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Full Length Research Paper

Using innovation platforms to scale out soil acidity-ameliorating technologies in Dedza district in central Malawi

V. H. Kabambe[1]*, A. D. C. Chilimba[2], A. Ngwira[2], M. Mbawe[3], G. Kambauwa[4] and P. Mapfumo[5]

[1]Bunda College of Agriculture, University of Malawi, P.O Box 219, Lilongwe, Malawi.
[2]Chitedze Research Station, Ministry of Agriculture and Food Security (MoAFS), P.O. Box 158, Lilongwe, Malawi.
[3]Dedza District Agriculture Office, MoAFS, Dedza, Malawi.
[4]Department of Land Resources Conservation, MoAFS, Lilongwe, Malawi.
[5]International Maize and Wheat Improvement Center (CIMMYT), P.O. Box MP 163, Mount. Pleasant, Harare, Zimbabwe.

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Soil acidity is a serious constraint in crop production in some parts of Malawi, particularly in high rainfall and high altitude areas. A learning platform was established in Bembeke Extension Planning Area (EPA) (14° 21′ E and 34° 21′ S, 1650 masl, normal annual rainfall of 1300 to 1500 mm) in Dedza District to scale out lime applications as amendments to low pH soils. In 2006/2007 and 2007/2008 seasons, 36 and 150 two-plot trials, respectively were established to serve as learning centers for the comparison of application of 2 t/ha of dolomitic lime to no application in maize (*Zea mays* L.) crop fertilized at 69:21:0+4S. In 2007/2008 season, a similar study compared application of compost manures. Application of lime increased (P < 0.05) maize yields from 3.58 to 4.68 t/ha in 2006/2007 and 3.35 to 4.2 t/ha in 2007/2008. In 2007/2008, the residual effects of lime increased (P < 0.05) yields of maize and beans (*Phaseolus vulgaris*). An innovation platform comprising of farmers, government and NGO extension and researchers organized exchange tours and end of season review meetings. The number of farmers hosting the learning centers grew from 36 to 150 due to the IP interactions. At the end of the project support in 2008, the participating farmers were willing to invest in the technology and raised funds for purchase of lime, assisted by government extension. The IP was unable to effectively engage any agri-input dealer to follow up on the demand on lime expressed by farmers. Application of compost manure increased maize yields from 4.25 to 5.84 t/ha, compared to 2.31 t/ha as practiced by farmers.

Key words: Dolomitic lime, innovation platforms, composting, soil acidity, Malawi.

INTRODUCTION

In Malawi, maize (*Zea mays* L.) is the staple food crop that dominates the cropping systems. Between 1997/1998 and 2007/2008 seasons, maize area ranged between 1.2 to 1.6 M ha, with average yields ranging between 0.81 and 2.65 t/ha (MoAFS, 2007; FEWSNET, 2008). The policy of the government is to increase yield per unit area in order to meet increasing demand for the growing population and release land for other food and cash crop (MoAIFS, 2005). Poor soil fertility is one of the major reasons for low yields (Kumwenda et al., 1997; ICRISAT MAI, 2000; Blackie and Mann, 2005; MoAIFS, 2005). Other constraints include recurrent droughts, poor management, foliar diseases, stalk borers, termites and the parasitic weeds species *Striga* (MoAIFS, 2005; Kabambe

*Corresponding author. E-mail: kabambev@yahoo.com.

et al., 2008). Other important food crops include cassava (*Manihot esculenta* Crantz), common beans (*Phaseolus vulgaris* L.), sweet potato (*Ipomoea batatas* L.), groundnuts (*Arachis hypogeal* L.), pigeon peas (*Cajanus cajan* L.), rice (*Oryza sativa*), potatoes (*Solanum tuberosum* L.) and soybeans (*Glycine max*) (MoAIFS, 2005).

To address the problem of low soil fertility, the Government of Malawi (GoM), through the Ministry of Agriculture and Food Security (MoAFS) initiated a Farm Inputs Subsidy Program (FISP) in 2005/2006 season in which targeted farmers accessed fertilizer, maize and legume seeds at very low prices (MoAFS, 2007). This government policy was in response to extensive research findings that highlighted soil fertility as one of the major constraints to crop production (Kumwenda et al., 1997, 1998; Kumwenda and Benson, 1998; ICRISAT/MAI, 2000). This also led to the development of area specific fertilizer recommenddations (MoAI, 1997, 1999). A range of stakeholders have promoted various aspects of Integrated Soil Fertility Management (ISFM) technologies (Gilbert et al., 2002; ICRISAT/MAI, 2000; MoAIFS, 2003). In some parts of the country, especially in high rainfall upland areas, aluminum toxicity due to low pH is a major constraint(Snapp, 1998).. Malawi upland soils are highly weathered, low in pH and low in soil nutrients. Over 40% of the soils belong to soil order Oxisols and Ultisols (US Taxonomy), which are highly weathered and strongly acidic with a pH (in water) of less than 5.5 (Chilimba and Saka, 1998). Soil acidity is predominant in Mzuzu Agricultural Development Division (ADD), Kasungu ADD, Lilongwe ADD, Blantyre ADD and Namwera RDP in Machinga ADD and Misuku Hills in Karonga ADD. After extensive studies, Chilima (2005) recommended application of lime at 2.0 t/ha for soils with pH_w (H2O) < 5.5 for the soils in Bembeke Extension Planning Area (EPA), the location of activities for the current report, and other areas.

Aluminium toxicity is considered the most important plant-growth limiting factors in many acid soils, particularly those with pH below 5.0 to 5.5. When acid soil are limed, exchangeable Al^{3+} and hydrohyaluminium cations such as $Al(OH)_2^+$ are converted to insoluble $Al(OH)_3$, resulting in removal of the Al_3^+ from cation exchange competition (Tisdale et al, 1985). Availability of P and K are improved with liming. Excess aluminium interferes with cell division in plant roots, fixes phosphorus in less available forms, decreases root respiration, and interferes with uptake, transport, and use of Ca, Mg and P (Tisdale et al., 1985). In Cameroon, Yamoah et al. (1996) reported that application of lime and green manure improved stand count, root and stem weights and yields of maize, bean and potato (*S. tuberosum*) and that high P application was unnecessary when lime was applied. In Kenya, Onwonga et al. (2008) reported that lime increased soil pH within two months of application and that organic amendments had similar effects.

Malawi has large deposits of limestone and dolomite is locally mined some 75 km from the area of this study.

The use of dolomite in Malawi soils would reduce soil acidity, as well as add calcium and magnesium for plant uptake. Nearly all of the extension efforts in Malawi have not targeted liming (Gilbert et al., 2002; ICRISAT/MAI, 2000; MoAIFS, 2003). In many cases, liming is considered too bulky and not feasible. One way to facilitate adoption of technology for farmers is to work together with research and extension staff so as to experiment how to apply it and observe its benefits. This paper reports on the activities of the Soil Fertility Consortium for Southern Africa (SOFECSA) to promote lime and compost manure application in Bembeke EPA in central Malawi.

Many countries in Sub-Saharan African, including Malawi have embraced a systems approach to Agricultural Research and Development (Anandajayasekeram, 2005). An innovation is defined by the Webster's Ninth New Collegiate Dictionary as 'an introduction of something' or 'a new idea, method or device'. It was defined by OECD (1997) as 'anything introduced into an economic or social process'. The use of Innovation Platforms (IP's) in Agricultural Research and Development is a further use of a systems approach that embraces all relevant players in the value chain for an innovation. Rubyogo et al. (2010) reported successful use of IP's to disseminate improved bean seeds to 3.8 million households in Southern Africa. Through the involvement of an IP of ISFM stakeholders (farmers, extension service providers, local leaders, researchers and agro-input dealers), the need to scale out the use of lime and compost manure in Dedza was given priority, promoted through the utility of learning centers and closely facilitated by IP partners.

MATERIALS AND METHODS

Innovation platforms initiate ISFM research and development issues

The activities undertaken in this report were collaborative efforts of the Soil Fertility Consortium for Southern Africa (SOFECSA) to scale out ISFM activities, initially in the Central Region of Malawi. An Innovation Platform (IP) approach was used, which involved promotion of interactions of key ISFM stakeholders at different levels. The first level was the SOFECSA Country Team (IP 0). It comprised organisational representatives at country level, which were researchers from university, CG centres and government; NGO's; representatives from government extension and specialist departments. Its mandate was to set priorities for focused and coordinated research and development on ISM challenges for smallholder farmers in predominantly maize based farming systems. The country's team was facilitated by a technical hub or chore team (IP2) comprising an agronomist, agricultural economist and land resource management extensionist. The chore team called for meetings and facilitated the implementation of IP0. The IP0 met in December 2005 to review current ISFM status and options and set priorities for SOFECSA to facilitate. Among the priorities was promotion of lime application to ameliorate soil acidity in Bembeke Extension Planning Area (EPA) in Dedza. The activities, however, intensified in 2006/07 season. During a review meeting soon after 2006/07 season, a District level IP (IP1) also prioritized to demonstrate the potential role of compost manure as a compliment to liming.

Description of Bembeke EPA

Bembeke EPA, the site for the studies, lies at 14° 21′ E and 34° 21′ S, with an elevation of 1650 masl and a 15-year normal annual rainfall of 1300 to 1500 mm. The area falls under Dedza District Agricultural office which also falls under Lilongwe Agricultural Development Division in central Malawi.

Liming comparison for 2006/2007 to 2007/2008 seasons

At a meeting held in October 2006 between Bembeke EPA extension personnel and farmers (IP level 3), some 36 farmers agreed to host field plots or learning centers (LCs). The objective of the LCs was to provide a platform for different forms of learning such as exchange of observations and experiences amongst extension staff, researcher, farmers and other relevant individuals. The LC comprised two plots of 15 m by 10 m each, one limed at the rate of 2 t ha^{-1} and the other un-limed. To apply lime, the ridges were split and the lime was broadcasted and incorporated, while covering the ridge. Maize was planted in ridges 75 cm apart, 25 cm between stations with one plant per station, giving a target plant population of 55,500 plants ha^{-1}. A blanket fertilizer application of kg ha^{-1} NPK 69:21:0+4S was made to both plots, using the compound 23:21:0+4S for basal dressing and urea for top dressing. The farmers' crop served as 'standard' practice for the learning centre. All the management was undertaken by participating farmers, with encouragement and supervision from government extension personnel (Bembeke EPA staff). Maize grain yields and moisture content were recorded from 10 middle ridges. Yields reported were adjusted to 12.5 moisture content. Inputs for the plots (fertilizers and maize seeds (hybrid SC627) were supplied and distributed by SOFECSA technical hub (IP2). In 2007/2008, more farmers requested to host learning centers. SOFECSA managed to support a further 150 farmers. The farmers provided fertilizers and seed (mainly accessed via the government subsidy program), while SOFECSA facilitated the access and distribution of lime. Some of the limes were donated by a private enterprise (name withheld). The same treatments, plot sizes and management were applied.

Assessing residual benefits for 2007/2008 season

At the start of the 2007/2008 season, a feedback meeting at EPA level agreed to assess the residual benefits not only on maize, but other crops namely dwarf beans, climbing beans, potatoes and soybeans. However, seed of climbing bean could not be sourced and was dropped. The maize plots received fertilizers as in the previous season. While the other crops were managed according recommendations (MoAIFS, 2005).

Compost manure learning centers

The planning meeting for 2007/2008 season (IP0 and IP1) recommended that some compost manure LCs as well be established in Bembeke EPA, Dedza. The objective was to provide a platform for demonstrating to farmers and extension staff the role of compost manure and fertilizer combinations in acid soils. Ten farmers hosted these LCs which had two treatments only. The first treatment was maize with fertilizer (69:21:0:4S) only, while the second was maize with the same fertilizer (69:21:0:4S) plus compost manure. The compost manure was made by farmers as part of an on-going campaign. Farmers volunteered to use their manure to quench their curiosity for knowledge. The application rates were at farmer's discretion as well. The purpose of the study was to determine overall effects of manure use by farmers. Plot sizes were 10 ridges × 10 m. Ridges were spaced at 90 cm apart. Within the ridges, maize was planted 25 cm apart, with one seed per station, giving an expected plant population of 44,000 plants per ha. Seed and fertilizer inputs were provided by SOFECSA.

Harvesting, data collection and analysis

Plots were harvested by farmers with the help of extension personnel. Once harvested, the produce were kept in bags and dried in the sun. Research personnel organized by IP2 then came to weigh the yields from the bags and measure moisture contents, and also verified the plot sizes from which yield was harvested. Bulk soil samples were collected for new farmers in both seasons. Four to six samples of equal volume were collected from experimental plot area and bulked up for a composite sample. Samples were analysed for available phosphorus, nitrogen, pH in water, % organic matter, and textural classes at Chitedze Research Station Laboratory. In 2007/2008, samples were collected from each plot of the continuing learning centers. Other data collected was mean daily rainfall. On-farm crop yield estimates collected by extension using standard national procedure (MoAFS 2008) were adopted and used to compare performance of LC plots. Data was analysed using the analysis of variance procedure.

Increasing innovation platform (IP) interactions

The process of experimentation was designed to encourage interactions between farmers, extensionists and researchers in order to maximize the impact of scaling out. The SOFECSA country team (Innovation Platform level 0) organized two main platforms to facilitate interaction at the operational level. The first was a travelling workshop in the middle of the season (March 2007 and 2008), which brought together ISFM stakeholders at national and district levels to visit the field activities. These included representatives of Department Heads from MoAFS, NGO's, Agricultural Development Division representatives, District Agriculture and Agro-input dealers. Also included were field extension officers from other district participating in SOFECSA activities. The platform was the district level review and planning meeting which also included training sessions on ISFM components. The original farmer briefings were organized by the EPA staff. Farmers also held their own meetings as felt necessary. There was also a meeting at country level which brought together ISFM stakeholders to review the season and reorganize the objectives and strategies. The SOFECSA focal person assisted by chore country team ensured implementation of such strategies.

RESULTS

Rainfall and soil analysis data

The mean daily rainfall for the two seasons was used in understanding the results. However, only the mean monthly rainfall was reported (Table 1). The rainfall was considered adequate for good maize growth in both seasons. The rains finished rather early in 2007/2008 season, leading to early harvest by farmers and hence inability by researchers to record some yield results. Soil tests were collected and analysed for some LCs only. The results on pH, organic matter (OM%), %N and P (ppm) for 2006/2007 season are summarized (as means, standard deviation and ranges) in Table 2. The classification of results into critical levels was based on

Table 1. Mean monthly rainfall (mm) for 2006/07 and 2007/08 seasons recorded at Bembeke Experiment Station in Bembeke EPA, Dedza District.

Month	Season	
	2006/2007	2007/2008
October	14.0	44.5
November	308.0	44.9
December	153.5	274.2
January	546.4	712.9
February	242.9	236.5
March	234.2	172.2
April	14.8	4.5
May	5.0	0
Seasonal mean	1518.8	1489.7

Table 2. Summary of initial soil test results for learning centers established 2006/2007 at 0 to 15 and 15 to 30 cm sampling depths.

Soil depth		pH	OM%	Est N%	P ppm
0 to 15 cm	Number, n	25	11	11	22
	Mean	4.9	4.07	0.20	94.7
	St. dev	0.43	1.15	0.06	74.4
	Range	4.1 - 6.1	2.49 - 5.73	0.12 - 0.29	7.3
15 to 30 cm	Number, n	24	11	11	21
	Mean	4.9	2.83	0.4	60
	St. dev	0.45	0.73	0.04	77
	Range	4.2 - 5.8	1.96 - 4.47	0.1 - 0.22	1-321

Table 3. Summary of soil texture classification results for 0 to 15 and 15 to 30 soil depth.

Textural class	Percentage of samples in class by soil depth	
	0 to 15 cm	15 to 30 cm
Number of samples, n	22	21
Sandy clay (SC)	14	33
Sandy Clay Loam	59	24
Sandy Clay/Clay	9	4
Clay (C')	9	39
Sandy Loam	5	0
Clay/Clay Loam	5	0

recommendations of Chitedze Research Station Soils Laboratory (Chilimba, 1996). Out of the 25 data points in the pH results in the 0 to 15 sampling depth, 16% of the samples were in pH range 4.5 or less (very strongly acid), 72% were in range 4.6 to 5.5 (strongly acidic to acidic) and 4% had pH greater than 5.5. For the 15 to 30 cm depth, 21% of the samples were in the range 4.5 or less, 70% between 4.6 and 5.5, while 8% were above 5.5. In addition, for% OM, a range of 1.5 to 4% was considered medium, while that of ≤ 1.5 was considered low. For P, amounts of > 25 ppm are considered high. The soil texture results are summarized by textural class (Table3). Most soils were in sandy clay and sandy clay loam categories.

Table 4. Maize yield response (t ha^{-1}) to direct applications of dolomitic lime in 2006/07 and 2007/2008 seasons.

Treatment and statistics	2006/2007	2007/2008
Number recorded, n	25	46
Maize +69:21:0+4S , no lime	3.58	3.35
Maize +69:21:0+4S , 2 t/ha lime	4.68	4.20
Mean	4.13	3.77
P level	<0.001	<0.001
% increase	31	25
SED	0.18	0.17

Table 5. Maize yield and bean yield response (t ha^{-1}) to residual effects of lime in 2007/2008 season.

Treatment and statistics	Maize yield	Beans
Number recorded, n	46	12
Maize +69:21:0+4S , no lime, then beans	3.70	0.61
Maize +69:21:0+4S , lime, then beans	4.75	1.00
Mean	4.23	0.81
P level	<0.001	0.004
% increase	32	63
SED	0.17	105

Table 6. Comparisons of lime and un-limed plot yields and pH values for the direct (2006/2007) and indirect (2007/2008) effects assessments in the lime learning centers.

Variable	2006/2007		2007/2008^{+}	
	No lime	With lime	No lime	With lime
Maize yield, t ha^{-1} (n = 14)$^{++}$	3.28	4.57	3.79	5.22
pH, 0 to 15 cm (n = 14)	4.9	4.8	5.6	5.5
pH, 15 to 30 cm (n = 14)	4.9	4.9	5.5	5.5

$^{+}$The 'no lime' treatments refer to previous season applications. $^{++}$Comparison involves plots on which pH measurements were done in both seasons.

The effects of direct lime application in 2006/2007 and 2007/2008 seasons

In 2006/2007, yield results were recorded from 25 out of 36 LCs as shown in Table 4. The mean yield for un-limed plots was 3.58 t ha^{-1} compared to 4.68 t ha^{-1} for limed. A further analysis of results also showed that 16% of the plots gave yield of ≤ 10%, 36% of plots recorded yield increase in 10 to 25% range, 28% in 26 to 50% range and 20% recorded yields increase ≥ 50%. In 2007/2008, of the 150 farmers that applied lime, yield was recorded from 46 learning centers. Results in Table 4 showed that lime application significantly increased yield from 3.35 to 4.2 t ha^{-1}. Furthermore, of the 46 farmers, 33% had yield change of ≤ 10%, 24% gave yield change of 10 to 25%, 20% gave increase in range 26 to 50%, and finally 24% gave yield increase of > 51%.

Residual effects of liming on crop yields and soil pH in 2007/2008

The plots from 2006/2007 were utilized to monitor the residual effects of liming on maize and beans (Table 5). For maize, yield was recorded from 24 farmers. The residual effects increased yield from 3.7 to 4.75 t ha^{-1}. Of these farmers, 26% had change ≤ 10%, 17% had yield increase between 11 to 25%, 39% had increase between 26 to 50%, while 21% had increase greater than 50%. For beans (n = 12), there was a significant yield increase from 0.61 to 1.0 t ha^{-1}. The residual effects of other crops such as potatoes and garden peas were not monitored because participating farmers used produce before weights were recorded. In 2007/2008, soil pH was measured from 14 LCs. A comparison of pH values in the two seasons from the same LCs is shown in Table 6.

Table 7. Maize yield response to lime application in 2006/2007, classified according original soil pH.

pH_w class	Yield without lime, t/ha	Yield with lime, t/ha	Average increase
≤4.5 (n = 5)	2.17	2.57	21%
4.6-5.5 (n = 18)	4.03	5.29	31%
≥ 5.6 (n = 2)	3.00	4.05	35%

Table 8. Maize yield response to compost manure application in 2007/2008 season.

Treatment	Maize yield, t/ha
Maize + 69:21:0+4S, no compost (n=8)	4.25
Maize + 69:21:0+4S, with compost (n=8)	5.84
Farmer practice (n=5)	2.31
Mean	4.14
P	<0.001
SED	0.99

Table 9. Smallholder crop yield estimates for Bembeke EPA compared to national figures in 2006/2007 and 2007/2008 seasons.

Variable	Season and crops			
	2006/2007		2007/2008	
	Maize	Beans	Maize	Beans
Bembeke, crop area (ha)	8280	4155	6727	4298
Bemkeke yields ($t\ ha^{-1}$)	0.90	0.39	1.16	0.39
National yields ($t\ ha^{-1}$)	2.65	0.494	1.53	0.556

Adapted from MoAFS 2007; FEWSNET 2008

While lime application resulted to an increase in soil pH the subsequent season, there was an unexplained increased pH in plots that had no lime application in previous season.

Compost manure results

The simultaneous application of compost manure and fertilizer gave a yield increase of 1.59 t ha^{-1} over fertilizer alone, but the increase was not significant (Table 8). Both fertilized treatments were significantly higher than the farmer practice.

Yield and soil data relationships on farm yield estimates

There was no significant regression between initial soil pH and yield, nor soil P and pH in the first season. However, in a further analysis, yield data was classified according to soil pH categories in top 0 to 15 cm (Table 7). The classification showed that LCs with pH ≤ 4.5 gave the lowest yield without lime, followed by LCs with pH ≥ 5.6. The average increase was about 30% for all categories. In order to compare yields from LCs with the general crop performance in Bembeke EPA and at national level, crop estimates for maize and beans were obtained and shown in Table 9. The data show that those from the LCs were higher than both the Bembeke EPA and national estimates.

Key outputs of IP interactions

To facilitate adoption of change, SOFECSA adopted Innovation Platform (IP) approach in setting out the liming interventions. There were 4 levels set up, with each having taken specified roles as summarized in Table 10. The roles undertaken are also described throughout this study.

DISCUSSION

Soil test results, rainfall and crop yields

The soil test results showed that although soil reaction was variable, most (72%) of the soils were acidic (pH_w ≤ 5.5), thus needing amendment (Chilimba, 1996, 2005 Snapp, 1988) Variability in soil pH in the same rainfall zone is usually due to variations in soil management

Table 10. Composition and roles Innovation Platforms (IP's) at different levels.

IP level and composition	Outputs relating activities on acid soil in Dedza
Country Team IP level 0. Comprising organizational representatives from government, NGO's and private sector. Convened by SOFECSA focal person	Organized initial and annual country level meetings, provided oversight to technical hub, review of technical oprtions
District level IP level 1, comprising district organizational representatives of IP level 0. Convened by district agriculture officials, facilitated by Technical Hub and SOFECSA focal person	Involved in monitoring and evaluation, set up priorities on activities undertaken, facilitated action at operational level.
Technical Hub, IP level 2. Comprising key researchers and technical matter specialists. Was convened by SOFECSA focal person.	Preparation of manuals for LC's, sourcing and circulating technical information and input sourcing, packaging and distribution of resources for learning centres, organized soil sampling, data recording and analysis and reporting.
Operational level at EPA. IP level 3. Comprising farmers, EPA staff, and value chain players at the EPA. Convened by EPA officials, facilitated by SOFECSA.	Participated in District level planning meeting, fostering linkages, feedback with farmers and other partners, implementing IP resolutions at all levels. Organized farmer to famer visits, and supervised learning centre management.

by individual farmers, particularly with respect to the use of fertilizer and organic matter. Management that promotes crop nutrient uptake and residue incorporation favors minimal leaching and higher pH (Yamoah et al., 1996; Hoyt and Turner, 1975). The yields of maize and beans (with or without lime application) recorded in these studies were well above EPA yield estimates (Table 4) and national yield estimates of 2.65 and 1.53 t ha^{-1} for 2006/2007 and 2007/2008, respectively. High yields were likely due to the use of fertilizer and proper crop management. Also average soil N, organic matter and P are classified medium or high (Chilimba, 1996). This observation of higher in test plots was consistent with most studies which show higher yields on supervised plots on farmer's fields (Kumwenda and Benson 1998; MAI, 1997, 1999).

Crop responses to lime and compost

In both 2006/2007 and 2007/2008 seasons, there was an overall maize yield response to direct lime application. The results support the recommendation for lime application (Chilimba, 2005). In addition, a further analysis of the responses showed that yields were lower in soils that were more acidic than in less acidic soils (Table 8). This result supports the knowledge that soil acidity is also indicative of the activity of soil microorganisms, likelihood of excess phytotoxic ions in soil solution and relative availability of most plant nutrients (Maida, 1985). Other benefits of liming have already been mentioned earlier in this paper. The yields and yield responses in Table 8 also strongly support the classification of pH critical levels by Chitedze Research Station (Chilimba, 1996). The lower yield in lower pH soils could suggest that the application rate of 2 t ha^{-1} was low for such soils. In 2006/2007 season, 52% of the LC's gave ≥ 25% yield, while in 2007/2008 40% of LCs gave ≥ 25% yield increase. This observation further confirms that responses varied. The current rate of 2 t ha^{-1} is the best rate as a blanket rate, as it reduces risks for non-responsive soils. It would be important to establish correlations between soil test parameters so that future application rates should be determined beforehand. Being able to make yield gains in same year of application is important for farmer acceptance. There are several other previous reports on yield gains in same season (Yamoah et al., 1996; Onwonga et al. 2008).

The variation in soil pH and other soil test variables, and the variation in crop responses to lime applications are of interest as they emphasize that reward exists for individual management of soils. In this study, however, meaningful inferences based on correlation between variables was hampered due to low numbers of tests conducted for soil organic, P and estimated N. The remarkable response to compost manure application is of interest since farmers can be encouraged to use this option noting that agricultural lime is not yet comercialized and easily available.

Role of innovation platforms

The use of innovation platform in the dissemination of agricultural technologies is considered to be an improvement over the farmer- researcher-extension approaches. The key difference being that IP's bring more players from value chain, such as input and output traders and policy makers. Experiences in this study showed it was hard to engage input or output traders, even with invitations served. A possible reason is the lack of tangible tradable opportunities in the early stages. It is interesting to note that while one company donated lime for the LC's in the second year, there was no further interest to attend actual IP meetings and field tours that should have created trade opportunities. In as far as scaling out of technologies is concerned, we consider the approach highly successful, looking at the large interest created amongst farmers. In a wide approach, Rubyogo et al. (2010) indicated that partnerships were solidified via Memoranda of Understanding (MoU). However, the project did not have full time personnel in the area to probe partnership engagement.

Conclusion

It can be concluded from these studies that lime and compost manure applications are effective methods to ameliorate the effects of soil acidity. It is therefore recommended that proper calibrations and correlations should be done by researchers to predict applications rate for each soil. The benefits can be accrued in same season of application, and can spill over at least to the subsequent season. The IP learning alliance approach to scaling out of technology is quite effective, although not effective in engaging traders, who perhaps needed much closer interactions by full time facilitators.

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