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Building on Smallholder Traditional Farming Practices to Enhance Cost-effective Land Resources Conservation in Malawi: A Case Study of Sangadzi Area

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Abstract

In Malawi land resources degradation is a serious problem threatening productivity of land resources and affecting the livelihood of the majority of smallholder farmers. Programs to curb further degradation of the land resources and ensure increased food security among the resource poor households are underway. Most of these programs however, tend to focus more on the research-tested conventional methods than on traditional farming methods and practices. However, understanding traditional farming practices and building on what farmers do based on the resources under their exposure, offers an opportunity to redirect conventional research efforts towards provision of sustainable solutions to the common rural problems of hunger and land resources degradation. Based on a field survey, the objective of this paper is to analyse smallholder traditional land resources conservation practices and soil fertility management techniques and try to find their compatibility with the research efforts.

1. Introduction

In most countries of the sub-Saharan Africa, rapid rural population growth has been associated with decline in farm sizes, degradation of the agricultural environment and other strains on the natural resource base. High rural population growth has led to a fast decline in the size of farmland, thereby forcing smallholder farmers to encroach some of the fragile land resources in the struggle to raise food production for the expanded household population. However, rather than population growth, intensified tillage practices on the fragile and small landholdings have more to do with land resources degradation than the mere increase of human beings on a given agricultural land. In agriculture, tillage is usually restricted to modifying soil conditions, managing crop residues and weeds, and incorporating chemicals for crop production (Anonymous, 1997). In many parts of Africa, high rural population growth has resulted in increased reliance upon continuous cropping rather than rotational fallows (Mrabet, 2002). Small farm size precludes the practice of traditional land fallowing as a means of restoring soil fertility and productivity (Ngugi, 2002). Land degradation is a serious problem in Malawi, and some of its indicators are soil erosion and declining soil fertility (Mulenga, 2001). Accelerated soil erosion is currently a major environmental problem in the tropical and subtropical areas of the world (Tivy, 1995). On average, Malawi loses 20 tons/ha/year of soil due to erosion and a corresponding yield loss of between 4% and 11.3% (Malawi Environment, 1998). Degradation of land threatens future food production potential (Shiferaw and Holden, 2000). Severity of soil erosion depends on a number of factors including, edaphic or soil properties (texture, structure, moisture content), topography, slope, vegetation cover, and cultivation (tillage) methods. Therefore, one of the approaches to ensure sustainable food production for the smallholder farmers is to facilitate tillage efforts that will promote the creation of sustainable soil and water conservation practices within the means of smallholder farmers. Such efforts ought to reflect on what farmers have and already do in their right as managers of the agricultural environment and as producers as well as consumers of the benefits from the land resources.

In order to stop further land degradation and to ensure increased food security for the smallholder households, the government of Malawi is currently implementing programs of soil and water conservation, and soil fertility improvement, giving emphasis on community participation, guided by the land resources conservation policy. However, despite the fact that not all farmers can benefit from the policy objectives, implementation of the programs tends to focus more on the research-tested technologies using research-tested methods than on traditional techniques, practices and methods by the smallholder farmers. The policy is silent on the significance of traditional farming practices followed by most of the smallholder farmers in solving land resources degradation and soil fertility problems. Failure to recognise smallholder traditional knowledge-based practices compromises the sustainability of the research efforts to solve the common rural problems of hunger and land resources degradation.

Based on a field survey, the objective of this paper is to analyse smallholder traditional land resources conservation practices and soil fertility management techniques and try to find their compatibility with the research efforts. Prior to analysis of traditional land resources conservation and soil fertility management techniques a review of research-tested land resources conservation programs implemented in Mangochi district will be done in order to capture a wider picture of land resources conservation activities. This paper also highlights the occurrence of soil erosion in the Sangadzi area by asking farmers whether they have had erosion problems on their farms during the previous three seasons (2000, 2001 and 2002 farming seasons), and what farmers think or know are the causes of soil erosion on their respective farms. In order to have an in depth understanding of the basic significance of traditional knowledge and practices the paper highlights the traditional criteria used to determine suitability of crops to soils (traditional land use planning criteria) by smallholder farmers in their traditional farming systems.

2. Study Methodology

2.1 Site Selection

The field survey was conducted in the Southern Region of Malawi in Mangochi District in the Nankumba peninsular within Monkey Bay area. Malawi is a landlocked country in South-eastern Africa, bordered by Tanzania to the north, Zambia to the west and Mozambique to the south, southwest and east. It is about 118,484 square kilometres in size, and about 20 percent of it is covered by water, mainly that of Lake Malawi. The country is located between 9ºS and 17ºS latitudes, and between 33ºE and 34ºE longitudes (**Figure 1**).

Figure 1: Map of Malawi showing geographical location of the country
Source: Magellan Geographics (1997)

The case study known as Sangadzi area was taken from Mbwadzulu Extension Planning Area (EPA) of Mangochi Rural Development Project (RDP). Mangochi RDP is one of the four RDPs of Machinga Agricultural Development Division[1] (ADD). **Figure 2** shows Map of Machinga ADD and the location of Mbwadzulu EPA (striped shaded area) in Mangochi RDP/District. The survey was conducted from August to September 2002. Mbwadzulu EPA/Sangadzi area lies along Sangadzi River, which forms the western border with the EPA as it pours into the western arm of Lake Malawi (**Figure 3**).

Sangadzi area was purposefully selected for this study because of its geographical characteristics. Besides the two perennial sources of water, Sangadzi area has a tropical savannah type of climate and vegetation. Generally, Sangadzi area has sandy-loam and clay-loamy soils. The area has mean annual temperature of 28ºC and receives about 855.4 mm of rainfall per annum, while the district receives annual mean rainfall of 814.6 mm (Malawi Government, 1998). Malawi receives between 763-994 mm of rainfall per annum, with higher altitudes receiving up to 1,000 mm annually (Ghai and Radwan, 1983, Malawi Government, 1998). About 90% of rains in Malawi fall between November and March (Reynolds, 2001). In Sangadzi area, rains start in late November to early December and stop falling in March or early April. However, most places maintain adequate moisture for farming throughout the year.

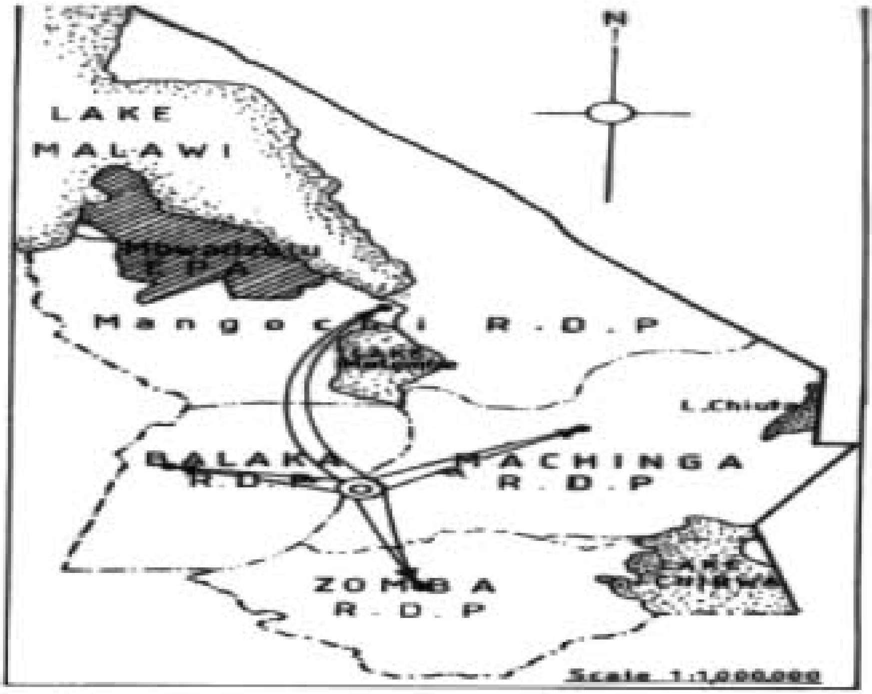

Figure 2: Map of Machinga ADD showing location of Mbwadzulu EPA*
Source: Machinga ADD (2002)
Note*: The striped shaded area along Lake Malawi shows the location of study area.

2.2 Sampling Procedure

The survey had covered seven villages with a total of 2,043 farm households. Sampling of farmers was done using three kinds of purposeful sampling strategies: (1) Stratified purposeful sampling, (2) Maximum variation (heterogeneity) sampling and (3) Purposeful random sampling. Using Stratified purposeful sampling strategy, the survey had its focus on smallholder farmers with landholdings between less than 0.5 ha and slightly more than 3 ha but not more than 5 ha. Stratified purposeful sampling illustrates characteristics of particular subgroups of interest and also facilitates comparisons (Patton, 2002). This strategy helped to differentiate smallholders from the large-scale or estate farmers. Information regarding landholding was obtained from the agricultural field officers. Focusing on smallholder farmers, the survey used Maximum variation sampling strategy - purposefully picking a wide range of cases that characterise smallholder farmers as a group of low socio-economic status while at the same time dealing with the variations that exist within this group of farmers.

Finally, using the Purposeful random sampling strategy, a sample of 138 smallholder farm households was randomly selected and orally interviewed with the structured questionnaire. To do this, in some places where a large number of smallholder farm households were clustered together, certain households were purposefully omitted by taking every other 5th household. This was done in order to minimise biases and make the survey representative of the whole area. As pointed out by Patton (2002), purposeful random sampling strategy adds credibility of results when potential purposeful sample is larger than one can handle; it also helps to reduce bias within the purposeful category. By doing so, areas with sparse population of farm households were equally represented with those of high-density population of farm households thereby considering them as farmers unified by common factors of having small landholdings and farming within the same agro-ecological zone. Where the use of questionnaire was not feasible, data was collected through participatory rural appraisal (PRA) methods with groups of farmers. This paper also uses secondary sources of data in order to support the survey findings.

Figure 3: Map of Mbwadzulu EPA/Sangadzi Area
Source: Machinga ADD (2002)

3. Land Resources Conservation Programs in Mangochi RDP

Under the guidance of the government's soil and water conservation policy objectives, a number of land resources conservation programs are implemented in all Agricultural Development Divisions in Malawi. Malawi's soil and water conservation policy emphasises on promoting integrated land use systems for smallholder farmers, use of organic fertilisers to reduce the cost burden of inorganic fertilisers, communal catchments conservation, promoting the use of vetiver grass in soil conservation, contour ridging and intercropping of cereals with leguminous plants (Malawi Government, 1995).

Implementation of this policy starts with participatory rural appraisal (PRA) meetings organised by land resources conservation field officers and extension field officers[2] or agronomists. The PRA is a new strategy based on bottom-up approach of extension and is mainly aimed at facilitating farmers' acquisition of information needed to help them improve agriculture. Previous agricultural extension in Malawi was based on delivery system using top-down approach in which the extension officer met farmers at a demonstration farm called a block every fortnight. The system became commonly known as a Block

System Approach. The main idea of a delivery system type of agricultural extension was that an organization with agricultural information should deliver the information, and other inputs like fertilizer, seed or credit to farmers (Axinn, in Rivera and Schram, 1987). In Malawi block system was followed from 1982 when the government had adopted the National Rural Development Programme in its agriculture led development efforts. **Figure 4** shows flow of extension and research information in smallholder agriculture in Malawi. As shown in this figure, there is direct linkage and flow of information between research and extension at the official level. On the part of farmers, only progressive farmers had more direct contact (sometimes visited by officers on house-to-house visit) with both research and extension. The rest of the farmers maintained with one-way mode of information flow, mainly treated as passive recipients of modern farm technologies. The concept of contact farmers was based on the fact that by reaching a few progressive farmers research and extension could reduce running costs while at the same time using the progressive farmers to be model farmers from whom the rest of the farmers could learn modern methods of farming. However, things did not work as expected, and at most the system left many farmers especially, the poor smallholders out of contact with modern farming techniques.

The advantage of block system was that it managed to reach many farmers. Its setbacks were that the system was costly to maintain operations both by field officers and other administrative officers; and shortage of staff to cover wide areas further weakened the system. In addition, as a top-down approach, farmers were passive recipients of knowledge and not as participants in the information generation.

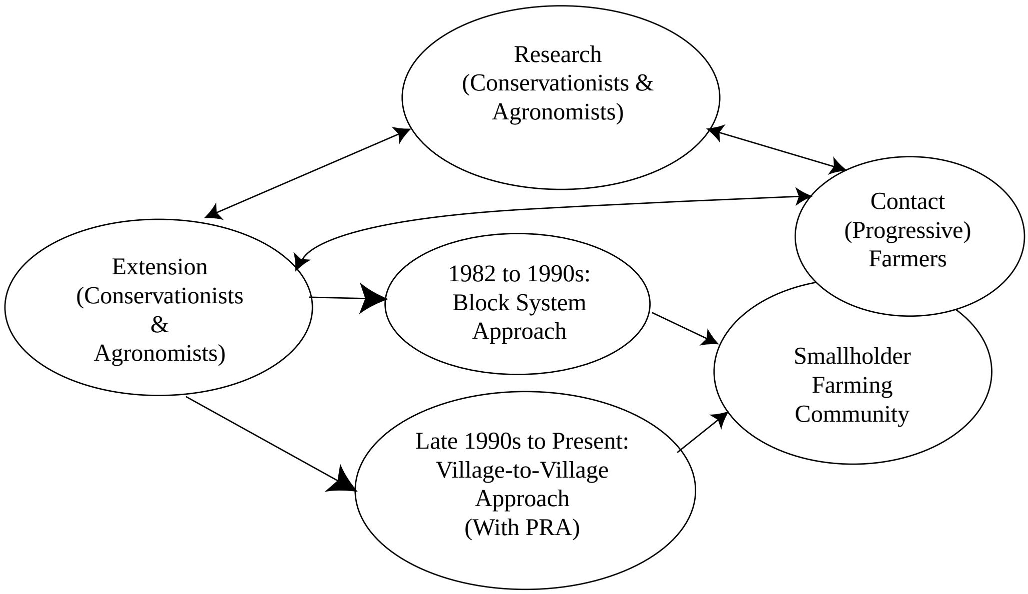

Figure 4: Research and extension information flow in smallholder agriculture in Malawi
Source: Based on field observations (1999 and 2002)

The PRA was introduced in the early to mid 1990s and the village-to-village approach came during the late 1990s as a cost reduction measure with wide coverage of farmers. In a village-to-village approach farmers of a given village gather at village meeting ground. Some of the advantages of the village-to-village approach are reduction in operational costs incurred by the government and reaching a large group of farmers at once. However, the meeting ground does not represent the farm situation. It is like theoretical learning and discussion in a classroom. The PRA is meant to enable the field officers to learn field problems from the farmers in an information sharing process with farmers so as to understand the field situation well. It is vital for researchers and field experts to work at field level to understand the farming enterprise and its problems, because learning should start from where the farmers are (Seppanen, 2002). Focusing on the farm as a unit, the PRA offers a great potential to help solve some of the farm problems. Such farm systems approach enables farmers to identify potential technological improvements (Carl and Staatz, 1984) and helps them to monitor long-term environmental changes on their farms. This can help them to adapt new land resources management practices to the environment on their own farms. After identifying problems using the PRA methods, farmers receive training in soil and water conservation, agroforestry and soil fertility improvement technologies. However, field experience has shown that the field officers only use PRA as a tool to guide smallholder farmers to identify farm problems by themselves. What follows later is a modified form of top-down approach in which the farmers are taught farm technologies from pre-coded packages. Farmers own traditional knowledge and techniques used in land resources conservation are never considered in program implementation.

Mangochi RDP is one of the four agricultural development projects currently implementing land resources conservation and soil fertility management programs guided by policy objectives. The RDP has 110,571 farm households with a total of 332,239 ha of farmland and 63 sections (Mangochi RDP, 2001, Mangochi RDP, 2002). Each section is supposed to be supervised by a field level extension officer. In the field, land husbandry field assistants and extension field officers implement the programs and they are supposed to reach every farmer with various types of farming technologies. During the PRA conducted in several EPAs of Mangochi RDP in 2001, farmers had identified three major problems: (i) water shortage, (ii) soil erosion, and (iii) low soil fertility (Mangochi RDP, 2001). In order to address the problems of water shortage and soil erosion, physical soil and water conservation programs were implemented to control soil erosion while at the same time conserving water for plant growth by reducing runoff. Soil fertility problems were addressed by implementing soil fertility improvement programs. The field officers who closely work with farmers introduced these programs. **Table 1** gives a summary of the programs, which were implemented in 2001 and 2002 farming seasons in Mangochi RDP. The two seasons have been considered for this study because they mark the period in which the given programs have received profound emphasis in Malawi.

There have been high adoption levels in soil and water conservation technologies, especially in contour ridging and ridge re-alignment, with recorded achievement of more than 100% for both 2001 and 2002 agricultural seasons. There were low adoption rates for gully reclamation techniques, achieving 25.9% of the number of planned gullies for reclamation and involving 25.1% of the targeted farmers in 2001, and 67.1% of the planned gullies involving 40.3% of the targeted farmers in 2002. In soil fertility improvement, higher adoption rates have been recorded for incorporation of crop residues and compost manure making, and a lower achievement in undersowing of agro-forestry trees. In 2001, achievements in undersowing of agro-forestry trees was 32% of the planned land area involving 31.6% of the targeted farmers while in 2002, achievement was 80% of the planned land area, involving 79.6% of targeted farmers. There were no reports on vetiver programs for the 2001 agricultural calendar in Mangochi RDP. However, low achievement (69%) in the area with planted vetiver grass in 2002 is mainly because of lack of nursery establishments in the RDP combined with transport problems involved in the outsourcing of vetiver grass.

Table 1: Land resources conservation activities and farmers involved in 2001 and 2002, Mangochi RDP

Type of conservation activities	2001 Farming Year			2002 Farming Year		
	Planned	Achieved	Percent achieved (%)	Planned	Achieved	Percent achieved (%)
Soil and Water Conservation						
Contour ridging						
Area with marker ridges (ha)	330	352.2	106.7	330	431.5	130.8
Number of farmers involved	890	1,363	153.1	890	1,438	161.6
Ridge re-alignment						
Area with re-aligned ridges (ha)	330	257.8	78.1	330	340.8	103.3
Number of farmers involved	920	1,228	133.5	890	1,303	146.4
Vetiver grass hedgerow planting						
Area with planted vetiver (ha)	-	-	-	210	145	69.0
Number of farmers involved	-	-	-	660	695	105.3
Gully reclamation						
Number of gullies being reclaimed	170	44	25.9	170	114	67.1
Number of farmers involved	335	84	25.1	335	135	40.3
Soil Fertility Improvement						
Undersowing						
Area undersown (ha)	95	30.4	32.0	95	76	80.0
Number of farmers involved	950	300	31.6	950	756	79.6
Incorporation of crop residues						
Area covered (ha)	520	352	67.7	520	765.1	147.1
Number of farmers involved	1,244	742	59.6	1,244	7,996	642.8
Compost manure making						
Number of compost heaps (1 pit)	7,030	3,522	50.1	7,030	28,571	406.4
Number of farmers involved	3,570	2,624	73.5	3,570	2,2690	635.6

Source: Mangochi RDP (2001 and 2002)

Generally, high adoption of physical conservation technologies signifies the seriousness of erosion problems and may imply that farmers do not underrate these problems. However, low adoption of gully reclamation may be because the technique involves more strenuous work than that of contour ridging and ridge re-alignment. Besides, the economic impact of not reclaiming gullies may not be significant in the short-term compared with the loss of soil and its fertility that can occur on the farm by immediate erosion due to poor ridge alignment. Furthermore, gullies seldom occur on the whole farm of an individual farmer at once. Only a portion of the farm may be affected and depending on the significance of the affected part in terms of its contribution to total farm production, it can influence farmer's decision making. Nevertheless, the negative impact of gullies can affect many farmers of a given agroecological zone. Similarly, benefits of gully reclamation by one farmer can accrue to a large number of the affected farmers. Thus, gully reclamation as a conservation practice could best be done by the whole society. As pointed out by Stonehouse and Protz (1993), consideration of externalities shows that many conservation practices are economically desirable for society as a whole even though their costs exceed the on-farm benefits. Individual farmers may be reluctant to reclaim gullies when they know that neither the costs (negative impact) nor the benefits may be immediately forthcoming. This kind of situation may be resolved by government involvement in the form of law and cost sharing for conservation practices (Troeh, et. al, 1999).

High rates of adoption of incorporation of crop residues and compost manure making are because of the intensified campaigns by the government backed by a strong political will. The two seasons, 2001 and 2002, have seen politicians coordinating efforts with agricultural field officers in disseminating messages about the significance of turning to the use of organic fertiliser over inorganic fertiliser to improve soil fertility because very few farmers in Malawi use inorganic fertiliser on their farms owing to financial problems. According to World Bank (2000), between 1979 and 1981 smallholder farmers in Malawi had used an average of 24.6 kg/ha of inorganic fertiliser and an average of 33.3 kg/ha between 1995 and 1997 on arable land. This survey had found that in 2002 the respondent smallholder farmers of Sangadzi area had used a total of 3,765 kg of inorganic fertiliser on the cultivated 172.14 ha of farm-land, giving an average of 21.9 kg/ha. In Malawi, the majority of smallholder farmers grow low value crops, mostly maize and cannot afford to purchase inorganic fertiliser. In order for smallholder farmers to make economic sense out of the use of inorganic fertiliser, the farm gate price of maize must increase more than threefold (Whiteside and Carr, 1997). On the other hand, low adoption of undersowing technologies is because of shortage of agroforestry seed made available to farmers, and that most of the seed/seedlings that are currently advocated tend to be prone to mice and termites (Mangochi RDP, 2002). This may on one hand imply that agroforestry technologies are presented to farmers without giving prior consideration to limitations that may be posed by local geographical factors, which affect successful establishment of various plant species. Low adoption of undersowing technologies may also be because of poor nursery management of agroforestry seedlings by the farmers, which may have led to poor germination of seeds and low seedling survival rates. Therefore, a practical approach may be to properly screen the agroforestry seedlings before promoting them to farmers for adoption. It is necessary to promote continuous adaptation trials in order to ensure that only the agroforestry planting materials, which successfully adapt to local conditions of a given agroecosystem, are selected for farmers to adopt. Farmers may be willing to adopt agroforestry trees that have high rates of survival in their local conditions. Nevertheless, it is necessary to intensify farmer training and awareness campaigns in order to boost their understanding and appreciation of the benefits of these research-tested technologies. Such efforts should be integrated with farmers' own practices so that they become internalised and cost effective in terms of labour as well as financial costs.

Although **table 1** generally shows high levels of adoption of land resources conservation technologies by farmers, the targets (planned figures) are by far lower than the total farming population of the RDP/district. While some farmers may not have been affected by soil erosion problems, the problems of soil fertility in Malawi affect almost all smallholder farmers. Low targets of farmers to be reached and low land area of coverage clearly show a deliberate action by the agricultural field officers during the planning phase of their field outreach programs. This may be because of the unforeseeable problems, which the field officers face in the working areas. For instance, poor rural transport infrastructure and unreliable mode of transport possessed by field officers, may limit their coverage in terms of area of outreach programs, forcing them to pick a few farmers who can easily be reached for implementation of agricultural programs. Notwithstanding these field problems, the fact that field officers repeated same figures despite having higher achievements shows that planning is done as a routine work without reflecting on the realities on the ground. After making outstanding achievements of more than 100% in most program activities in 2001, one would expect to have a higher figure for the planned targets for the year 2002. This is an issue that may involve cross-examination of the role of monitoring and supervision of programs in the field. This issue is beyond the scope of this paper.

4. The Case Study of Sangadzi Area

4.1 Occurrence of Soil Erosion and Farmers' Knowledge of its Causes

In order to understand the level of external sources of knowledge and farmers' own traditional knowledge of farming practices; the survey had investigated on the frequency of regular meetings between field experts and the farmers. Out of 134 respondents, 65.7% said:"we never meet and discuss farming with agricultural advisors." The remaining 34.3% indicated that they have monthly meetings with the three agricultural officers stationed in the area. Officially, field level extension officers are supposed to have sessions with farmers twice a month on a fortnightly basis. Reasons for low farmer-expert meetings were on the part of field officers, due to mobility problems and because of extension biases against poor smallholders in favour of progressive farmers. Field experience has shown that most field officers find it easier to work with progressive smallholder farmers most of whom have few problems on their farms compared to poor resource endowed smallholders. On the farmer's side, the survey had found that some farmers have vested interests in such meetings because of prejudices against field officers who in most cases are strangers in their working areas. Thorough understanding of the socio-economic factors that characterise smallholder farmers may be necessary to facilitate targeted extension outreach programs to minimise the problems.

4.1.1 Identifying Soil Erosion

Soil erosion is mainly caused by water and wind. While wind erosion frequently occurs in dry land such as hot deserts, water erosion mainly takes place during the rainy season and is therefore significant to agricultural production. The movement of soil by water occurs in three main stages (1) detachment of individual grains from the soil mass, (2) transportation of the detached grains over the land surface, and (3) deposition of soil grains on new sites. Based on the nature and extent of soil removal, water erosion comes under three classifications as sheet erosion, rill erosion and gully erosion. Sheet erosion is the removal of thin layers of soil over the whole soil surface (Troeh, et. al, 1999). Sheet erosion is caused by raindrop splash and surface flow, with the splash providing most of the energy to remove soil grains while surface flow transports the soil grains from one place to another. Sheet erosion is difficult to identify, as it is not easily seen especially, on flat land or on gentle slopes. The first sign of sheet erosion is when subsoil colour begins to show during cultivation as surface soil mixes with subsoil. In Malawi in general and in Sangadzi area in particular, almost all farmers cannot identify sheet erosion at first sight, as its magnitude does not seem to pose an immediate threat to agricultural production. Long-term effects of sheet erosion may be quite significant, however its identification by smallholder farmers is out of the scope of this study.

Thus the scope of this study considers erosion problems from the perspective of rill erosion and gully erosion. In rill erosion, water tends to concentrate in streamlets as it passes downhill with a greater scouring action than that of sheet erosion. Rill erosion cuts small channels by removing soil from edges and beds of the streamlets; these small channels frequently occur between crop rows and along tillage marks (Troeh, et. al, 1999). Some of the channels cross plant rows and break through crop ridges forming small gullies. Rill erosion is easily identifiable. In study area (Sangadzi), smallholder farmers easily recognise rill erosion because it gives them extra work of rebuilding the broken ridges to avoid plant lodging. It is the commonest form of erosion in Malawi’s agriculture and its short-term solution lies in normalising cultivation to smoothen the surface where small channels (rills) form.

Erosion channels too large to be erased by ordinary tillage are called gullies (Troeh, et. al, 1999). Gullies are easily identifiable. Gully erosion is characterised by deep, relatively straight-sided channels, which are U-shaped or broad V-shaped channels where friable surface soils overlie cohesive, tight, nonerodible subsoil. Gully erosion easily occurs where the soil material is uniformly friable throughout the profile. Gullies may be active if they are not protected by vegetation and may be inactive when the soil surface is stabilised by vegetation. Gullies may range in size from small, medium to large according to depth of the channels. Gully erosion is the most serious and devastating form of erosion and can form small streams if left unmanaged.

On occurrence of soil erosion problems during the previous three farming seasons of 1999/2000, 2000/2001 and 2001/2002, 58.7% of the respondents indicated that they had experienced erosion problems on their farms, while 41.3% said that they have had no erosion problems (**Table 2**).

Table 2: Occurrence of soil erosion on farms and farmers’ knowledge of its causes according to landholding

Soil erosion question	Landholding category										Sample Totals	
	Less than 0.5 ha		0.5-1.0 ha		1.1-2.0 ha		2.1-3.0 ha		More than 3.0ha			
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Does soil erosion occur on the farm?												
Yes	3	75.0	28	52.8	38	62.3	7	53.8	5	71.4	81	58.7
No	1	25.0	25	47.2	23	37.7	6	46.2	2	28.6	57	41.3
Totals	4	100	53	100	61	100	13	100	7	100	138	100
Farmers’ knowledge of causes of soil erosion												
River flooding by rain storms	3	75.0	21	39.6	20	32.8	5	38.5	3	42.9	52	37.7
Improper ridge alignment	1	25.0	4	7.5	9	14.8	2	15.4			16	11.6
The farm lies on stream course	-	-	7	13.2	7	11.5	-	-	2	28.6	16	11.6
Absence of conservation structures on the farm	-	-	1	1.9	3	4.9	1	7.7	-	-	5	3.6
Soil exhaustion due to continuous cultivation	-	-	-	-	1	1.6	-	-	-	-	1	0.7
Destruction of vegetation cover	-	-	1	1.9	-	-	-	-	-	-	1	0.7
Do not know the cause			19	35.8	21	34.4	5	38.5	2	28.6	47	34.1
Totals	4	100	53	100	61	100	13	100	7	100	138	100

Source: Field Survey (2002)

According to the farmers' knowledge, the causes of soil erosion in Sangadzi area are as follows: (1) because of river flooding by rain storms (37.7%), (2) improper ridge alignment (11.6%), (3) because the farm lies on the stream course or water way (11.6%), (4) due to absence of conservation structures (3.6%), (5) because of destruction of vegetation cover (0.7%) and (6) because the soil in the farm has been exhausted due to continuous cultivation using same methods and inputs (0.7%). About 34.1% indicated that they have no knowledge of what causes soil erosion on their farms.

4. 2 Traditional Land Resources Conservation Practices

Irrespective of whether soil erosion occurs on the farm or not, the survey examined the traditional criteria and the basis which smallholder farmers use to determine suitability of crops to soils on their farms, and to examine traditional methods of land resources conservation and soil fertility management in the absence of direct contact with external sources of knowledge. **Table 3** summarises the findings.

On the crop-soil suitability criteria, the study found that 53.6% of the respondents use soil properties such as texture, soil colour and wetness to determine suitability of crops to soils. When asked as to how crop-soil matching is done, generally most farmers indicated that they use presence of sand particles in the soil to check whether it can keep water for a period of time. They indicated: "We plant rice to a soil that keeps more water because rice demands a lot of water." They also indicated that "crops like maize require black soils with less sand particles but not sticky soils in order to avoid keeping and losing too much water for the crop; and that cassava grows well in soils where sand particles are slightly more friable than those for maize, explaining that cassava does not need much water and neither does it need sticky soils." The farmers also indicated that: "even brown soils are suitable for groundnuts, soils which are not so fertile as groundnuts feeds itself."

About 12.3% make decisions based on soil fertility judged by vegetation growth on the land and 34.1% of the respondents indicated that they "just plant anyhow," without any criteria. On ridge alignment it was found that 73.2% of the respondents align their ridges across the slope, indicating that they do so in order to "keep moisture in the soil, reduce run-off and avoid soil erosion." About 11.6% indicated that they align their crop ridges along the slope mainly because they would like to drain water out of the farm. Another 11.6% said that they do it "just anyhow" explaining that they do so because the farmland is on flat ground. About 3.6% indicated that they align ridges either across or along the slope depending on the location of the farm relative to watercourses or streams in order to avoid soil erosion or to avoid water logging in the farm.

In soil fertility management, the study found that compost manure making was the dominant soil fertility management technology, although its actual benefits on the farm had not yet been realised by the time of the survey owing to the fact that compost manure making was a newly introduced program in the area. All the respondents had one or two pits of compost manure ready for first use in the 2002/2003 farming season. Almost 11.6% of the respondents use intercropping of maize with pigeon peas (*Cajanus cajan*) and/or dolicos beans (*Dolicos lablab*) to maintain soil fertility, besides growing these crops for food, and 24.6% improve soil fertility by incorporating crop residues under the soil. About 50% of the respondent farmers combine intercropping and incorporation of crop residues, while the remaining 13.8% do nothing to improve soil fertility on their farms.

Table 3: Smallholder traditional land resources conservation techniques according to landholding

Conservation techniques	Landholding category: Less than 0.5 ha		0.5-1.0 ha		1.1-2.0 ha		2.1-3.0 ha		More than 3.0 ha		Sample Totals	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Criteria for crop-soil suitability												
Soil texture, colour and wetness.	1	25.0	24	45.3	37	60.7	8	61.3	4	57.1	74	53.6
Judge fertility based on vegetation growth.	-	-	8	15.1	7	11.5	1	7.7	1	14.3	17	12.3
Just plant anyhow.	3	75.0	21	39.6	17	27.9	4	30.8	2	28.6	47	34.1
Totals	4	100	53	100	61	100	13	100	7	100	138	100
Ridge Alignment												
Along the slope.	-	-	9	17.0	4	6.6	3	23.1	-	-	16	11.6
Across the slope.	4	100	32	60.4	50	82.0	9	69.2	6	85.7	101	73.2
Both strategies above.	-	-	4	7.5	1	1.6	-	-	-	-	5	3.6
"We do nothing".	-	-	8	15.1	6	9.8	1	7.7	1	14.3	16	11.6
Totals	4	100	53	100	61	100	13	100	7	100	138	100
Soil fertility management												
Intercropping maize with peas.	-	-	4	7.5	10	16.4	1	7.7	1	14.3	16	11.6
Ploughing under crop residues.	2	50.0	14	26.4	15	24.6	2	15.4	1	14.3	34	24.6
Both strategies above.	1	25.0	27	50.9	28	45.9	8	61.5	5	71.4	69	50.0
"We do nothing".	1	25.0	8	15.1	8	13.1	2	15.4	-	-	19	13.8
Totals	4	100	53	100	61	100	13	100	7	100	138	100

Source: Field Survey (2002)

5. Discussion

5.1 Implications of the Findings

The findings on the occurrence of soil erosion and its causes (**Table 2**) as revealed by smallholder farmers of Sangadzi area have significant policy challenges. It has been shown that soil erosion is a problem in Sangadzi area just as it had been identified at the district level during the PRA sessions in 2001. The findings show that occurrence of soil erosion on smallholder farms does not necessarily depend on the size of landholding. The causes of soil erosion according to the farmers' knowledge and opinion also have mixed findings not directly related with the size of landholding. Of striking significance however, is what most smallholder farmers (37.7%) indicated as the causes of soil erosion. In Malawi, it is believed that soil erosion is caused by wanton cutting down of trees, destruction of vegetation cover, poor ridge alignment and absence of physical as well as biological conservation structures (Malawi Environment, 1998). Although Malawi has a lot of publications on degradation of the land resources and the occurrence of soil erosion on the agricultural land, this study has shown that much of the knowledge of its causes as given by conventional researchers has not yet been delivered to the land users. In Sangadzi area, the findings give the impression that river flooding is the most serious cause of soil erosion. However, cross examining this point with the other reason, which states that soil erosion occurs "because the farm lies on the stream course or waterway" (11.6%), shows that in this area a farm is opened without consideration of the physical geographical characteristics of the land. River flooding may be part of the cause of soil erosion but mainly occurrence of soil erosion on the farm depends on the location of the farm in terms of slope and how the land is managed. In most cases, depressions or river courses which allow huge volumes of runoff are considered as fragile areas demanding special type of cultivation whenever necessary. Such areas may be put to cultivation of such crops like sugarcane, bananas and to a less extent rice, because these crops have a higher threshold to withstand floods than most arable crops like maize, tobacco, cotton and others.

Another important observation of this study is the issue of identification of erosion problems by the farmers. It has been shown that smallholder farmers in Sangadzi area consider soil erosion as a problem from the point of rill erosion upwards to gully erosion and not from the sheet erosion. While rill and gully erosion types cause significant damage on the farm and can easily be observed, it should be stressed that in the long-term the neglected sheet erosion has as significant impact on soil as rill erosion. Repeated and uninterrupted occurrence of sheet erosion eventually leaves similar effects on soil to rill erosion (Troeh, et. al, 1999). These findings show that there exists knowledge gap between what farmers consider to be a problem and what the soil scientists (conservationists) take as the entry point in problem identification in terms of occurrence of soil erosion. Farmers may sometimes look at the problem because of its immediate impacts on their livelihood while scientists may have a long-term objective. Thus, a well guided land use policy backed by effective extension messages can help to correct farmers' misconceptions while at the same time build on their useful traditional knowledge base.

The findings on smallholder land resources conservation techniques (**Table 3**) have significant research implications in land resources conservation. The traditional criteria for crop-soil suitability can help to guide in land use planning which aims among others, at protecting the current land use, guide future developments and avoid pollution (Troeh, et al, 1999). For instance, the knowledge of soil properties such as soil texture and structure, soil colour and fertility in determining soil-crop suitability can guide conventional soil and water conservation research programs to come up with appropriate physical conservation and soil fertility management strategies. The findings on crop-soil suitability have some basic scientific implications. For instance, indications by the farmers that rice suits poorly drained soils, maize and cassava suit well-drained friable soils and that groundnuts suits brown low-fertile soils have mixed implications in terms of physical and chemical properties of soils. Generally, most arable crops grow poorly on waterlogged soils and most cereals perform badly on poorly drained low fertile soils such as clay soils and well-drained shallow soils such as sandy soils. These observations can help in planning drainage systems on the soils used for agricultural purposes. However, the criteria used by the farmers do not show much in terms of chemical properties of soil such as soil acidity or alkalinity, and neither does it give the extent of chemical composition in the soil. The criteria do not show salt composition of the soil, for instance, how much calcium, iron, potassium, phosphate, nitrates, or sodium the soil contains. Nevertheless, their explanations and the success of crop production on such soils are significant enough to be used as guides towards basic agricultural research on suitable soils for improving crop production. Reference of soil colour to determine crop suitability can facilitate research to determine soil pH, soil temperature, organic matter content of the soil and the level of microbial activities in the soil before planting any crop so as to enhance potential productivity of the land.

On ridge alignment, the findings can serve as a guide in the design and dissemination of land resources conservation technologies. It is recommended that ridge alignment should always be “across the slope” and not “along the slope,” hence contour ridging (Malawi Government, 1995, Troeh et.al, 1999), and yet some farmers still believe it is a proper way of draining excess water from the farm. However, by aligning ridges along the slope farmers encourage accelerated runoff, soil erosion and flooding because storms of water are allowed to descend the farm at high speed, thereby carrying away large volumes of valuable soil as well as planted crops and natural vegetation. This information can be an input to help in the formulation of a well-targeted on-farm research and extension on proper ridge alignment.

On soil fertility management, the findings have sustainability impacts in land resources conservation, as these technologies are affordable, readily available and self-replenishing, with a large potential to raise land productivity and farm yields. The purpose of soil conservation is not merely to preserve the soil but to maintain its productive capacity while using it for the long-term usefulness as well as for the current needs (Troeh, et. al, 1999). Intercropping cereals with legumes has the advantage of improving soil fertility, soil structure and water holding capacity of the soil. Besides nitrogen fixation by rhizobia species through the root nodules, the leaves of leguminous plants also release nitrogen compounds in the soil after decomposition. Those leaves on the surface become useful mulches, which help to conserve moisture needed for plant growth, and also help to prevent soil erosion by raindrops or wind. Intercropping also helps to reduce pest attack especially, that of herbivores (Carroll, et al, 1990). Incorporation of crop residues on the other hand, also improves soil structure and soil fertility. During the crop production season, accumulation of crop residues between ridges serves in the same way as box ridges and thus, help to reduce runoff and water erosion, while at the same time, control weeds. However, burying crop residues under the soil and leaving the soil exposed (bare), has some limitations in controlling soil erosion. Crop residues on the surface reduce both water and wind erosion (Troeh, et. al, 1999). Therefore, careful planning is necessary to ensure that fertility improvement by incorporation of crop residues under the soil does not leave a serious burden of soil erosion. This exercise must be complemented by other agroforestry technologies with the potential to either improve soil fertility or help to reduce erosion.

Traditional soil fertility improvement practices by farmers must be complemented by introduction of more practices with the potential to raise soil fertility. For instance, introducing some of the research-tested agroforestry techniques such as relay cropping of maize with sesbania (*Sesbania sesban*) and mixed intercropping with gliricidiia (*Gliricidia sepium*), (for example, maize/gliricidia intercropping) can play a big role in improving soil fertility in this area, so long as their adaptation is put into consideration. In Malawi, research results have demonstrated marked improvements of maize yield in relay intercropping of maize with sesbania (Ngugi, 2002). Both sesbania and gliricidia are nitrogen fixers and good suppliers of green manure. Leucaena (*Leucaena leucocephala*) is another agroforestry tree that has research proven large soil fertility benefits in Malawi and other African countries. Although leucaena was spotted in different places in Sangadzi area, only one farmer had been using it to improve soil fertility on his farm. **Figure 5** shows the picture of a well-grown leucaena plant commonly found in Sangadzi area, taken in August 2002.

Figure 5: Leucaena tree grown in Sangadzi area
Source: Field survey (2002)

This study observed that leucaena is used as shade tree and source of firewood, mainly because farmers do not know its agronomic role. With proper guidance, resource poor farmers can put such useful unutilised local resources to productive use in order to improve soil fertility and raise food security for their households. Thus, farmers must be assisted to maximise the use of the low cost beneficial traditional practices.

5.2 Supporting Smallholder Farmers' Efforts

Considering the disparities in the distribution of knowledge and innovation capacity among and between farmers of the same community, extension and conservation personnel can help to facilitate dissemination of knowledge between and among farmers through networking systems to encourage information exchange and learning. Indeed, indigenous technical knowledge and innovation capacity tends to be unevenly distributed within and across communities (Chambers, et. al., 1989). In any given farming community some farmers are more knowledgeable in farming technologies than others, and therefore, they are more likely to progress faster than those without adequate farming technologies. This may leave a huge socio-economic gap between the farmers. This is one area where agricultural officers in the field can help farmers to develop networking systems as facilitators of agricultural development. Active and member-driven networks can be effective disseminators (Gorjestani, 2000), because farmers will easily understand and appreciate technologies practiced by their colleagues within the local context more than in external technologies loaded with heavy costs. Farmer tours and exchange visits have a huge potential to encourage farmers to share knowledge and learn from each other. This will enable smallholder farmers to participate more actively in land resources conservation programs. **Figure 6** presents an example of a generalised technology transfer networking in agriculture. This networking system may involve intra and inter knowledge sharing among and between smallholder farmers, land resources conservation, and extension field officers.

In order to achieve this, farmers should be encouraged to organise into working committees to work with field level extension and land husbandry officers to bridge the knowledge gap between and amongst farmers of respective agroecological zones. Both extension officers and land husbandry field officers should constantly be in touch with every line of technology flow in their respective disciplines, including research in order to be continuously updated with the on-going research findings reflecting on the current changes in the agricultural environment. Field observations show that the field officers of Sangadzi area have for a long time been cut off from their respective research departments thereby denying them of the most necessary new farming technologies. The survey also noted that for the past ten years all the three extension field officers in Sangadzi area have not been exposed to refresher courses[3] to get updated with new research findings in agronomy, soil and water conservation and fertility management. The situation has been like that partly because the research on its side was designed in such a way that it established very little contact with the field officers. If the research was to maintain a close link with the field officers, it could incur heavy financial costs needed for operation and maintenance of such linkages. Thus, research is mainly considered as a paramount producer of modern agricultural technologies at the station backed by a few conveniently selected farm fields, while the field officers play the role of one-way middlemen, merely as disseminators of the research tested agricultural technologies to the passive recipient farmers. The process involves a top-down approach in which agricultural technologies trickle down to the farmers through the field officers who in most cases lack training on the scope and how the new farming technologies should work. However, field officers can play a great role in formulating cost-effective research programs meant for agricultural development. Since they work at farm level, field officers can present a first hand situation of smallholder agriculture, its problems as well as its potential for growth, which can help to guide the direction of research efforts to solve food security problems while at the same time protect the land resources from degradation. Therefore it is necessary for research to build strong structures at field level by maximising the role of field officers while working with the farmers as key informants and as research partners.

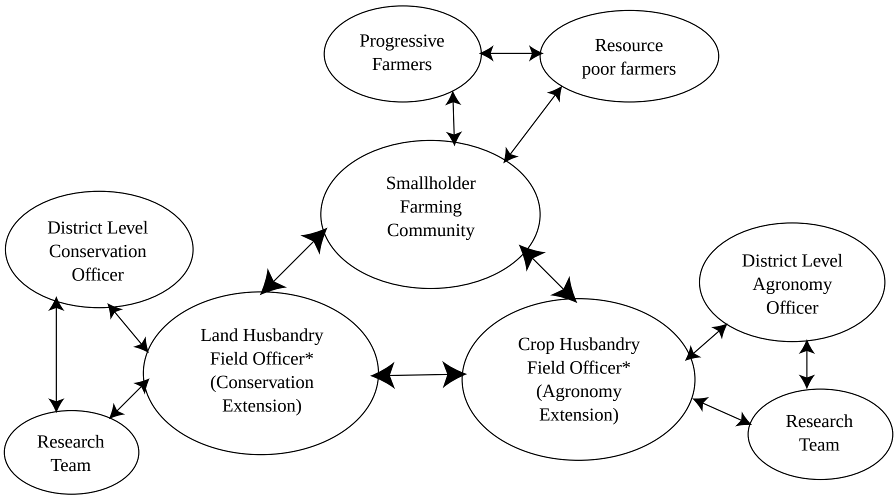

Figure 6: A proposed technology transfer networking in smallholder land resources conservation

Note*: Since both Land husbandry and Crop husbandry field officers play the roles of extension agents in land resources conservation and agronomy, respectively, coordination or synchronization of program activities is necessary to avoid duplication of efforts.

In order to strengthen these efforts the government must through policy formulation, recognise the significance of traditional farming practices to the sustainability of land resources conservation efforts and the development of smallholder agriculture. In countries like Kenya and Uganda for instance, policies on indigenous traditional knowledge (ITK) have been institutionalised (Gorjestani, 2000). The Malawi government does not have a policy that emphasises on the significance of traditional knowledge base in land resources conservation and in agriculture in general. The absence of such an important policy may encourage the perception that traditional technology base is rather an inferior entity to conventional research-tested technologies. It should be emphasised that the policy on traditional farming practices may help farmers to regain confidence in themselves, as they will feel elevated to the status of not only as mere recipients of conventional technologies but also as to being both users and contributors to the knowledge base. Furthermore, the government ought to recognize the work of field officers as a priority area for agricultural and rural development and hence should be provided with adequate resources from the budget to facilitate training and field operations.

6. Conclusion

This paper has shown that implementation of land resources conservation programs in Mangochi RDP has a lot of challenges which field officers alone cannot manage to deal with. In physical soil and water conservation, potential exists for higher achievements however, some activities such as gully reclamation and vetiver grass establishment can best be done through the involvement of the society of farmers. The impact of gullies may not affect an individual farmer but the whole community of farmers sharing farm borders in a given agroecological zone, both negatively and positively. Therefore, higher achievenment in gully reclamation may be realized when farmers get mobilised to work as a group for the common goal, backed by government support whenever necessary and feasible. The problem of lack of vetiver can be solved by encouraging farmers to plant community vetiver nurseries. This has been successfully done in other districts in Malawi like Mchinji, Kasungu and Dowa where the vetiver programs started earlier than in Mangochi RDP. One of the ways to address transport problems is by helping farmers to form vetiver cooperatives through which they can use their own or hire basic transport facilities such as wheelbarrows, ox-carts and bicycles within the community to transport the outsourced vetiver planting materials needed for establishing their own community vetiver nurseries. The group can also be asked to pay a minimum contribution as a revolving fee to serve not only in vetiver programs but also in other farming activities.

The paper has also shown that some traditional technologies and practices of smallholder farmers are more sustainable for land resources conservation than the research-tested technologies. Farmers' land use criteria for example, successfully guides them to allocate various crops according to soils on the farm. Since traditional farming rests on farmers' long and continuous experiences and trial and error experimentation efforts, most of the land use systems tend to take into consideration the nature of the basic agroecosystem which shape the direction of most farmers livelihoods. In the same places where conventional agroforestry has failed, farmers have established soil fertility improvement techniques by combining cereal crops with legumes in intercropping systems, thereby creating double benefit of improving soil fertility and diversifying their nutritional base. It should be pointed out that while some research-tested technologies are superior in performance over traditional technologies, like any other technology, practice or knowledge, they have limitations and therefore need to be adapted to local agroecological conditions surrounding smallholder farmers, in order to get established and bring the intended benefits to society.

Smallholder traditional farming practices are a useful input to programs of land resources conservation. In order to enhance sustainable land resources conservation the traditional knowledge of resource poor farmers must be taken into consideration in the implementation of conventional technologies. Combining traditional knowledge-based practices with conventional technologies, methods and practices offers a big potential to save the land resources from further degradation, while at the same time improve on smallholder food production at a minimum cost. Chances of success are high so long as all stakeholders in the field work as a team and coordinate their efforts by sharing technological knowledge and information between and among themselves. Thus, at expert level, extension and conservation personnel must coordinate their efforts and strive to work as equal partners since both groups strive to reach the same farmers. This may help to reduce duplication of efforts and minimise operational costs. Research can efficiently use the field officers to help in the establishment of feasible, practical and cost-effective programs for smallholder land resources conservation. Since the field officers work and live with farmers, they possess first hand experience and knowledge of the field situation, which characterises farmers. The coordinated team of extension and conservation field officers must plan and execute programs together with farmers, to promote sustainable land resources conservation technologies within the means of poor resource smallholder farmers. At the farmer level, farmers must be assisted to work through networking systems in order to facilitate learning and sharing of knowledge between and amongst farmers of various socio-economic statuses. Recognising and institutionalising traditional practices within the government policy framework can add an impetus to the realisation of the goal of sustainable land resources conservation in smallholder agriculture cost-effectively.

Endnotes

[1] In Malawi the agricultural sector is administratively divided into five main ladders as follows, in a descending order: (1) Ministry of Agriculture Headquarters, administered by the Principal Secretary, (2) Agricultural Development Divisions (ADDs), administered by Programme Managers, (3) Rural Development Projects (RDPs), under the administration of Project Officers, (4) Extension Planning Areas (EPAs), under the Development Officers, and (5) Sections, administered by Field Level Officers.

[2] The land resources conservation field officers (land husbandry field officers) and extension field officers (crop husbandry field officers or agronomists), work under the Ministry of Agriculture of the Malawi Government (some do have chance to join the NGOs). Both Land husbandry and Crop husbandry field officers play the role of extension agents in land resources conservation and agronomy or crop production techniques, respectively. All extension officers are mainly O-level Certificate holders after successfully completing four years of secondary education. The Department of Land Resources and Conservation at the Land Husbandry Training Center in Zomba trains land husbandry field officers, while Crop Husbandry field officers become extension officers after successfully completing a two-year course at the Natural Resources College in Lilongwe, the Capital City of Malawi. Posting to work stations is done by the government (employer).

[3] Besides, field officers hardly get any budget support for their outreach programs; they also lack incentives such as bicycle allowances for maintenance of their most reliable mode of transport in the outreach programs.

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