Harnessing sustainability, resilience and productivity through conservation agriculture: the case of likoti in Lesotho

Laura Silici1*, Palesa Ndabe2, Theodor Friedrich1 and Amir Kassam1*

1 Plant Production and Protection Division, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy
2 P.O. Box 756, Mafeteng 900, Lesotho

Subsistence farmers in Lesotho have been able to boost agricultural yields and increase food production by adopting conservation agriculture. The practice, locally known as likoti, also contributes to combating soil erosion and to enhancing fertility. The socio-economic and environmental benefits help poor households to rehabilitate and strengthen their livelihood capital base and ultimately help rural communities to build system resilience in the face of widespread poverty and increasing vulnerability that affect the country. This paper discusses the major advantages associated with the spread of likoti. By drawing on primary data collected by FAO-Lesotho, it enquires into the determinants of adoption, thereby highlighting constraints and options for future up-scaling. The results show that attending appropriate training is a crucial prerequisite for the correct adoption of likoti. However, training is more effective when trainers pursue true participation and when social capital among farmers is stronger. Further important determinants of adoption are the level of education and the economic incentives provided to vulnerable households. Stronger policy and institutional support in all these areas would thus help address the cultural and resource constraints that limit the full potential of likoti to be harnessed and ultimately hinder its further spread throughout the country.

Keywords: conservation agriculture; Lesotho; likoti; productivity; resilience; social capital; sustainable crop intensification

Introduction

Conservation agriculture (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. It is characterized by three principles that are linked to each other: (i) continuous minimum mechanical soil disturbance (i.e. no tilling and direct planting of crop seeds); (ii) permanent organic soil cover with residues and cover cropping; and (iii) diversification of crop species grown in sequence and associations (source: www.fao.org/ag/ca). One of the most important advantages associated with CA is that it can be applied to different farming systems, with different combinations of crops, sources of power and production inputs.

In recent years, CA has been adopted in several African countries, showing a meaningful potential to enhancing rural livelihoods through sustainable production intensification. The benefits associated with its use include long-term yield increase and output stability, usually obtained by reducing inputs and costs as well as greater adaptability to climatic variability. CA practices also help stop and reverse land degradation processes to facilitate rehabilitation and enhancement of the soil productive capacity (Kassam et al., 2009). Thus, compared to conventional tillage-based production systems, CA leads to higher net profitability, greater environmental sustainability and – especially important in Africa – higher food security.

*Corresponding authors. Emails: l.silici@btinternet.com and kassamamir@aol.com

INTERNATIONAL JOURNAL OF AGRICULTURAL SUSTAINABILITY 9(1) 2011
PAGES 1–8, doi:10.3763/ijas.2010.9125 © 2010 Earthscan. ISSN: 1473-5903 (print), 1747-762X (online). www.earthscan.co.uk/journals/ijas
In Lesotho, subsistence farmers have achieved higher yields and increased food production by adopting a CA practice, locally known as likoti. The practice contributes to combating field erosion and to enhancing soil health and fertility. In 2006, the FAO Representation in Lesotho in collaboration with the University of Roma Tre, the National University of Lesotho and the Faculty of Lifescience of Copenhagen University undertook a survey in order to assess the socio-economic impacts of likoti on small-scale farmers. Under the initiative, two sub-sample populations (117 CA and 112 ‘conventional’ farmers, or a total of 229) were monitored through a household survey in the areas of Maphoakhoeng and Ha Mamathe in the western lowlands of Butha-Buthe and Berea districts, respectively, and Tebellong and Tsoelike in Qacha’s Nek, in the south-eastern highlands (see Figure 1).

The present paper discusses the most important advantages associated with the spread of CA in Lesotho. By drawing on the primary data collected in 2006 (Silici et al., 2007), as well as on a more recent case study (FAO, 2010), it enquires into the determinants of adoption thereby, highlighting constraints and options for future up-scaling.

**Diffusion of conservation agriculture as an innovation for coping with vulnerability and food insecurity**

Lesotho is a small, mountainous country characterized by extensive land degradation and erratic climate conditions. It has a population of about 2 million people, 68 per cent of whom live below the national poverty line (UNDP, 2009). The high unemployment rates (mainly due to the massive retrenchment of miners in South Africa) are among the major causes of poverty. The rapid spread of HIV/AIDS, the migration towards urban and peri-urban areas, the absorption of many young female workers by the textile industries and the consequent breakdowns in traditional social structures are further drivers of distress and destitution. Such economic and social transformations occur in a risk-prone
environment, where the scarcity of natural resources, especially fertile agricultural land, is at the same time a cause and a consequence of poverty. As a result, the Basotho live in a context of growing vulnerability, reflected in increasing inequality, deteriorating health conditions (including low standards of food and nutrition security) and increasing exposure to external shocks (Figure 2).

The complex interaction of socio-economic factors and environmental constraints along with erratic climate are steadily reducing agricultural productivity and output: since the mid-1970s, maize yields have fallen from an average 1400 kg/ha to a current 450–500 kg/ha in most of the districts (Figure 3). In spite of its poor performance, agriculture remains a major source of livelihood for the vast majority of households engaged in subsistence farming. For that reason, a growing number of local and international actors have been promoting more sustainable, ecologically friendly practices that enable farmers to increase and stabilize the output on a long-standing basis. Among these, a CA-based practice locally called likoti has so far shown the highest potential.

The practice of likoti

The practice of likoti was first introduced in Tebellong – a harsh mountainous area in the south-eastern highlands of Qacha’s Nek district – by Pastor August Basson and his local charity, Growing Nations. For almost 10 years, Rev. Basson had been trying in vain to help local farmers to enhance their agricultural yields. In 2000, after some time spent in South Africa to learn more about CA, he developed a planting basins system adapted to the local conditions and began to promote it with a Sesotho name, likoti, which means ‘holes’. Since 2002, the practice has captured the interest of more non-governmental and international organizations, including, among others, German Red Cross, FAO and World Food Programme (WFP), which have supported dissemination of the practice throughout the country.

According to the likoti method, pits of about 15 × 30 cm in diameter and 15–20 cm deep (or smaller) are dug in a 75 × 75 cm grid. A small quantity of fertilizer (either inorganic or organic) and seeds (the number depends on the desired crop density) are placed in each basin and covered with soil. Additionally, farmers must leave enough crop residues on the
field as mulch, and must also practise crop rotation and/or inter-cropping. The next season farmers must plant in the same pits without turning the soil. Although likoti was originally deployed in the production of maize and beans, innovative farmers have used it to produce other crops such as sunflower, sorghum, potato and tomato.

Analysis of the data collected under the FAO survey has shown that so far three factors have mostly determined the adoption of likoti. These are the economic incentives provided to vulnerable households, the level of education of the head of the household, and the degree of trust and cooperation, especially when combined with a participatory approach pursued by committed trainers, as discussed in the next section.

Most of the households interviewed under the survey are poor or very poor, but the CA farmers, and especially the female adopters, are poorer with regard to several aspects. This would suggest that the adoption of CA is not hampered by the lack of assets and income, nor does it depend on household features, such as number of members, their gender and so on. Nonetheless, very vulnerable households may initially need some support for buying the inputs and be sure to obtain enough yields so that they can continue to farm with their own resources. Indeed, the majority of interviewees received some form of subsidy – either inputs or food – to start likoti, but the incentives, except in a few cases, had already stopped at the time of the survey.

Although the ownership of physical assets seems not to be a determinant factor for the adoption of CA, literacy and education play an important role. CA farmers are more educated than conventional farmers. In particular, female adopters, who are least endowed with economic assets and other resources, are significantly more educated than the rest of the respondents, especially compared with female conventional farmers. Thus, human capital has been found to be an important determinant of adoption, especially when access to other resources is limited (as is the case for many Basotho women).

**Role of social capital in the adoption and the performance of likoti**

Beyond being a major source of livelihoods, farming in Lesotho has an intrinsic cultural value and is ‘an activity characterized by a high level of sociality’ (Boehm, 2003). Since most farmers lack all the necessary means of production, they depend on various forms of co-operation and sharecropping agreements, for which they need to use a number of ‘social skills’, including trust, reliability and reciprocity. In other words, they need to rely on social capital.

Social capital may be defined as the social relations within and among groups and communities, and the features and norms that characterize these relations, which enable the individuals to reach desirable outcomes. ‘Structural’ social capital refers to the types of social interactions that can be established (networks, formal and informal associations, kinship and friendship ties, etc.) whereas ‘cognitive’ aspects include the attributes (such as behavioural norms, shared moral values, personalized and generalized trust) as well as the informal and formal agreements through which these relationships work (Silici, 2009).

Social capital is crucially important when farmers shift from conventional to conservation agriculture. Whenever an innovative practice is introduced, enhanced cooperation and collective action facilitate extension and field activities and encourage adaptive research by enabling the formation of groups and networks among farmers, extensionists and researchers. More generally, the presence of social capital supports a receptive attitude towards the cultural and institutional changes that any innovation process implies. As a means to support institutional agreements, avoid conflicts and foster community participation, social capital also helps to solve the problems related to the use of common pool resources.

As has been mentioned, high unemployment, the associated increase in income poverty and the spread of HIV/AIDS are progressively depleting Basotho social capital, thereby limiting their capability to sharecrop and ultimately to farm. Indeed, the socio-economic suitability of likoti is also counterbalanced by a number of cultural and relational issues. For example, some Basotho stigmatize the practice due to the fact that labour is provided by people instead of animals. Also the customary rules that allow villagers to collect crop residues and herd the livestock in the harvested fields may represent an obstacle to the adoption of CA. Farmers, who do not allow the neighbours into their fields, in order to keep the mulch cover and avoid soil compaction, could incur relational social problems with the rest of the community. A higher degree of trust and cooperation among community members might thus help to find appropriate institutional solutions to solve the issues related to land tenure and the integration of farming and livestock activities.

The role that social capital played in the adoption and performance of likoti has been investigated by
who adopted likoti were more endowed with social assets than those who did not. In particular, a ‘network dimension’ characterizes CA farmers in the lowland sites, whereas a ‘trust dimension’ is stronger among CA respondents in the mountains. These differences reflect the different impacts that the socio-economic trends discussed earlier have on the local communities. In the lowlands, where temporary migration to South Africa and urban and peri-urban areas is frequent, community and kinship linkages deteriorate faster than in the mountains and traditional coping strategies are less effective. At the same time, ‘looser’, choice-based networks with balanced reciprocity are substituting community groups that used to rely on generalized reciprocity. In the mountain sites, instead, the ‘trust dimension’ seems to be closely related to the persistence of traditional institutions, including community support mechanisms. These findings are also supported by the information provided by key interviewees. While all the interviewed chiefs felt that, mostly due to the general impoverishment of the people, the quality of relationships and the degree of cooperation are worse than in the past, those living in the lowlands especially stressed the decrease in reciprocal trust and the diffusion of a nascent ‘payback’ mentality.

Apart from these location specificities, the dependency analysis conducted through the structural learning of Bayesian networks found that the two dimensions of social capital – network and trust – are interrelated, and both are linked to the ‘CA adoption’ variables, suggesting that a higher endowment with social assets has fostered adoption of the practice. The analysis also found that the degree of knowledge of CA is strongly correlated to the attainment of training, and that the effect of training on the degree of knowledge is stronger in the mountains than in the lowlands. That is, likoti adopters in the mountains – who were shown to be more cooperative – have a better knowledge of CA principles and apply them more correctly than adopters in the lowlands do.

Most likely, these differences depend on the different approach used by CA trainers in Qacha’s Nek (the mountain district) and in Butha-Buthe and Leribe (in the lowlands). The former interact frequently with the trainees, organize field visits and gatherings to discuss problems and issues, and encourage farmers to work collectively. The trainers in Butha-Buthe and Leribe visit the trainees on average once a month and do not organize regular meetings, although they describe individual interaction as quite constant. Even though they encourage CA farmers to work collectively, farmers do not cooperate as they do not trust each other’s commitment.

The positive impact of the commitment of CA trainers in Qacha’s Nek on the performance and acceptance of the technology, along with the farmers’ good attitude towards cooperation and trustfulness, confirms the critical role that a proper combination of social capital and capable agency plays in the achievement of local development objectives, as highlighted, among others, by Reid and Salmen (2000), Krishna (2004) and Meinzen-Dick and Di Gregorio (2004). Q3

Impact of likoti on sustainable crop intensification

Analysis of the survey data has shown that the adoption of likoti has brought about significant advantages compared with conventional tillage practices. The most important are:

- higher agricultural productivity, due to improved efficiency in the use of inputs and other resources;
- greater environmental sustainability, due to improved soil structure and enhanced fertility; and
- higher social sustainability, due to accessibility to the technology by all social categories, including the most vulnerable.

Both CA and conventional tillage farmers plant mainly maize, sorghum and beans. Most farmers cultivate one or two fields (including both owned and sharecropped fields), the total land cultivated by CA farmers (0.77ha) being on average smaller than the land cultivated by conventional farmers (0.95ha). In order to obtain a good estimation of the yields, the output was directly measured for a sub-sample of farmers. Data were recorded from 14 likoti fields and 15 ploughed fields in Makhoakhoe (Butha-Buthe district), 26 being comparable fields (fields located next to each other with similar soil characteristics). In Tebellong and Tsolike (Qacha’s Nek), records were collected from 24 CA farmers, whereas it was not possible to directly measure the yields of conventional farmers due to logistical and time problems. The district average yields estimated by FAO and WFP were thus used as a proxy for the yields obtained by conventional farmers in these areas.

According to the records, farmers using likoti achieve larger yields in spite of employing relatively fewer means. Table 1 shows that the average maize...
yields obtained by the likoti farmers in Butha-Buthe (1.36t/ha) were higher than those obtained in the ploughed fields (0.87t/ha), the difference being statistically significant at the 0.1 level according to the one-tailed t-test performed on the means. In Qacha’s Nek, CA farmers got about 0.73t/ha of maize, which is more than three times the district average yield for that growing season – 0.2t/ha, according to WFP and FAO (2006).

Comparing the value of the output with the costs of the inputs showed that farmers producing maize with likoti in Qacha’s Nek returned a profit whereas those who ploughed incurred a loss. In Butha-Buthe, CA adopters’ average profit was double that obtained by farmers who employed draught power whereas it was almost four times that obtained by farmers who used tractor power. Also the economic analysis and the assessment of returns to labour suggest that the CA practice is profitable, notwithstanding the significant workload needed especially in the first two seasons in setting it up. In fact, the overall amount of net labour required tends to decrease over time, because after the first season it is not necessary to design the grid and break the hardpan to dig the basins. Furthermore, if well managed, the preparation of the land can be spread over the dry season and over several seasons, thereby relocating the heavy labour out of the peak planting period and also spreading it over time. Preparing the field during the dry season also enables farmers to sow earlier and benefit from timely planting as well as to programme other off-farm activities. Early planting, in turn, allows farmers to concentrate on weeding during the weed flush rather than ploughing and planting, as is the case in conventional farming systems (Baudeon et al., 2007).

The spread of CA practice also has significant impacts on the environment. According to a soil fertility index built from the analysis of 123 soil samples, the overall soil quality is significantly higher in the no-tilled fields. Improved fertility and a stronger soil structure are the primary causes of the increase in yields. At the same time, they contribute to stop and reverse the process of soil erosion and land degradation, which dramatically affects the Lesotho landscape. Considering that many farmers do not keep a proper soil cover, the full potential of likoti in combating land degradation has yet to be realized.

The adoption of likoti is also associated with several positive socio-economic outcomes. Most of the interviewed households rely on a reduced or unstable livelihood capital base. The increase in crop yields and the high profitability thus suggest that CA has been effectively used by vulnerable households as a means to cope with scarcity of resources. Moreover, farmers who adopted likoti have started to improve their food security status. In both phases of the survey, households’ diet diversity was monitored through a food consumption score (FCS). After the harvest, both farmer categories recorded a more diversified diet (i.e. a higher average FCS), but the improvement was much more significant for likoti adopters (19 per cent) than for conventional farmers (6 per cent), suggesting that the former rely more on their own production (Table 2).

The social and environmental sustainability associated with CA practice are extremely important. Poor resource farmers obtain higher yields, improve household food security and possibly, in the longer run, will be able to make a living from farming. Indeed, since its first introduction in Tebellong, CA has been

### Table 1 | Average maize yields (t/ha), by location and tillage method

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of observations</th>
<th>Average yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Likoti</td>
<td>Ploughed</td>
</tr>
<tr>
<td>Makhoakhoeng (Butha-Buthe)</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Tebelong and Tsoelike (Qacha’s Nek)</td>
<td>21</td>
<td>1</td>
</tr>
</tbody>
</table>

1District average yields, 2005/2006 agricultural production season (WFP and FAO, 2006).

### Table 2 | Average FCS obtained in February and August and percentage variation

<table>
<thead>
<tr>
<th></th>
<th>Conventional farmers’ households</th>
<th>Likoti farmers’ households</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average FCS, February</td>
<td>20.17</td>
<td>18.00</td>
<td>19.07</td>
</tr>
<tr>
<td>Average FCS, August</td>
<td>21.39</td>
<td>21.47</td>
<td>21.43</td>
</tr>
<tr>
<td>% Variation</td>
<td>6</td>
<td>19</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Silici et al. (2007)
adopted by more and more farmers throughout the country. According to the information collected by FAO, in 2006 there were about 850 likoti farmers in the country. Since then, their number has steadily increased. Even though precise figures are not available, WFP alone estimates that so far about 5000 households – or 1.5 per cent of rural households – have adopted likoti with its support in different districts. Considering that farmers supported by WFP cultivate on average 1.63ha of land, currently there are about 8163ha of land under CA (2.5 per cent of total arable land). However, these figures do not include farmers who have adopted the likoti practice with the support of other organizations such as Growing Nations and FAO as well as farmers who have adopted the practice on their own accord.

Lessons learnt and options for further spread

The CA practice has been shown to be very suitable to local socio-economic conditions, and to overcome environmental constraints. However, the long-term sustainability of crop intensification as a means to sustain livelihoods and build system resilience depends greatly on social, cultural and institutional factors.

Attending appropriate training is indeed the most important prerequisite for the correct adoption of CA, whose performance largely depends on the timely and coordinated management of all farming activities. Equally important is the approach used by the trainers. In Qacha’s Nek, in fact, the higher level of trust among respondents along with a closer interaction between farmers and trainers has been especially relevant to both the performance and the acceptance of likoti. These findings confirm the critical role that a proper combination of social capital and capable agency of committed leaders play in the adoption of innovative farming practices.

In spite of the determinant role that social capital is known to have for the adoption and the performance of CA (and confirmed by the present work), the interventions originally undertaken to spread likoti did not address specifically community participation and relational aspects. The analysis thus suggests that in future the promoters of CA should take social-capital-related issues into greater account. Indeed, a more participatory approach would help local communities to better address a number of issues, for instance, the need to look for alternative fodder and fuel sources in order to limit the access by herders and other villagers into CA fields. Similarly, a closer integration of farming and livestock could help overcome other constraints, such as the supply of organic manure or the production of fodder crops in rotation with other crops.

In July 2009, Growing Nations signed an agreement with the International Fund for Agricultural Development for the provision of a grant to establish a training centre and to develop new training curriculum. By involving participants from the whole country, the organization aims to expand its outreach activities to other districts and agro-ecological zones. Playing a catalyst role, it will also provide the right incentive for more actors to get involved in the diffusion of the practice. Especially important is the training conceived for the MAFS extension staff, who in turn can directly contribute to raise awareness about the long-term environmental and social benefits of CA and so foster a wider acceptance of these practices. A more general effort is also needed to enhance education, which was found to be particularly relevant to women’s involvement.

The provision of incentives to poor resource farmers has been identified as another important determinant of the adoption of likoti and can be justified by three reasons:

- The critical impact that CA practices can have on the livelihoods of vulnerable households.
- The initial labour intensiveness, which may represent a major deterrent to the adoption.
- The environmental benefits, which represent positive externalities from which the whole society benefits, but which are not perceived by individuals.

Although useful for those households who need to recover their livelihood basis, food aid and other forms of subsidies should be used carefully so as not to create dependency or discourage food production. Most of the CA farmers interviewed under the survey had already stopped receiving subsidies when they were interviewed. Furthermore, only 5 per cent of the farmers who had already abandoned CA and 8 per cent of those who were still practising asserted that the ‘provision of food and other incentives’ was the main reason for starting CA, meaning that in 92–95 per cent of the cases farmers would continue to practise CA even after the subsidies have stopped.
Whether to provide incentives remains a debated issue. WFP continues to give out incentives, recognizing the positive role they play in motivating poor households during the lean period and in the initial stages of adoption. At the opposite, Growing Nations decided to stop subsidy-based incentives because they consider that motivation and passion should be the main leverages of farmers’ involvement and perseverance. Apart from the fact that incentives may discourage long-term adoption, the different approach may also be explained by the different objectives that the two organizations pursue: the WFP mandate is to help vulnerable and food-deficit households to enhance food security, whereas Growing Nations aims above all to change farmers’ mindset, as explained in the following paragraph.

With regard to the future, the promoters of likoti anticipate a great potential that can be harnessed. Many farmers have so far achieved encouraging results. Some farmers who earlier harvested 0.4t/ha have steadily increased their yields to 2t/ha over a period of two years. Such positive results should encourage more farmers to shift to CA. However, according to Rev. Basson, who was interviewed on 12 January 2010, Growing Nations current strategy focuses on the quality of the performance and the maintenance of high standards rather than the speed of the adoption rate. The association, in fact, has realized from experience that to perform well (and so to convince more farmers to try), it is better to work with fewer people, get them right and then expand gradually. The reason is that, as was mentioned earlier, the maximum benefits of CA are realized when all the three key basic practices are applied simultaneously. Failure to do so adequately may seriously undermine the quality of production and other benefits. Therefore, it is important to emphasize the value of observing and maintaining high standards at all times.

The survey revealed that many likoti farmers, despite their innovativeness, are sometimes unable to adequately implement all the recommendations simultaneously. In some cases, this may depend on the scarcity of the resources available; in other cases, cultural-related issues hamper the correct adoption of residue management practice (e.g. farmers cannot maintain an adequate soil cover because other villagers are allowed to collect the stovers for fuel or fodder). As a result, additional policy and institutional support may be necessary to overcome such resource and cultural constraints and so allow the greater potentials of CA to be harnessed. These considerations are especially relevant if they are put in the context of the need to address the growing socio-economic and environmental vulnerability which affects the whole country. Indeed, as this case has shown, the suitability of CA for bringing about improvement in productivity and livelihoods in the different social and economic conditions, even the poorest, is one of the most important benefits associated with its adoption. As one farmer well put it, the main advantage of likoti is just that ‘Everybody can do it’.

References


