Land Degradation and Smallholder Farmers' Response: A Case of Villages in the Southern Parts of Ludewa District, Iringa Region

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Abstract

A cross sectional study was conducted to investigate response of smallholder farmers to land degradation in the southern parts of Ludewa District. The study involved 240 respondents randomly selected from stratified population based on gender and type of village. Besides, focus group discussions were made to gauge farmers' opinions based on age and gender for sixteen groups, and key informants provided trends of land use. The smallholder farmers' perceptions on the status of soil fertility varied from one village type to another, where over 70 % of the respondents in the villages that experienced out-migration acknowledged the decline in soil fertility in their farms compared to less than half (44 %) in those villages that experienced in-migration. Over 50 % of the respondents in all villages attributed the decline of soil fertility to continuous cultivation where less than 30 % of the respondents left their farm fallow for two to five years. To overcome the impact of loss in soil fertility, over 50 % of farmers adopted improved cultivars of cassava, and 12 % adopted new maize cultivars. Over 90 % of new cassava crop cultivars were supplied by farmers. However, only 4.2 % irrigated their rice farms, 28.3 % used animal manure and 8.8 % applied pesticides in their farms. Based on the findings, it can be concluded that few farmers are accessed by extension services and efforts to restore soil fertility are negligible. The study recommends extension services to enhance its support to smallholder farmers' initiatives in maintenance of crop cultivars and ensure proper land uses.

Keywords: Adoption of new crop cultivars, improved production practices, land degradation, smallholder farmers, soil fertility, southern parts of Ludewa District.

Introduction

Land degradation is one the challenges that affect the quality of land resources used by smallholder farmers. The damages in the state of land resources due to land degradation not only lower land productivity but also reduce the quantity of available land (Dumanski and Pieri, 2000). In most cases, land degradation induces land shortages resulting in shortened fallow periods, increased continuous cultivation, and increased pressure on the immediate accessible land (Ehui, 1993). Land shortage in the sparsely populated parts of Ludewa District is associated with the villagization programme of the 1970s (Friis-Hansen, 1987). The villagization programme increased population pressure in the southern parts of Ludewa District by increasing population density from 6.1 persons per square kilometre in 1967 to 16.7 persons per square kilometre in 2002 census (URT, 2005). The increased population pressure and continuous cultivation exacerbated the problem of land degradation. Continuous cultivation depletes soil fertility and reduces crop yields (NSS, 1988). The depletion of soil fertility affects the capability of the soil to supply nutrients essential to enhance plant growth (Follet and Wilkison, 1985 cited by Follet *et al.*, 1987). In the absence of crop rotations, low soil fertility status favour build up of pests and diseases in both the soil and host plants (Meindertsma, 1997). Recent study in Iringa and Chunya Districts found that low soil fertility favoured striga infestation and led to low

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maize yields (Msaky *et al.*, 2007). Similarly in the southern parts of Ludewa District, low soil fertility status was behind the outbreak of Cassava Mealy Bug in 1987 and localized famine in 1990s (EWB-SFP and NGEDEA, 2005).

Despite vast knowledge on impact of low soil fertility on crop production, there is late response among smallholder farmers to take the required corrective measures. This is due to lack of early awareness on the loss of organic matter and nutrients compared to other manifestations of land degradation such as soil erosion (MacDonagh *et al.*, 2001 cited by Amede, 2003). In that case, the actions taken to tackle the problem always come not only too late but also when it is out of control. In addition to the limited resources, some farmers are forced to abandon their farms and migrate to other areas to open up new farms. Hence, assessment and building of farmers' awareness on the decline of soil fertility and associated changes is essential for improvement of their livelihoods.

Tanzania has employed various strategies to overcome the problem of soil fertility and to ensure optimal plant growth and effective use of available land. The first strategy is to promote the use of external inputs to either increase productivity or maintain an absolute yield level for subsistence is needed (Johnson, 1997). This involves availing subsidized inorganic fertilizers to smallholder farmers. In 2006/2007 season, the government increased subsidy on inorganic fertilizer from Tshs. 7.5 billion to Tshs. 21 billion so that its use in maize production could increase from the current average of 8 to 50 kg of fertilizer per hectare. The low levels of fertilizer use in Tanzania can be attributed to among others, the lack of mechanisms to ensure that subsidies given on fertilizer are not siphoned by sources other than farmers as observed in Turkey by Aydin (2002).

Apart from chemical fertilizers, other strategies available in order to raise per capita food production among smallholder farmers include use pesticides, improved seeds, and herbicides. However, the external induced agricultural intensification efforts have concentrated on the main export crops and in cereals, particularly maize in high potential areas (Maxwell, 2001; Sanders and Shapiro, 2005). In addition, policy interventions rarely consider the low potential areas and its associated traditional crops such as cassava, pigeon peas, groundnuts, millet, and sorghum (Glantz, 1994). As a result of the neglect of land management aspects, farmers tend to abandon degraded land and move to new land. With vast unoccupied lands, extensive farming is likely to continue and intensification is unlikely to occur (Holmén, 2005). In that case, inadequate agricultural intensification is responsible for degradation of marginal lands and is behind the inability to produce sufficient food (Brown and Haddad, 1994). Land degradation affects food security through its impacts on food production (Wiebe, 2003).

Despite the known importance of improved technologies in crop and animal production, most studies in agricultural intensification have paid attention to farmers' response to new technologies and the extent to which these technologies had been adopted (Rasmussen, 1986; Mwangi *et al.,* 1999; Mwaseba *et al.*, 2005). Under the Agricultural Sector Programme Support (ASPS), on-farm seed production projects were implemented in the southern parts of Ludewa District to induce increased availability and use of quality seed varieties (Kamuzora, 2003). But little is known on how the existing sources of seeds and planting materials are sustained and maintained. The shortage of seeds and/or planting materials among smallholder farmers is behind the decrease in area planted and persistent food insecurity (Meindertsma, 1997). This paper presents the findings of a study that was done to examine the smallholder farmers' responses to change in soil fertility due to land degradation in the southern parts of Ludewa District. To achieve this, the study assessed the farmers' perceptions on the change in the status of soil fertility in their farms, identified and analysed agricultural practices adopted by farmers to overcome impacts of change in soil fertility and achieve food security.

Materials and methods

Study Area

This study was conducted in Masasi division, in Ludewa District which is the southern part of Iringa Region, in the Southern Highlands of Tanzania. Masasi division is found in the Ruhuhu Basin whose landscape is characterized by undulating with some rocky hills and steep ridges with elevation ranging from 500m to 1100m above mean sea level from Lake Nyasa shore to the Ruhuhu escarpment. The dominant vegetation in Masasi division is Miombo woodland in hilly and upland areas, wooded or bushed grassland on undulating landscape, and scattered acacia shrubs, baobabs and combretum spp on plains and floodplains along major rivers. The average annual total rainfalls vary from 800 to 1,200 mm and rainy season start in mid December and continue until April.

Four villages namely, Lifua and Kipangala in Luilo ward, Kiyogo in Masasi ward and Kimelembe in Nkomang'ombe ward were purposively selected based on the history of population movements. In mid-1970s as a result of villagization programme, Lifua and Kipangala villages received many new comers. But in the late 1980s and early 1990s the villages witnessed an increased number of their people going back to areas they had occupied prior to villagization or migrating to neighbouring villages. In contrast, all residents of Kiyogo and Kimelembe villages were moved to other places during the villagization programme. Settlements in Kimelembe were re-established by the government in 1981 for people who were affected by floods in Lituhi village in Mbinga District. However, since early 1990s, the village had received people from neighbouring villages. Likewise, people started to return to Kiyogo village willingly in 1986. In recent years, the villages that are experiencing in-migration produce food surplus in most of the seasons to the extent of supporting the villages experiencing out-migration. This is also confirmed by survey in the study area which revealed that over 60 % of the respondents in the villages that experience in-migration reported to never food insecurity whereas relative similar ratio (62.5%) in the villages that experience out-migration often experienced food insecurity. In this paper, Lifua and Kipangala villages will be referred to as the villages experiencing out-migration, whilst Kiyogo and Kimelembe as the villages experiencing in-migration.

Research design

This study used a cross-sectional survey design, which constituted collection of data from stratified population of smallholder farmers at a single point-in-time (Stern *et al.,* 2004). The sample of 240 households was randomly selected from stratified population based on gender and type of village. The lists of households in the sub-village registers were used as the sampling frames where 24 female-headed households and 36 male-headed households in each village were included in the survey. The distribution of respondents for sub-villages was purposefully made through discussions with village leaders based on the number of households. In addition, a sample of 20 farmers in each study village from different age groups and gender (five males, five females aged above 40 years, five males, five females aged below 40 years) were used in the focus group discussions (FGDs). The composition of participants in the FGDs based on age and gender enabled to get different opinions on the use of various production strategies based on accessibility to various resources. Besides, 18 to 24 members of the village government councils (VCs) and 10 District staff were purposively selected and used as key informants on issues related to policies, by-laws and trends related to land use.

Data collection and analysis

A structured questionnaire was administered to smallholder farmers' households to collect information on farmers' perceptions on change in the status of soil fertility and agricultural practices adopted to ensure food security. The farmers' questionnaire was pre-tested in Luilo and Nkomang'ombe villages that were not used in the main study. In addition, the focus group discussions (FGDs) based on semi-structured interviews were conducted to groups of five persons of the same gender and age group. All FGDs were tape recorded except for Kimelembe village due to technical problems with the tape recorder. Farmers' interviews were held at their respective homesteads while FGDs were carried out in the village offices. Besides, discussions with key informants were also used to collect data.

The data collected were analysed both quantitatively and qualitatively. The qualitative data analysis was grounded on the original accounts of experience and observations of the people and their interactions with land resources in the field (Ritchie and Spencer, 2002). The information from FGDs and key informants were analysed with the help of content analysis. The recorded dialogue was transcribed, sorted, and labelled to make judgements about meaning as it stands or in the context of interview, relevance, and importance of key emerging issues. In contrast, survey data collected were verified, coded and analysed using the Statistical Package for Social Scientists (SPSS) computer programme (Field, 2000). The counts, category of peoples' perceptions and products were used to generate descriptive statistics such as mean, mode, frequencies and percentages that summarized the distribution of respondents. On the other hand, chi-square, frequency tables and bar charts explained the relationship between variables such as perceptions on change in soil fertility. The differences in emerging relationships for different study variables were decided at $p \leq 0.05$ level of significance.

Ressults and discussion

Farmers' perceptions on the status of soil fertility

Farmers' perception on the status of soil fertility in their farms was a major indicator used in understanding the change in the state of land resources due to land degradation. Figure 1 shows that over two thirds of the respondents, (71.7%) in the study villages that had experienced out-migration indicated that their farms had experienced a decrease in the status of soil fertility in the past five years (2000-2005). In contrast, more than half, (54.2%) of the respondents in the villages that had experienced in-migration were on opinion that for the period between 2000 and 2005, the status of soil fertility in their farms had not changed (Figure 1). Respondents' views on the status of soil fertility were statistically significant at $p \leq 0.05$ between the villages that had experienced out-migration and those that had in-migration.

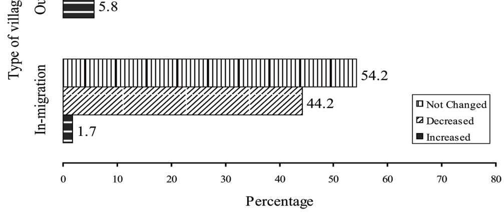

Figure 1: Farmers' perceptions on the status of soil fertility

Figure 2 shows the major reasons for the decline in soil fertility in the study area. Continuous cultivation was the main reason for the depletion of soil fertility identified by 63 (69%) and 27(51%) of the respondents in the villages that had experienced out-migration and in-migration, respectively. According to FGDs, the major reasons for continuous cultivation tended to vary from one village to another (Table 1). FGDs' participants in Kipangala and Kiyogo attributed continuous cultivation on a piece of land as a result of land shortages. High concerns for land shortages were noted among the male participants aged below 40 years and female participants aged above 40 years in Lifua village. In contrast, males aged above 40 and female aged below 40 years indicated that the main reason for continuous cultivation of their farms the main reason for continuous cultivation of their farms was labour shortages especially in clearance of new land. The participants argued that in the past, most of the intensive land clearing works were done by hired labour. But, the deterioration of land and worsening livelihoods in the southern parts of Ludewa District had lowered the economic power of most farmers forcing them not to hire labour from outside.

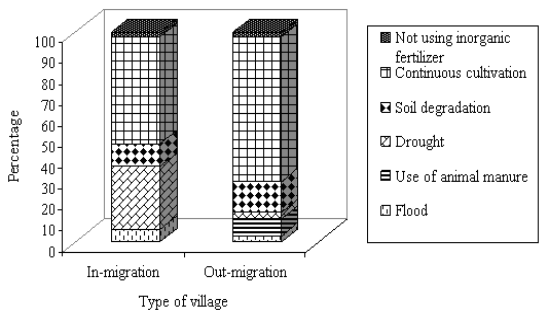

Figure 2: Reasons for change in soil fertility

On the other hand, survey results indicated that the contribution of incidence of floods to the change in soil conditions was negligible in the study villages (Fig. 2). The influence of floods on change in soil conditions depended on the amount of rain, as mentioned by 30 percent of the respondents in the villages that had experienced in-migration that drought was responsible for the change in soil fertility. Farmers association of drought to decline in soil fertility is also reported in Manyoni District, Tanzania by Mnkabenga (2001).

Table 1: Scores on reasons for continuous cultivation as reported by FGDs participants by age group and gender at Lifua, Kipangala and Kiyogo Village

Variable	Participants scores in Lifua village				
	Participants above 40 years		Participants below 40 years		Total Score
Reason for continuous cultivation	Male	Female	Male	Female	
Land shortage	15	17	20	15	67
Shortage of labour for clearance of new farms	18	16	9	20	63
Population growth	9	9	9	9	36
Difference in soil fertility	8	9	12	6	35
	Participants scores in Kipangala village				
Land shortages	12	13	13	9	47
Enable effective use of animal manure	10	9	6	9	34
Farms being close to the homesteads	10	6	11	6	33
	Participants' concern scores in Kiyogo village				
Land shortage	9	10	12	12	43
Land considered fertile	6	10	8	4	28
Farms being close to the homesteads	3	4	4	8	19

The decline in soil fertility due to continuous cultivation in the study area is associated by the shortening of fallow period as shown in Figure 3. Traditionally, the fallow periods in the study areas had been long enough to allow for soil fertility replenishment. Less than half of the respondents, (42%) in the villages that experienced in-migration were forced to cultivate their farms continuously. Because of this, only 6% of all 240 respondents reported to had left their farms fallow for three to five years, which was the longest period the farm were allowed to rest. There were no statistically significant differences at p≤0.05 in the trends of fallow period between the villages that had experienced out-migration and in-migration. The reported shortened fallow period in the study area implied that there was an induced land shortage, which created an opportunity for intensification of land use. But, with no addition of external inputs such as organic manure and inorganic fertilizers, the reduced fallow period led to soil mining with reduced yields and increased food insecurity. The current inefficient land use and/or the existing technologies available to smallholder farmers in improving exhausted land had also been illustrated by the study in Iringa District by Birch-Thomsen *et al*. (2002).

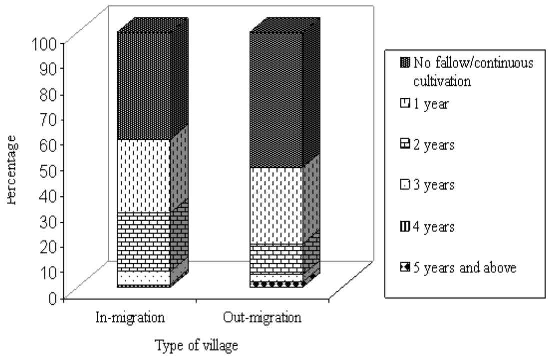

Figure 3: Fallow period variations across villages

Efforts to overcome impact of land degradation to achieve food security

In order to overcome the decline in yields as a result of reduced soil fertility, smallholder farmers in the study areas responded by adopting different cropping patterns as given in Table 2. Over 75 percent of the respondents reported to practice intercropping. In contrast, less than 35 percent respondents were practicing monoculture and sequential cropping was reported by less than 30 percent of the respondents in Kiyogo village. The reasons for intercropping and monoculture at Lifua and Kimelembe villages are given in Table 2. Intercropping enabled proper utilization of the first rains. The utilization of first rains scored low though it was essential in spreading

Table 2: FGDs reasons for intercropping and monoculture by age group and gender at Lifua and Kimelembe Village

Variable	Participants scores at Lifua village				
	Participants above 40 years		Participants below 40 years		Total Score
Reasons for intercropping	**Male**	**Female**	**Male**	**Female**	
Shortage of labour	17	25	15	30	87
Land shortage	18	23	25	19	85
Traditional methods of cropping	24	16	18	25	83
Timing of early rain plating	16	10	16	13	55
Improve soil fertility	16	15	20	10	61
Need for diverse crops	14	19	11	8	52
Reasons for intercropping	**Participants scores at Kimelembe village**				
Timing of early rain plating	25	24	23	23	95
Land shortages	15	18	20	22	75
Need for diverse crops	18	16	15	15	64
Lack of enough seeds for preferred crop	15	15	11	10	51
Prevent spread of pests	5	8	6	5	24
Reasons for monoculture	**Participants scores at Kimelembe village**				
Good crop growth	24	24	20	21	89
More yield	19	21	24	22	86
Simplify weeding	15	14	16	17	62
Simplify harvesting	8	11	10	10	39
Soil type	8	5	5	5	23

the drought risk and avoiding crop failure as reported by Tengö and Belfrage (2004) in Mbulu highlands of Tanzania.

In areas of acute shortage of arable land (more than 50% of land in Kiyogo is rocky outcrops), sequential cropping maximized crop harvested from a unit area of land and enhanced food security. Double cropping in Kiyogo village was made possible by excess moisture stored in Ruhuhu floodplains enabling maize and sweet potatoes to be planted and harvested more than once per season. Such developments were also observed in Lifua village where sweet potatoes were planted after harvest of rice. However, in general, the opportunity of double cropping in the villages that experienced out-migration has been limited by the drying of wetland areas.

Apart from practicing different ways of cropping, in the period between 2000 and 2005 farmers in the study area reported to adopt improved production practices (Table 3). The results show that most of the respondents, (99.2%) in the study area never applied inorganic fertilizers in their farms. The number included all respondents in villages that had experienced out-migration plus 98.3% of the respondents in those with in-migration. There were no statistically significant differences ($p=0.109$) in the use of inorganic fertilizers between villages that experienced out-migration and those with in-migration. Low adoption rate of inorganic fertilizer among farmers is contrary to efforts taken by the government in recent years to increase the use of inorganic fertilizers especially with the resumption of subsidies. Participants in FGDs asserted that the use of inorganic fertilizers in the study area was only common in the tobacco fields. The termination of tobacco cultivation in 1999 not only cut off the supply of inorganic fertilizers in the study area but also removed the institutions responsible for supporting smallholder farmers in input supply.

On the other hand, the study found that there was significant increase in the use of animal manure in the villages that had experienced out-migration. The results show that fifty percent of the respondents in the village that have experienced out-migration were using animal manure. The main sources of animal manure were livestock keepers. Discussions with female participants aged below forty years in Lifua village, asserted that manure was offered free of charge by cattle keepers for the first request (one season demand). Later requests for manure must be paid either in cash or in kind. In contrast, male aged below forty said they are willing to buy inorganic fertilizers and considered that traditionally it is unfair to buy locally produced manure.

Table 3: Adoption of improved production practices in four study villages in Ludewa District, Iringa Region

Variable	Percentage of surveyed households using improved crop production techniques											
	Inorganic fertilizer		Animal draught		Pesticides		Compost		Animal manure		Irrigation	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
In-migration	98.3	1.7	98.2	1.7	99.2	0.8	95.0	5.0	93.3	6.7	100	0.0
Out-migration	100	0.0	100	0.0	83.3	16.7	96.7	3.3	50.0	50.0	91.7	8.3
Total	99.2ns	0.8ns	99.2	0.8ns	91.3*	8.8*	95.8ns	4.2ns	71.7*	28.3*	95.8*	4.2*

* Statistically significant at p≤0.05; ns not statistically significant at p>0.05

Notwithstanding this opinion, the negative attitude towards the use of animal manure could be the reason for its low adoption. Other studies done in Southern Highlands of Tanzania found that farmers failed to use manure in their croplands due to its low supply as the number of cattle kept was low (Jackson and Mtengeti, 2005). The official figures offered by Village Executive Officers (VEOs) indicated that Lifua had 603 cattle, Kipangala 850, Kiyogo 420, and Kimelembe 140 during the time of the survey. Other reasons that FGDs members mentioned for low use of animal manure were laziness of villagers at Kipangala, fear of increased weed growth, increased soil moisture stress during dry spells, long distance to the farms, lack of transport, and availability of alternatives source of nutrients from acacia tree stems and leaves in Kiyogo village.

The study also revealed that 10 (4%) of the respondents reported to irrigate their field crops, especially those in the Nyangundi irrigation scheme in Lifua village. According to the socio-economic reports available in the District Council, Lifua had an area measuring 1,500 hectares with a potential for irrigation and the irrigation scheme served only 60 members out of the 1,158 villagers who irrigated 279 hectares of paddy. The increase in irrigated land away from the river banks has potential for reducing the invasion of natural springs in the wetlands. But, such expansion was limited due to inadequate water supply. Discussions with key informants at Lifua village indicated that for the 2005/06 and 2006/07 growing seasons, water failed to reach the scheme area as floods swept away part of the poorly constructed canal. Lack of water for two seasons was a great loss to farmers since participants in the FGDs reported that incomes from irrigated rice were high next to cashew nuts and cattle.

Despite efforts made by CONCERN in the study area in the mid 1990s to promote crop production techniques, study results showed that there were no significant increases in the adoption of draught animal power and use of compost manure among villagers (Table 3). The low use of mechanization for cultivation, farm transport, and processing in Tanzania has also been reported by Mpanduji *et al.* (2007). The study results revealed high use of pesticides though for few households in villages that had experienced out-migration. FGDs participants attributed the increase in pesticides use to the revival of cashew nut production. The necessity of applying sulphur dust on the cashew trees to control powdery mildew disease that infests terminal buds, young shoots, flower buds, young fruit and nuts in southern Tanzania is also reported by Ngatunga (2001).

Another strategy that villagers took to mitigate the impact of reduced crop production due to land degradation in the study area was to adopt new crop cultivars. Respondents in the study villages indicated to have adopted five new cassava cultivars namely, Sawalepi, Gomani, Kifuu cha Nazi, Goma Stella and Leonia as shown in Table 4. The adoption of new cassava cultivars was found to be statistically significant but differently in the study villages. Gomani and Kifuu cha nazi were the widely adopted cultivars (by 88 and 77 out of 240 respondents, respectively) across all villages in the study area whereas Leonia and Sawalepi were dominating in Kiyogo and Lifua villages, respectively.

According to discussions with key informants, of all the new cultivars grown, the bitter Sawalepi variety did well in the sandy soils provided there was enough moisture. Sawalepi's high demand for moisture could be the reason for the increasing trend of villagers to

Table 4: Distribution of respondents who adopted new cassava and maize cultivars in the study villages

Variable	Village										
	Kimelembe (n=60)		Kipangala (n=60)		Kiyogo (n=60)		Lifua (n=60)				
New cassava cultivars	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**χ2**	**df**	**p-value**
Gomani	50	10	11	49	53	7	38	22	78.804	3	.000
Goma Stella	51	9	57	3	59	1	57	3	9.643	3	.022
Kifuu cha nazi	57	3	31	29	18	42	57	3	87.54	3	.000
Leonia	60	0	60	0	16	44	60	0	161.633	3	.000
Sawalepi	60	0	59	1	60	0	19	41	143.261	3	.000
New maize cultivars											
TMV	60	0	48	12	60	0	60	0	37.895	3	.000
Katumani	59	1	44	16	36	24	49	11	27.300	3	.000
Kilima	37	23	60	0	60	0	60	0	76.313	3	.000

encroach water sources and river banks. Key informants reported that most of the traditional cassava cultivars (Songoro, Maulidi, Bandua meno etc.) with exception of Kagunila had vanished with the outbreak of cassava mealy bug as they failed to withstand the new pests.

Furthermore, discussions with members of the village councils revealed that extinction of traditional cassava cultivars is attributed to the action taken by the government in responses to outbreak of cassava mealy bug. First, the government forced farmers in Masasi division to uproot all growing cassava stocks in their farms. Second, the government banned cassava growing for three consecutive years. In the absence of centres for production of cassava planting materials in the District, the uprooting of cassava not only denied farmers the sources of planting materials but also led to the extinction of most of the traditional cultivars.

Apart from adoption of new cassava cultivars, respondents in the study area indicated to have adopted new maize cultivars, but the extent was statistically different between the villages (Table 4). The results show that the adoption of Katumani was widespread across the study villages, whilst the adoption of TMV and Kilima were common among the respondents in Kipangala and Kimelembe village, respectively. According to discussions with the Council Management Team, new maize cultivars were introduced to suit the agro-climatic conditions. According to discussion with DALDO office staff, Kilima does well at high altitudes while TMV performs well at the low altitudes.

On the other hand, participants in FGDs attributed the increasing importance of maize in the traditional cassava producing area to increased use of animal manure and other domestic wastes. The use of organic manure made possible the utilization of depleted sandy soils close to their homesteads for maize cultivation. In addition, the increase in importance of maize is attributed to the shorter time (two to three months) required for maize to mature and be ready for harvesting compared to cassava which take more than a year in Kipangala and Lifua villages.

To assess the support given by various institutions to enable smallholder farmers to improve their livelihoods, it was necessary to establish the sources of improved crop cultivars adopted by smallholder farmers. The results in Table 5 indicate that the first source of cassava planting materials for 99.4% of the respondents was neighbouring farmers. This fact is typified by the names given to new cassava cultivars such as Sawalepi and Leonia that had been named after those who introduced them. Neighbouring farmers were also the main sources for the adopted maize cultivars in the study area. According to the District staff, the farmers who supplied new maize seeds were those who collaborated with researchers in the on-farm seed production projects under the Agricultural Sector Programme Support (ASPS).

Unlike the case for cassava, there were more villagers who introduced new maize cultivars (Table 5). The support and importance given to cereals like maize in extension packages was also noted in Zimbabwe by Mapfumo *et al.* (2001).

Despite the increasing number of actors participating in the promotion of improved maize cultivars, only three female headed households reported to have access to extension services compared to the 15 male headed households. NGOs managed to supply improved maize cultivars to 13 (15.1%) of the female headed households respondents compared to 12 (14%) males. These results imply that the multiplicities of actors do not always guarantee accessibility to all. Also, the results remind decision-makers of the long standing need for the current government extension system agencies to enhance gender balances.

Table 5: Respondents source of new cassava and maize cultivars in Ludewa District

Variable	Distribution of households in the study villages			
Source of new cassava cultivars	**Kimelembe**	**Kipangala**	**Kiyogo**	**Lifua**
Extension officer	1(9.1)	0(0)	0(0)	0(0)
Neighbouring farmer	10(90.9)	57(100)	56(100)	47(100)
Source of new maize cultivars				
Extension officer	5(21.7)	0(0)	7(29.2)	6(50)
Neighbouring farmer	11(47.8)	18(66.7)	10(41.7)	1(8.3)
NGOs	5(21.7)	8(29.6)	7(29.2)	5(41.7)
Pilot Project	2(8.7)	1(3.7)	0(0)	0(0)

Figures in parentheses are percentages and those out of it are frequencies

Conclusion

This study has revealed that land degradation as manifested by soil fertility depletion is one of the challenges facing smallholder farmers in southern parts of Ludewa District. In this case, farmers' perceptions on the status of soil fertility have a significant contribution addressing the impacts of land degradation. The study has revealed that smallholder farmers were aware of the changing status of soil fertility in their farms and attributed it to continuous cultivation and shortened fallow periods brought about by land shortage. In the absence of use of the inorganic fertilizers and/or limited application of animal manures land degradation in the study area is likely to continue.

In addition, the study has demonstrated that smallholder farmers have adopted various agricultural technologies to overcome the problem of depleted soil fertility and achieve food security. The study has also found smallholder farmers to be the main source of planting material and seeds in the study villages. The role of smallholder farmers in introduction and adoption of new technologies though recognized by policy-makers, it has not been fully utilized in the supply and maintenance of crop cultivars. The current extension systems need to address and incorporate smallholder farmers to make use of the local knowledge and experiences essential for agricultural development.

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