwe. These

studies revealed that despite many SFMT options for farmers, and efforts to popularize and promote them, their use and adoption has been very slow and the future is uncertain. These studies have identified that lack of appropriate information about technologies, their often modest potential financial returns, lack of input availability and affordability, no access to credit and output marketing, are factors that constrain adoption of SFMTs. Farmers need to make a significant initial investment in knowledge, land, capital or labor. The existence of a time lag before the farmer starts to obtain benefits from legume options and often more complex management requirements have been identified to be additional critical factors in the adoption process. Private profitability of introducing legumes into the system was found to depend on the opportunity cost of land and family labor. Under these circumstances, smallholder farmers who have limited resources at their disposal tend to be risk averse to invest in SMTs.

Table 1. Partial budgets of soil fertility technologies compared to farmers fertilization practice (69:21:0:4S) in Malawi-US$/ha (from Chilongo, 2003)

	Soil fertility cropping pattern				
	Mucuna-maize rotation	**Groundnut-maize rotation**	**Pigeonpea / maize intercrop**	**Tephrosia/maize undersowing**	**Soyabean-maize rotation**
Yield increase of maize (kg/ha)	1580	1190	655	-65	985
Yield of intercrops (kg/ha)			1059		
Yield of rotated crop (kg/ha)	2073	4215			1170
Total benefits (US$/ha)	606.45	4160.70	964.70	86.60	1116.80
Total costs (US$/ha)	508.23	623.95	79.63	125.93	543.71
Net benefits (US$/ha)	98.22	3536.75	885.07	-39.33	573.09
Marginal Rate of Return (%)	19	567	1112	-31	105

Table 2. Farmer awareness, frequency and intensity of adoption of a range of soil fertility management technologies (SFMT) in selected sites of northern Zimbabwe, 2001-2002. (from Mano and Rugube, 2003)

	Aware	Willing to use	Using	Rate of application (kg/ha)	Recommended rate (kg/ha)	Percent arable area under technology
	Percent of farmers					
Fertilizer	99	90	97	193	400	65
Cattle manure	98	93	86	1224	6000	20
Lime	81	74	13	18	300 per yr	6
Soybean rotation	85	93	58	-	-	-
Green manure	51	88	35	3% of maize area	50% of maize area	6
Termite mound	94	65	45	-	-	-

A synthesis of SFMT adoption studies by EPWG-Zimbabwe (Mano, 2003) confirmed that the likelihood of adoption is influenced by type of technology, farmer specific socio economic characteristics and crosscutting economic policies and institutional parameters. For mineral fertilizers and cattle manure, households with more land, more wealth and those with more experience (and for manure older) than average, higher rainfall and farm size were important determinants of adoption. In the case of lime use, households with more land and more wealth, active membership in an extension group and high rainfall are more likely to adopt. Table 2 depicts that a higher percentage of farmers reported to have adopted mineral fertilizers and cattle manure. Incidence of adoption for lime, green manure and termite mound are low. In the semiarid areas of Zimbabwe, both the pattern and intensity of adoption of SFMTs are very low.

Lessons for institutional and policy support

Economic reforms introduced since the early 1990s have not favored small farm agriculture in general as market imperfections still persist within regional economies. The rate of liberalization of input markets was much faster than that of output markets, especially that of maize. Maize has been re-controlled in some countries. The changing policy framework in grain marketing in Zambia and Zimbabwe has created uncertainty and a vacuum in the delivery of inputs and output marketing. The low producer pricing policies adopted by governments heavily tax smallholders while subsidizing urban consumers. In the last two years, the maize producer price in Zimbabwe has been 30% of the import parity price. Low producer prices reduce the financial ability of farmers to invest in SFMTs, contributing to low yields, reduced maize production and to national food insecurity.

Absence of market outlets selling SFM inputs for green manures (*Mucuna*), grain legumes (cowpea, soyabean seed and *Rhizobium*), lack of competitive providers of marketing services linking farmers to markets, distance to input and output market are major institutional constraints that require the attention of policy makers. New market innovations that are likely to reduce transaction costs and increase farm level returns to the adoption of SFMTs are being examined in the region. Pilot studies in Zimbabwe and Malawi demonstrated the potential role of trained rural agro dealers in bringing inputs and information nearer to farmers and making them available in small packages. Alternative output marketing arrangements that would reduce marketing costs and encourage the adoption of SFMTs are also being tested. Findings from EPWG studies need to be urgently communicated to policy makers. Identification of technology-specific policy support and advocacy strategies required for improving soil fertility have been limited. Under the new regional Soil Fertility Consortium, members plan to produce policy briefs that document these lessons, and identify the policy implications and policy instruments required to enhance the adoption and promotion of SFMTs.

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[1] This is now being expanded into a broader Consortium that involves a wider range of institutions and disciplines, target agroecologies and farming systems.

[2] For more details of criteria used to select best bets see Mekuria and Waddington (2002).