S. Afr. J. Agric. Ext. Nyathi, Stevens & Salomons
Vol. 49 No. 2, 2021: 1-14
http://dx.doi.org/10.17159/2413-3221/2021/v49n2a12783

Sustainability of conservation agriculture adoption and the role lead farmers play in Zimbabwe

Nyathi, P.[1]; Stevens, J.[2] and Salomons, M.[3]

Corresponding author: Joe Stevens. Email: joe.stevens@up.ac.za

ABSTRACT

Conservation Agriculture (CA) has been promoted widely in Zimbabwe through several organizations, including government and non-governmental organizations, to help address food insecurity. The sustainability of donor led interventions has been questioned as they are of limited duration, and some research has reported that farmers stop practicing CA when a project ends. However, agriculture extension services are reported crucial in adopting new agriculture technologies; hence, continued access to services is crucial for the sustainable uptake of CA. The use of farmer-led extension approaches has been used to reach more farmers at low cost to promote CA and for sustainability. The study evaluates the sustainability of CA practices as well as lead farmers roles after the end of Christian Care project activities. The findings reveal continued adoption of CA principles, albeit on a small scale. We conclude that CA has become part of the traditional farming system and recommend labour-saving technologies for the uptake of CA on a greater scale. Government extension support has also continued, although lead farmers played a minor role in these extension activities. Lead farmers alone cannot sustainably provide extension services without institutional support. The recommendation is that public extension systems work closely with lead farmers in communities to efficiently reach farmers and ensure better coordination between NGOs and government extension activities.

Key words: Lead farmer, conservation agriculture, extension, sustainability

1. INTRODUCTION

Access to agriculture extension has proven to be an important factors that positively influence the adoption of agricultural technologies, including Conservation Agriculture (CA) (Mazvimavi and Twomlow, 2009; Arsalan *et al.*, 2013; Ngwira *et al.*, 2014). However, despite this important

[1] PhD Student, Department of Agriculture Economics, Extension and Rural Development, University of Pretoria, South Africa. Lynnwood Rd, Hatfield, Pretoria, 0002.
[2] Department of Agriculture Economics, Extension and Rural Development, University of Pretoria, South Africa. Lynnwood Rd, Hatfield, Pretoria, 0002
[3] Canadian Food Grains Bank, Winnipeg, Canada

http://dx.doi.org/10.17159/2413-3221/2021/v49n2a12783

influence of extension in technology adoption, investment in public extension systems have been very low in most countries in Sub Sahara Africa (Andersson, 2007). To counter the challenges of agriculture extension services, government and non-governmental organizations (NGOs) are increasingly using farmer-to-farmer approaches to facilitate technology dissemination. Farmer-to-farmer approaches include Farmer Field Schools (Andersson, 2007), contact or lead farmers (Taye, 2013) and participatory demonstration and training extension systems (Davies, 2008). Farmer-to-farmer approaches help extension agents reach a wide number of farmers faster and at a low cost (Kiptot & Franzels, 2015). The use of contact/lead farmers, who are farmers selected to train other farmers based on set criteria (Zimbabwe Conservation Agriculture Task Force, 2012; Khaila *et al*., 2015) has been a popular strategy in promoting CA. There are various names given to such farmers, including contact, model or volunteer farmers (Fischer *et al.,* 2017), even though they have the same roles. In this research, such farmers will be called lead farmers.

Studies on the effectiveness of farmer-led approaches reveal that farmer characteristics and their social roles in a community, as well as the type of technology, influence the success of interacting with farmers (Kiptot and Franzel, 2015). The simpler the information or technology, the higher the chances of being passed on. Kinship and close associates are often beneficiaries of new technologies from farmer-led extension (Kiptot *et al*., 2006). More networked farmers or those in influential positions are more likely to pass on their knowledge to others (Kiptot *et al.*, 2006).

Sub–Saharan Africa has the highest rates of hunger and malnutrition in the developing world, with about a third of the population lacking food (UNDP, 2012). Farmers' production shortfalls of their subsistence requirements pose a challenge for increased hunger and poverty. In Zimbabwe, smallholder agriculture plays an important role in the livelihood activities of many rural households as approximately 70% of the population are involved in smallholder agriculture (Zimstat, 2012). Since 2004, the Zimbabwe Ministry of Agriculture and numerous NGO's through various donor-funded initiatives, have promoted Conservation Agriculture (CA) with the aim of improving food security and addressing low productivity amongst smallholder farmers. CA is a sustainable way of farming that aims to achieve high production whilst conserving the environment through the application of three principles: minimum soil disturbance, permanent soil cover, and crop rotations and associations (FAO, 2010). Ample evidence exists of the biophysical benefits of CA (Wall, 2007; Giller *et al*., 2009; Kassam *et al.,* 2014) and the agronomic impacts of CA (Nyamangara *et al*., 2013, Ngwira *et al.,* 2014). However, the applicability of CA to smallholder farmers after a project has ended has been questioned because it is not reflected in the adoption statistics (Andersson & D'Souza, 2015) and the complimentary role that lead farmers play in technology dissemination (Fischer *et al.*, 2017), especially after a project ends are also not known. This article seeks to add value to the existing literature by exploring the sustainability of CA after donor-funded projects end and the role that lead farmers play to promote CA.

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2. RESEARCH METHODOLOGY

The study was conducted in five districts of Zimbabwe, namely, Chimanimani, Chirumanzu, Gutu, Nkayi and Nyaminyami (the rural part of Kariba), where CA projects were implemented by Christian Care (CC) (Figure 1). Nyaminyami is the driest district falling mostly in agro-ecological region V which receives less than 450 mm of rainfall per annum. The other regions receive between 450 to 600mm of rainfall per annum (Vincent & Thomas, 1960). Nyaminyami is also the remotest district with limited infrastructure development in terms of roads and markets.

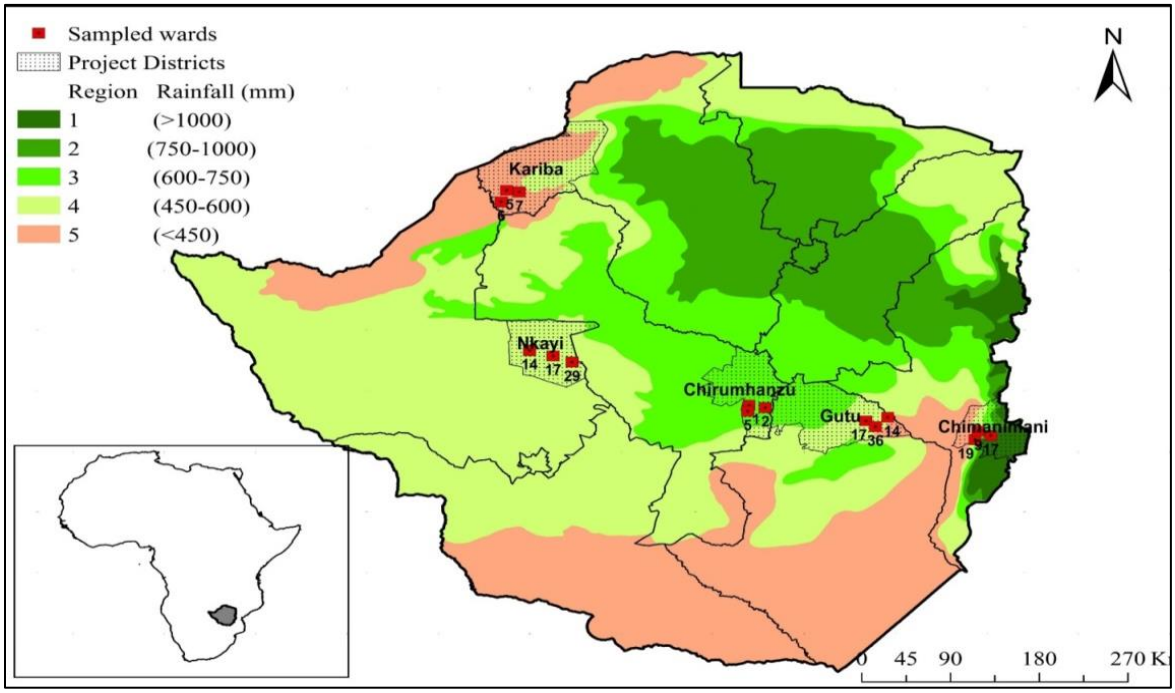

FIGURE 1: Study area and sampled wards

Christian Care (CC), a faith-based voluntary organization formed by the Zimbabwe Council of Churches, provided food aid to the five districts with funding from the Canadian Food Grains Bank (CFGB) and United Church of Canada (UCC). In 2006 Christian Care introduced CA as a sustainable way to address challenges of chronic food insecurity associated with low soil fertility and frequent droughts and dry spells in these districts. CA was promoted using Christian Care project staff in collaboration with the Department of Agriculture Technical and Extension Services (AGRITEX), an extension services arm of the Ministry of Agriculture. Lead farmers were selected and trained and were expected to train other farmers in their respective districts. The interventions of Christian Care in the promotion of CA ended in 2014.

Data collection involved both primary and secondary sources. Existing project documents were assessed, while primary sources included household surveys with participating farmers and focus

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group discussions (FGDs). In each district, sampled wards were purposefully selected to represent wards that had participated in CA training programmes for a minimum of three years. A total of 305 households were interviewed farmers in May 2017. Data were analysed using descriptive statistics in SPSS Version 25.

3. RESULTS

The following presents results on the adoption of CA principles in these districts, as well as the perceived role of lead farmers in the dissemination of CA knowledge.

3.1 Average area under CA practice

The average field size of farmers in these five districts was 2.2 ha. CA plots were limited to mostly homestead fields which could be fenced and protected from livestock, and the average area in which farmers apply CA principles was 0.5 ha in comparison to conventional tillage, which was practiced on average 1.4 ha (Table 1). As a percentage of total area, CA was practiced on 22% of total arable land while conventional farming practices prevail on 78% of the farms. A further breakdown by districts showed that the highest area allocation to CA was in Chimanimani (47%) and the lowest in Nyaminyami (8%). The low area allocation for Nyaminyami could be due to the low potential for crop production in the Nyaminyami district due to its climate. These findings on the area allocated to CA concur with studies by Ngwira *et al.* (2014) and Kassam *et al.* (2014), who report that CA was practiced on approximately 30% of total land holdings in Malawi and in Africa, respectively.

TABLE 1: Area allocation in the five districts of Zimbabwe

District	Average land size (ha)	Area under CA (ha)	
		n	%
Chimanimani	1.7	0.8	47
Chirumanzu	2.1	0.5	24
Gutu	2.2	0.5	23
Nkayi	2.5	0.4	16
Nyaminyami	2.6	0.2	8
Average	2.2	0.5	22

3.2 Adoption of CA principles

After the official CA promotion and external support and training by CC was ended, some farmers continued to practice certain CA principles like minimum soil disturbance involving digging of properly spaced planting stations or basins using hoes during dry seasons. The latter was illustrated by 89% of practicing respondents who stated that they dug planting basins during the 2016/2017

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cropping season. CA is practiced in these five districts in a non-mechanical way, meaning farmers are using hand hoes and not mechanical implements in the preparation of fields. These findings on minimum soil disturbance adoption concur with Mazvimavi *et al*. (2010), who found minimum tillage to be widely adopted by farmers.

CA advocates crop rotation as well as no tillage. The positive impact of crop rotation in climate change adaptation is widely accepted (Thielfelder & Wall, 2010). Crop rotation was adopted by 81% and the application of soil cover by 79% of respondents, respectively. These figures reveal a relatively high adoption rate of these two principles, considering conflicting uses of crop residues with livestock feeding (Giller *et al.*, 2009; Mazvimavi *et al*., 2010), market challenges and incompatibility of planting basin spacing to incorporate rotations with legumes (Mazvimavi & Twomlow, 2009) which have limited the adoption of these two principles in previous studies. A possible reason for the high adoption rate of mulching is that farmers were practising CA on homestead plots that were properly fenced and therefore prevented livestock from grazing. Crop rotation (mostly cereal /legume rotations) was practiced by approximately a third of the CA fields in the study area to ensure optimum plant nutrient use through the synergy between different crop types. Another benefit of including legumes in crop rotation or intercropping is nutrition, especially during years when not enough calories can be produced.

3.3 Perceived drivers and barriers to continued practice of CA

CA farmers were asked to list the potential drivers and barriers that either encourage or discourage them from practising CA as a management system on their fields. A summary of these drivers and barriers to CA adoption is shown in Table 2. Drivers to the practice of CA included: (i) higher crop yields under CA (58%); (ii) relatively simple technology for farmers to implement even for those without livestock and animal-drawn ploughs (16.4%); (iii) improved soil fertility and moisture conservation (9.3%); (iv) training by NGOs (World Vision, CARITAS and World Vision) and public extension staff, and seeing other farmers also motivated 8.4% of respondents to practice CA and (v) saving of farming inputs through precision application of nutrients (7.9%).

High yields and the facility to implement CA without draught power were major drivers to continue practising CA in the study. The findings concur with studies by Mazvimavi *et al*. (2008) and Marongwe et al. (2011), who found that farmers were motivated to practice CA by increased yields and the ability of farmers who do not have livestock to plant early. The research revealed that some smallholder farmers who had initially practiced CA had since stopped. The perceived barriers to sustain adoption included lack of farming inputs such as seed and fertilizer/manure (21%), which were promoted during training; labour challenges (13.6%); old age (13.6%); illness (10.7%); lack of mulching material (10.7%); climate change (8.9%) and lack of fencing material (7.9%) (Table 2). There was generally a perception that hand-hoe based CA was more labour

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intensive (9.3%) than conventional farming and thus contributed to poor health, such as backaches and premature ageing.

TABLE 2: Perceived drivers and barriers to continued practice of CA

Motivation to continue (n =304)		Barriers to practice CA (n =214)	
Drivers	**Percentage (%) Respondents**	**Barrier**	**% Respondents**
Higher crop yields under CA	58.0	Lack of farming inputs-fertilizer and seed	21.0
Easy for those without draft power	16.4	Labour challenges	13.6
Improved soil fertility and moisture conservation	9.3	Illness	10.7
Training and seeing other farmers practice	8.4	Age	13.6
Save inputs	7.9	Lack of mulching material	10.7
		Climate change	8.9
		Lack of fencing material	7.9
		Lack of access to extension support	3.7
		Nothing will stop them	9.9

A farmer who had stopped practicing CA in Nkayi revealed during one of the focus group discussions that most farmers practising CA did not look healthy due to too much work in order to practice CA. Interestingly, the lack of extension support was cited by only a few respondents, suggesting that extension services on CA are still available, which could have contributed to the continued practice of CA after the project came to an end. Labour and input challenges have been reported in various studies as major bottlenecks in the adoption of CA (Wall, 2007, Mazvimavi *et al*., 2008; (Marongwe *et al.*, 2011) Pedzisa *et al*., 2015). Although CA is a climate-smart technology (Thierfelder & Wall, 2010), it was surprising that 9% of respondents indicated that climate change stopped them from practicing CA. The latter could be due to the variability of rainfall experienced in these districts, particularly the late start of the rain season and long dry spells, which has shortened the cropping season and affected the production of crops.

3.4 Agriculture support

3.4.1 Sources of agricultural support

In Zimbabwe, the extension services are pluralistic, with NGOs, the private sector, bilateral organizations and the private sector providing advice to farmers, although the government is the main service provider (Hanyani-Mlambo, 2002). The study revealed that after Christian Care

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ended the project, 72% of respondents were still accessing agriculture support either through training or provision of farming inputs. The most important sources of agriculture support were public extension agents and NGOs. In all the districts, except Chimanimani (32%), government extension agents were ranked as the most important source of external support (Figure 2). There was little or no NGO support in Gutu and Nkayi districts

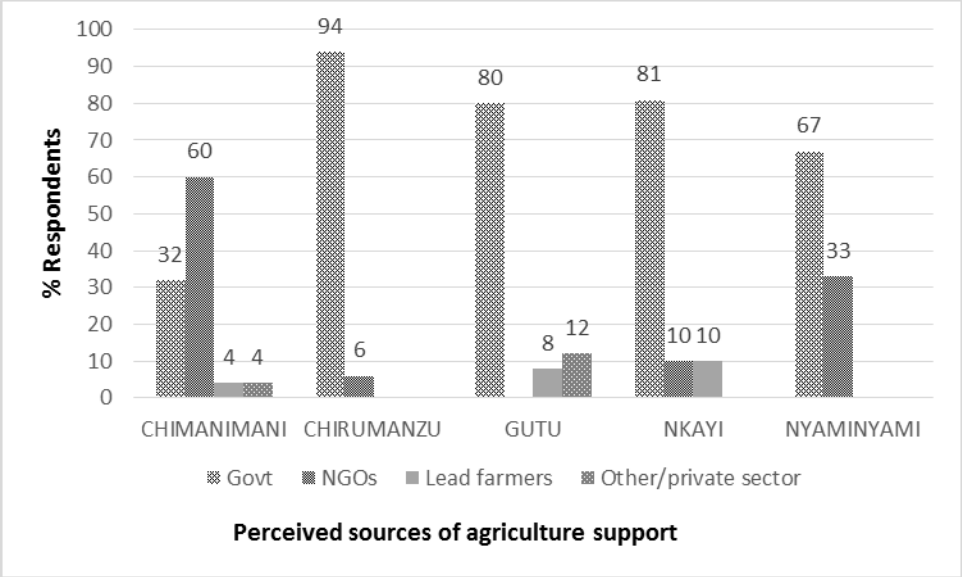

FIGURE 2: Sources of agriculture support to farmers

Support by lead farmers was evident in Chimanimani (4%), Gutu (8%) and Nkayi (10%), where integration of lead farmers with government extension system was better, particularly in Nkayi where government extension staff were working closely with lead farmers. In other districts such as Chirumanzu, there was a feeling that the role and relationship of lead farmers with public extension was not clear. Similar trends were reported in the Zimbabwe Vulnerability Assessment Report (2017), where government crop extension support was the highest (88%), followed by NGOs (8 %) and lead farmers (4 %).

3.4.2 Type of agricultural support

There was variation between districts in terms of agriculture support that farmers were receiving after the project ended (FIGURE 3). In Chimanimani and Nyaminyami, support was mainly in the form of production inputs, whilst in Chirumanzu, Gutu and Nkayi, it was mainly extension services. This could explain the lack of or low ranking of lead farmers in districts such as Nyaminyami, as farmers seem to receive more material than technical support, something the lead farmers could not provide. These findings concur with the Zimbabwe Vulnerability Assessment Report (2017), which reported that 76% of support provided was in the form of production inputs

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and food from the government. However, the same report reports that only 31% of farmers received extension visits during the project period.

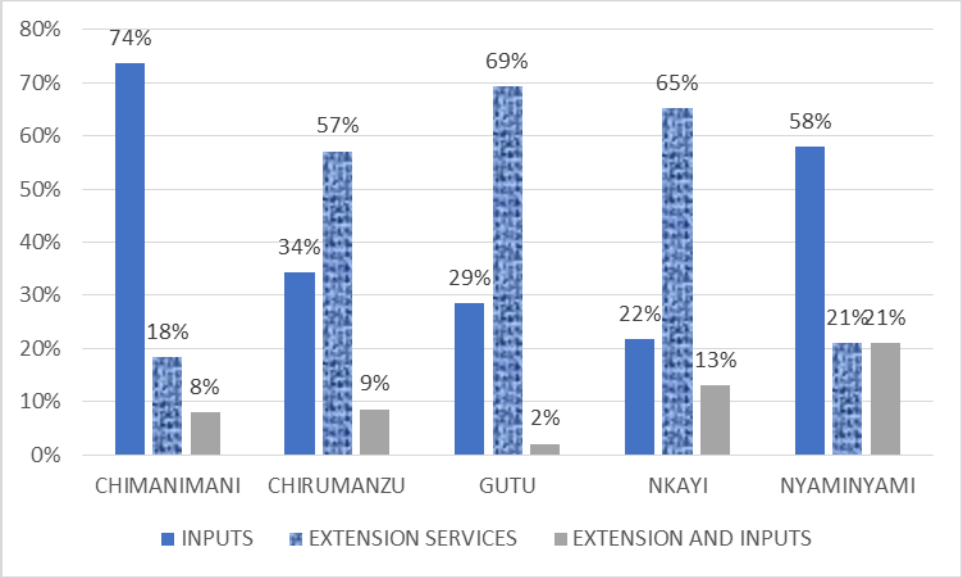

FIGURE 3: Type of agriculture support provided to farmers

3.5 Accessibility of lead farmers to fellow farmers

Respondents were asked whether lead farmers were accessible to farmers after the project ended. The responses reveal that the accessibility of lead farmers is still high in all the districts except in Nkayi, where only 56% of respondents were positive about lead farmer accessibility, whilst more than 75% of respondents reported access in the other four districts (FIGURE 4). During focus group discussions, farmers revealed that lead farmer services were mainly demand-driven, which implies that lead farmers only assist when consulted. This could be due to a lack of external support from government extension services, which has reduced lead farmer motivation. Lack of resources and incentives have been reported by other studies (Kiptot and Franzel, 2015; Khaila *et al.*, 2015) as the major challenges that affect lead farmers.

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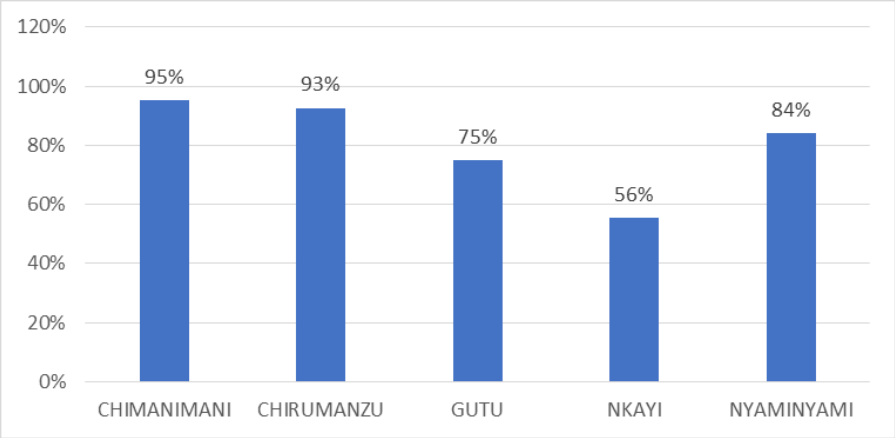

FIGURE 4: Accessibility of lead farmers to other farmers

3.6 The role of lead farmers in promoting conservation agriculture

Constant dialogue with farmers implementing CA is important to ensure that the technology is adapted to local conditions, and lead farmers play a critical role in this process of institutionalisation. A question to farmers on the role of lead farmers after the projects ended revealed that lead farmers continued to be an important source of technical support (58%), moral support (28%) and played an important role in the coordination of activities (11%) (FIGURE 5). Respondents, however, lamented that lead farmers were only supporting those farmers that actively sought advice. In Chirumanzu and Chimanimani, the general feeling was that lead farmers were accessible but not very active in supporting farmers. In a case in Chirumanzu, a lead farmer felt that the local extension departmental officers were undermining his trustworthiness and, as such, could not continue with his duties. In Gutu, very active coordination between lead farmers and public extension officers existed in supporting farmers.

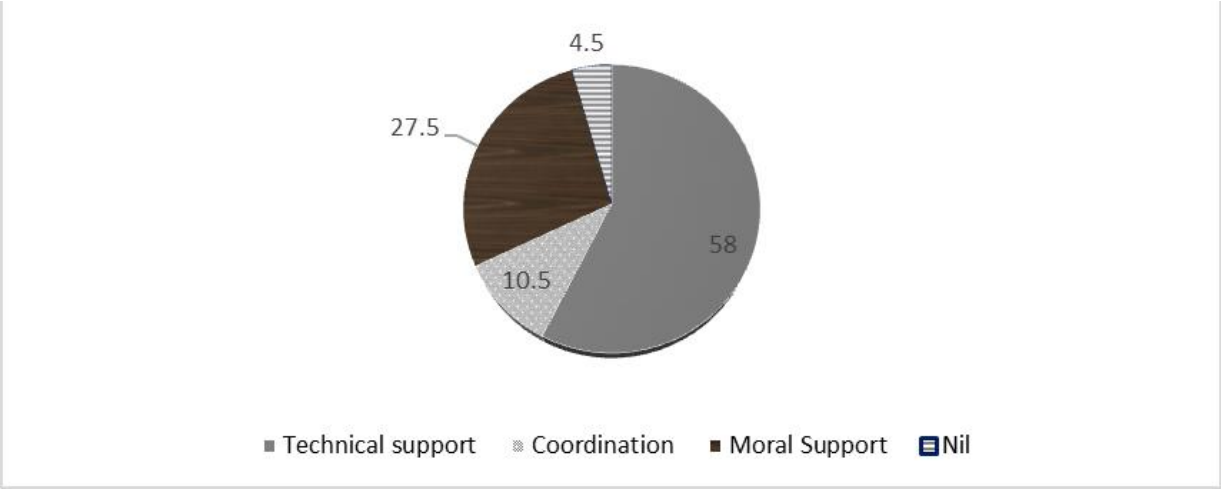

FIGURE 5: Perceived lead farmer roles by respondents

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a) Lead farmer roles in field day organization

A popular extension strategy in the promotion of technologies is through the organization of field days. Field days are an extension method meant to show the performance of a new technology and to encourage fellow farmers to learn from a hosting farmer (Khaila *et al.*, 2015). Involvement of lead farmers was generally low in the organization of field days (FIGURE 6). The highest involvement of lead farmers was in Gutu (36%), followed by Nyaminyami (21%), Chirumanzu (17%) and then Nkayi at 7%. Chimanimani respondents did not mention any lead farmer involvement. Across all districts, government extension agents are the main organizer of field days, as shown in FIGURE 6. The findings concur with a report by Khaila *et al.* (2015), who report that field days are usually organized by government extension officers with assistance from lead farmers.

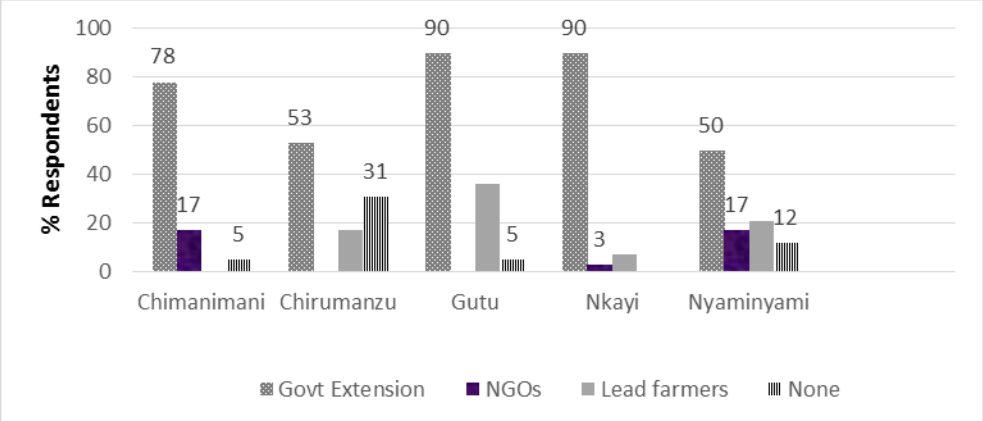

FIGURE 6: The role of lead farmers in field day organization

b) Demonstration plot organization

Farmer participation with regard to training is important in the process of adoption of innovation like CA, and demonstration plots allow farmers to learn by seeing (Kiptot & Franzel, 2015; Khaila *et al.*, 2015). The effectiveness of CA practices largely depends on the timely and appropriate management of all farming activities. Demonstration plots are usually organised by extension officers who identify a "good farmer", usually a lead farmer, who can in most cases compare the performance of the new technology with an existing technology under his/her farming conditions. Demonstration plots are therefore perceived as a place for training follower farmers. Lead farmers play an important role in building the necessary degree of cooperation and trust between farmers and extension officers. However, lead farmers were not very actively involved in the organising of demonstration plots (FIGURE 7) in Chirumanzu, Nkayi, and Nyaminyami compared to other extension stakeholders. Demonstration plots and field days are usually funded through the provision of inputs (Khaila *et al.*, 2015), so without financial support, it may be difficult for lead farmers to organize demonstration plots.

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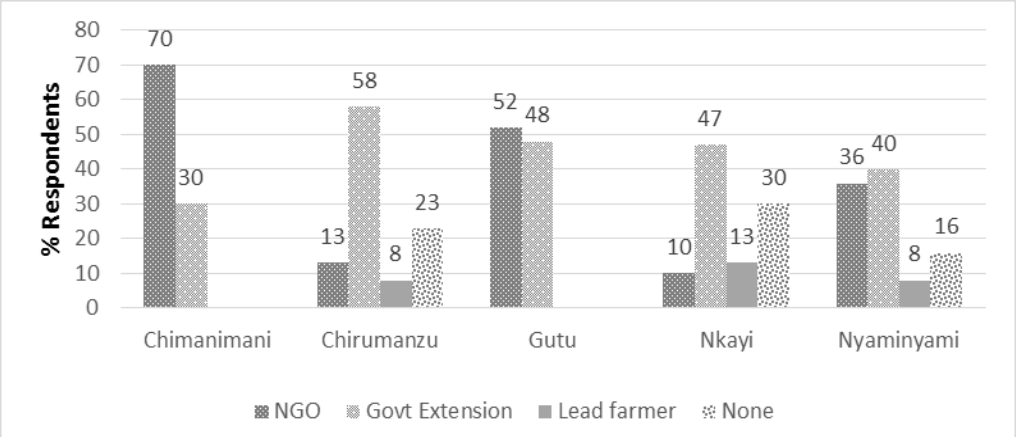

FIGURE 7: The role of lead farmers in setting up demonstration plots

4. CONCLUSION AND RECOMMENDATIONS

Conservation agriculture has proved to form an important part of the farming systems in the districts in Zimbabwe. The continued support that farmers received from government extension services and benefits associated with the adoption of CA may have contributed to the sustained practice of CA. However, the area under CA practices is still relatively low compared to conventional farming practices, which is largely due to labour challenges and perceived negative effects of CA on health and the elderly. Labour-saving technologies such as promotion of semi-mechanized CA options like the use of rippers and promotion of other mulching options such as the use of live mulching through intercropping with legumes and some cover crops, should be promoted to ensure the sustainable adoption of CA on a large scale. The use of crop residues as mulch or soil cover competes directly with other important uses such as fodder to feed animals in mixed farming systems, and sometimes poor households use maize stover as cooking fuel. It is important to highlight these constraints to the uptake of CA principles by small scale farmers, as perceived benefits may often vary according to a specific farming situation. Some farmers may receive better returns by using crop residues for fodder or fuel, while others may benefit from its use for mulching or nutrient recycling.

In all the districts, lead farmers are considered to play a complimentary role in agricultural extension services. However, their role has changed from farmer-to-farmer visits to demand-driven support, where farmers were expected to consult lead farmers for support and not *vice versa.* The role of lead farmers in organizing demonstration plots and field days has been disappointing low across districts, which may be due to the lack of access to production inputs necessary for lead farmers to play an active role in the process. On their own, lead farmers can only provide limited technical support to fellow farmers, which would normally be informal. Regular training can help

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boost their skills confidence and competency level. Lead farmers need to be properly institutionalized into the extension system by public extension services which should continue to use them to reach other farmers. Coordination between NGOs and government extension agents is necessary for ensuring the use of lead farmers is sustained.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the support from Canadian Food Grains Bank in carrying out the research and availing the data to authors for publishing purposes.

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