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Assessment of Adoption of Conservation Agriculture in Roma Valley, Lesotho

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Abstract: ***The study assessed adoption of CA in Roma Valley. The specific objectives were to: assess whether farmers possess knowledge of CA, assess the attitudes of farmers towards CA and find out the extent to which farmers have implemented CA. The study involved 47 farmers based in Roma Valley. An interview schedule was used for collecting data which were analyzed using Statistical Package for Social Sciences (SPSS) computer programme version 20. The findings revealed that majority of the respondents possessed knowledge of CA and positive attitudes towards it. They also revealed that none of the farmers practiced CA in Roma Valley. The study concluded that while respondents in Roma Valley are generally aware of CA as a farming practice and have positive attitude towards it, implying potential inclination towards adopting it, they have generally not practiced it.***

Keywords: Assessment, Adoption, Conservation Agriculture, Roma, Lesotho

1. Introduction

According to [2], CA system upholds three conservation principles. These are: minimum soil disturbance, permanent soil cover and optimum crop rotation. Minimum soil disturbance involves growing of crops with minimum soil disturbance since the harvest of the previous crop. Its advantages are that it: protects the soil against erosion by water and wind; saves cost, fuel, time, and labour in the long term; improves infiltration and conserves soil moisture; improves soil organic matter and increases yield per unit of fertilizer or manure applied [4].

Permanent soil cover involves crop residues and live mulch on the field. Mulch and special cover crops protect the soil from erosion and limit weed growth throughout the year, unlike in conventional farming where farmers remove or burn the crop residues or mix them into the soil with a plough or hoe. The soil is left bare, so it is easily washed away by rain, or is blown away by the wind. Its advantages are that it: suppresses weed germination and growth, it reduces evaporation of water from the soil, and keeps the soil warm especially in winter for crops to grow well [4].

Retaining residues on the soil surface can provide cover to reduce evaporation, provide barriers against runoff, and improve precipitation infiltration [5]. In addition, the crop residues can also reduce the rate of evaporation by isolating the soil from sun heating and ambient air temperature, and increasing resistance to water vapour flux by reducing wind speed. Some crops do not produce sufficient residue to intercept raindrops, while there are some crops that act as cover crops to reduce the intensity of rain that can cause splash erosion.

According to Food and Agriculture Organization [3], Reverend August Basson, an Africa Inland Mission (AIM) missionary, moved with his family to the harsh mountainous area of Tebellong in Qacha's Nek District in 1993. For several years, he tried to improve and develop local agriculture by investing donor money in tractors, greenhouses and inputs but the yields never repaid his investments. Furthermore, most Basotho could not afford to buy such equipment. Alternatively, the pastor then switched to testing farming practices that relied on low external inputs which were more suitable to the local socio-economic conditions. He later realized that the tillage methods that were in use in Lesotho were exacerbating soil erosion and land degradation. Eventually, in 2000 Reverend Basson went to South Africa tolearn more about conservation agriculture (CA). Back in Lesotho, he developed a planting basin system adapted to the local conditions and started to promote it with a Sesotho name *likoti*, meaning holes or pits. The *likoti* method pits are about 15×30cm large in diameter and 15-20cm deep and they are dug in 75×75cm grid. A small quantity of fertilizer, either organic or inorganic and seeds, depending on the desired crop density are placed in each basin and covered with soil. Additionally, farmers are expected to leave crop residues on the field as mulch and practice crop rotation and intercropping. The *likoti* method was originally deployed in the production of maize and beans. However, innovative farmers have also used it to produce other crops such as sunflower, sorghum, potatoes and tomatoes.

In order to diffuse the conservation farming technique to rural farmers, Rev. Basson founded a Lesotho based-charity, Growing Nations. He rented fields to set up demonstration plots and organized several training sessions. It took some time for the first group of *likoti* farmers to gain confidence with the new practice [3]. Meanwhile, Pastor John Mokoena and Rev. Pete West from Rehoboth Christian Church also promoted CA in the northern district of Botha-Bothe. In 2001, Brian Oldrieve, a pioneer of the planting basin system in Zimbabwe and other African countries since the eighties came to Lesotho to provide training both in Tebellong and Makhoakhoeng. From 2002, the practice attracted the interest of more non-governmental organizations (NGOs) and international organizations, such as German Red Cross, Food and Agriculture Organization (FAO) and World Food Programme (WFP) that provide support with various kinds of incentives to farmers who adopt it [3]. According to information provided by Conservation Farming Network Group (CFNG) members in 2006, about 500 households were practicing *likoti* in the southern districts of Qacha's Nek, Quthing and Mohale's Hoek, whereas the number of

CA farmers in Botha-Bothe and Berea districts in the northern lowlands was about 350 [3]. Since then the number of *likoti* farmers has increased steadily. World Food Programme estimates that, so far, about 5000 households or farmers have adopted *likoti* in different districts with its support. Farmers supported by WFP cultivate an average of 1.63ha of land and currently there were about 8163ha of land under CA. However, those figures do not include farmers who have adopted the *likoti* practice with the support of organizations, such as Growing Nations and FAO as well as those farmers who have executed the practice on their own accord. The Roma Valley is situated in the foothills of Lesotho characterized by severe land degradation and low soil fertility due to the use of conventional tillage methods and erratic climatic conditions exacerbated by the effects of climate change that sometimes contribute to low agricultural production. They also contribute to shortage of arable land that leads to low food security and nutrition. Farmers in Roma Valley have limited or inadequate capability to deal with and adapt to the environmental conditions due to climate change [3]. High unemployment rates due to the retrenchment of many Basotho miners are among the most important causes of poverty and vulnerability.

This poverty can be alleviated by practicing CA to ensure food security. Forests and pastures are progressively disappearing due to the increase in the extent of soil and river siltation [3]. Rain water harvesting techniques are seldom practiced for irrigation of crops during droughts, resulting in decline in agricultural productivity due to lack of moisture. Abandonment of fields due to drought and consequent scarcity of investments have limited the adoption of products and technologies suitable to the local conditions and ultimately hampered the growth of productivity. The general objective of the study was to assess factors that contribute to farmers' adoption of conservation agriculture (CA) in Roma Valley. The specific objectives were:

- To assess whether farmers possess knowledge of conservation agriculture.
- To assess the attitudes of farmers towards conservation agriculture.
- To find out the extent to which farmers have implemented conservation agriculture.

2. Methodology

The research used a quantitative design meaning that it utilized numerical data; and was cross-sectional, meaning that data were collected at one point in time. The target population of the study was 932 households living in five villages. A sample of 5% was drawn proportionately each villages to make a total of 47 farmers (Table 1). The snowball technique was used to select the sample.

Table 1: Sampling Technique

Village	Population (N)	Sample size (n)
Pae-lea-itlhatsoa,	(75)	4
Hata-Butle,	(321)	16
Thoteng,	(122)	6
Mafikeng,	(281)	14
Mafefooane,	(133)	7
Total	932	47

Data were collected through interview schedule with close-ended and open-ended questions and items. This instrument was developed with the help of literature and consultation. The key aspects of the instrument were: farmers' knowledge of CA, farmers' attitudes towards CA and extent of implementation of CA.

Data were collected from October to November 2016. The researcher made appointments with the farmers to schedule convenient times for the interviews.

Data were analyzed using the Statistical Package for Social Science (SPSS) computer programme version 20. The findings were presented in tabular form involving frequencies, percentages, standard deviations and means.

3. Results and Discussion

3.1 Farmers' Knowledge of Conservation Agriculture

Respondents were asked to indicate their awareness of *likoti*. The findings indicate that the majority (68%) of respondents were aware while 32% were not. Possession of knowledge on CA is found to be strongly correlated to the attainment of training. Participation at community level of all members, especially of the local leadership, allows a better understanding and a wider acceptance of new ideas and practices, especially if they need not just a technical shift but also a radical cultural change, as in the case of conservation practices. The respondents are generally aware of CA and this shows high chances of adoption of this innovation, especially if more training is offered to facilitate their knowledge.

The respondents were asked to explain CA and, if they were aware of it. The explanation was largely that CA is a type of farming where food is produced by sowing seeds in pits or minimum tillage. The majority of the respondents were inclined to define CA as a practice where seeds are sown in pits without tillage to produce food. According to [8], CA is a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment. This means that adoption and implementation of CA in Roma Valley will facilitate resource-saving by farmers in the form of resources like seeds, soil, water and land. The yield will also increase to the maximum level while simultaneously conserving their already degraded land.

Respondents were requested to indicate their opinions regarding CA, as reflected in selected facts about it. The findings on the extent to which they agreed with the facts are summarized in Table 1. The opinions were based on a four-point Likert-type scale which was presented as follows: 1 = Strongly disagree, 2 = Disagree, 3 = Agree and 4 = Strongly disagree. For purposes of interpretation of findings, means ranging from 2.50 and above were taken to imply that respondents agree with the facts about CA and those below 2.50 to imply that respondents disagree. Standard deviations of less than 1.000 were taken to imply that respondents did not vary in opinions, while those from 1.000 and above were regarded to imply respondents' variation in opinions. The

findings indicate that respondents agreed with all the facts about CA. Standard deviations ranged from 0.612 to 0.824 and overall were 0.742 reflecting that respondents did not vary in opinions regarding CA.

Specifically, the respondents agreed with the following facts about CA:

1) Crop residues left in the field after harvesting increase organic matter in the soil (Mean = 3.17);
2) Retaining residues on the soil surface can provide cover to reduce evaporation (Mean = 3.13);
3) CA reduces soil compaction thereby preventing soil structure decline (Mean = 3.00);
4) CA reduces erosion in the fields (Mean = 2.98);
5) CA advocates for the use of organic fertilizer (Mean = 2.96)
6) CA increases long term yields, compared to conventional tillage (Mean = 2.94);
7) CA leads to higher profitability, compared to conventional tillage (Mean = 2.91);
8) CA has been fundamental to crop production compared to conventional tillage (Mean = 2.87);
9) In CA, fertilizer is applied before planting (Mean = 2.79).

Table 2: Distribution of respondents by opinions regarding facts about CA

Facts about CA	n	Mean	SD
CA reduces erosion in the fields	47	2.98	0.766
CA advocates for the use organic fertilizer	47	2.96	0.658
In CA, fertilizer is applied before planting	47	2.79	0.750
Crop residues left in the field after harvesting Increase organic matter in the soil	47	3.17	0.670
Retaining residues on the soil surface can provide cover to reduce evaporation	47	3.13	0.612
CA has been fundamental to crop production compared to conventional tillage	47	2.87	0.824
CA increases long term yields, compared to conventional tillage	47	2.94	0.791
CA leads to higher profitability, compared to conventional tillage	47	2.91	0.803
CA reduces soil compaction thereby preventing soil structure decline	47	3.00	0.808
Overall		2.97	0.742

According to these findings, respondents agreed with the facts about CA. This implies that *likoti* has higher chances of being adopted if facilitated fully by extension agents in Roma Valley. Adoption of *likoti* can lead to higher agricultural productivity, due to improved efficiency in the use of inputs and other resources. Furthermore, CA contributes to greater environmental sustainability due to improved soil structure and enhanced fertility. It also contributes to higher social sustainability due to accessibility to the technology by all social categories, including the most vulnerable [8].The CA practice has been shown to be very suitable to local socio-economic conditions, and to overcome environmental constraints.

3.2 Attitudes of Farmers towards CA

The study examined the attitudes of farmers by enquiring whether they liked CA and about their opinions regarding facts concerning CA. The findings indicate that majority (81%) of respondents like CA, while only (19%) of them dislike it. It is evident, therefore that respondents possess positive attitudes towards CA. Those who liked CA indicated that it contributes to high output; low costs are incurred, utilizes organic matter, can be practiced by anybody, is cost-effective and is done without tillage.

The majority of them said that they liked it because it conserves soil and water. Crop residues left on the soil surface protect the soil from wind erosion and break the impact of raindrop splash, slowing down the velocity of surface runoff and impeding water erosion.

Table 3: Distribution of respondents' opinions about CA

Farmers opinions about CA	n	Mean	SD
CA is better than conventional tillage	47	2.81	0.647
CA is less labour intensive than conventional farming	47	3.17	0.564
CA saves time compared to conventional farming	47	3.19	0.647
CA contributes to higher environmental sustainability compared to conventional tillage	47	3.09	0.686
CA leads to higher profitability compared to conventional tillage	47	3.04	0.721
CA conserves water	47	3.13	0.647
CA can be practiced by anybody	47	3.26	0.642
CA should be introduced in every village	47	3.11	0.814
CA can lead to higher output from low input	47	3.11	0.814
Overall		3.10	0.687

Reduced runoff results in a reduced loss of water and soil. Huang *et al.* (2008) showed that no-till with stubble retention increased surface soil water content significantly. Retaining residues on the soil surface can provide cover to reduce evaporation, provide barriers against runoff, and improve precipitation infiltration [7]. To facilitate adoption of CA, positive farmers' attitudes need to be reinforced by stronger and wider demonstration of CA. This implies that positive attitudes contribute to the facilitation of adoption of CA.

Those who disliked CA mentioned that farming is associated with excessively tilling the soil which is not the case with CA and that it wastes time and yield is low. The majority of them gave such reasons as: in CA, crop residues are not fed to animals as a form of compensation to them after providing animal power during farming activities. They also said that farmers have many uses for crop residues as: fodder, fencing, roofing and fuel. Livestock keepers let their animals graze on stubble; therefore crop residues serve as a vital source of animal feed [7]. This implies that they need extension services to provide them with explanations about the importance of leaving and chopping crop residues on the field after harvesting as one of the pillars of CA.

Respondents were requested to rate opinions about CA using a four-point Likert-type scale. For purposes of interpretation of findings, means ranging from 2.50 and above were taken to imply positive attitude and those below 2.50 to imply negative attitude of farmers towards CA. Furthermore, standard deviations of less than 1.000 were taken to imply that respondents did not vary in their opinions, while those from 1.000 and above were regarded to imply respondents'

variation in opinions. Therefore, the findings, as presented in Table 2, indicate that respondents had a positive attitude towards CA. The standard deviation ranged from 0.564 to 0.814 and overall was 0.687 reflecting that respondents did not vary in opinions regarding CA.

Specifically, the respondents' opinions were that:

1) CA can be practiced by anybody (Mean = 3.26);
2) CA saves time compared to conventional farming (Mean = 3.19);
3) CA is less labour intensive than conventional farming (Mean = 3.17);
4) CA conserves water (Mean = 3.13);
5) CA should be introduced in every village (Mean = 3.11);
6) CA can lead to higher output from low input (Mean = 3.11);
7) CA contributes to higher environmental sustainability compared to conventional tillage (Mean = 3.09);
8) CA leads to higher profitability compared to conventional tillage (Mean = 3.04);
9) ix. CA is better than conventional tillage (Mean = 2.81).

According to these findings, farmers in Roma Valley have a positive attitude towards CA. They believe that CA conserves soil and water, saves time compared to normal conventional farming, can be done or practiced by anybody, requires less labour and contributes to the sustainability of the environment compared to conventional tillage. As noted by FAO (2010), CA conserves water, saves time compared to conventional tillage, can be practiced by anybody contributes to the environmental sustainability and leads to higher yields from low input. This clearly indicates that this technology is slowly being understood by peasant farmers living in Roma Valley. This implies that, with this kind of disposition, adoption of CA in Roma Valley is likely.

3.3 Extent to Which Farmers Have Implemented CA

The study sought to find out if farmers practice CA. The findings revealed that none of the farmers practice CA. This is quite surprising for the fact that previous findings revealed that they possess adequate knowledge and positive attitudes towards CA. Failure to practice CA may be due to fear of experiencing increased pest and disease problems. [1] noted that the retention of surface residues encourages some pests and diseases. Reduced root system may be another reason, root systems of no tillage crops occupy a smaller volume of soil than under tillage leading to crop lodging that can result in low yield. Some Basotho stigmatize the practice due to the fact that labour is provided by people instead of animals [8]. The study sought opinions on the extent to which respondents in Roma Valley have implemented CA. The opinions were based on a four-point Likert-type scale. For purposes of interpretation of findings, means ranging from 2.50 and above were taken to imply implementation of CA and those below 2.50 to imply non-implementation. Furthermore, standard deviations of less than 1.000 were taken to imply that respondents did not vary in their opinions, while those from 1.000 and above were regarded to imply respondents' variation in opinions. Therefore, the findings presented in Table 3 indicate that the respondents have not implemented CA in Roma Valley since the overall mean is 2.19. The standard deviations ranged from 0.312 to 0.637 while the overall was 0.505, reflecting that respondents did not vary in opinions regarding CA implementation.

Table 4: Distribution of respondents by opinions regarding implementation of CA

Extent to which farmers have implemented CA	n	Mean	SD
All farmers in the area practice CA	47	1.89	0.312
CA is usually practiced in spring	47	1.96	0.464
The government provides subsidies to farmers who practice CA	47	1.96	0.509
Farmers will stop practicing CA if subsidies are stopped	47	2.19	0.537
It is important to dig 15cm×30cm pits when practicing CA	47	2.13	0.575
It is important to make pits 15-20cm deep in CA practice	47	2.13	0.575
It is vital to dig pits in 75×75cm grid	47	2.09	0.583
CA crop residues are left as mulch after harvesting to conserve moisture	47	2.83	0.637
CA is deployed in production of maize and beans only	47	1.89	0.312
CA is practiced on any arable land	47	2.79	0.549
Overall		2.19	0.505

Specifically, respondents disagreed with the following opinions regarding implementation of CA:

i. Farmers will stop practicing CA if subsidies are stopped (Mean = 2.19);
ii. It is important to dig 15cm×30cm pits when practicing CA (Mean = 2.13);
iii. It is important to make pits 15-20cm deep in CA practice (Mean = 2.13);
iv. It is vital to dig pits in 75×75cm grid (Mean = 2.09);
v. CA is usually practiced in spring (Mean = 1.96);
1. The government provides subsidies to farmers who practice CA (Mean = 1.96);
All farmers in the area practice CA (Mean = 1.89);
CA is deployed in production of maize and beans only (Mean = 1.89).

It is evident from their responses that farmers in Roma Valley have not yet implemented CA at all. As noted by FAO (2010), lack of development of appropriate technology packages and training, lack of creation and operation of farmers groups and research and extension networks and lack of appropriate use of incentives like credit, inputs and labour are the major constraints to the adoption and implementation of CA. Farmers in Roma Valley might have been experiencing these problems, hence failure of implementing CA. This implies that there is a need for extension services to disseminate pertinent information to farmers in Roma Valley regarding the adoption of CA.

4. Conclusions and Recommendations

4.1 Conclusions

Based on the findings of the study, it can be concluded that:
Respondents in Roma Valley are generally aware of CA as a farming practice. Respondents in Roma Valley have positive attitude towards CA as a farming practice, implying

potential inclination towards adopting it. Respondents in Roma Valley have generally not practiced CA.

4.2 Recommendations for Action

Majority of respondents have knowledge of CA and positive attitude towards it, the inability to implement it could be associated with lack of opportunity to "learn by doing" CA. Thus, in order to promote adoption of CA practice, there is need for extension staff in the area to engage farmers in method and result demonstrations so that they can have hands-on experience.

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