ENHANCING AGRICULTURAL RESILIENCE AND SUSTAINABILITY IN EASTERN AND SOUTHERN AFRICA

Key Findings and Recommendations for Malawi

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Ministry of Agriculture, Irrigation & Water Development

CIMMYT

SIMLESA
Sustainable Intensification of Maize and Legume Systems for Food Security in Eastern and Southern Africa

Australian Government
Australian Centre for International Agricultural Research

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List of Acronyms

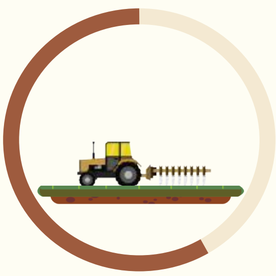
ACIAR	Australian Centre for International Agricultural Research
AIP(s)	agricultural innovation platform(s)
CASI	conservation agriculture-based sustainable intensification
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
DARS	Department of Agricultural Research Services
DAES	Department of Agricultural Extension Services
EPA	Extension Planning Area
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
NGOs	nongovernmental organizations
QAAFI	Queensland Alliance for Agriculture and Food Innovation, University of Queensland, (Australia)
SIMLESA	Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa

AGRICULTURE IN MALAWI

Agriculture accounts for about 29 percent of Malawi's gross domestic product [1] and provides nearly 80 percent of the country's employment [2]. Agricultural lands constitute roughly 47 percent of the total land area [3], yet food insecurity is widespread. Approximately half of the country's rural population, about 6.7 million people, were food-insecure in 2016/17 [4]. A high-input, high-productivity export sector, comprising a small number of large-scale estate farmers, occupies about 60 percent of the fertile land. In contrast, high numbers of smallholder farmers mainly grow low-yielding food crops with minimal input use [5]. More than half of all smallholder farmers operate less than 0.5 hectares, and more than 75 percent cultivate less than one hectare [6, 7]. Smallholder agriculture accounts for more than 85 percent of production, primarily of staple foods, but with some export surplus [7, 8].

Numerous agricultural challenges include overreliance on rainfall, which renders the country vulnerable to weather shocks and hazards. Erratic rainfall, increased water scarcity, rising temperatures and extreme weather events, such as drought and flooding, have increased in magnitude and frequency over the years [9]. Malawi is also affected by deforestation and land degradation. Yaron et al. [10] showed that soil losses through erosion averaged 20 tons per hectare per year, translating to yield losses of 4–25 percent per year. This undermines rural livelihoods and exacerbates food insecurity and rural poverty.

Large-scale estate farmers occupy about



60%

of the fertile land

More than

75%

cultivate less than one hectare

Average soil losses of

20

tons per hectare per year

translate to yield losses of

4–25%

per year

A New Approach to Agriculture

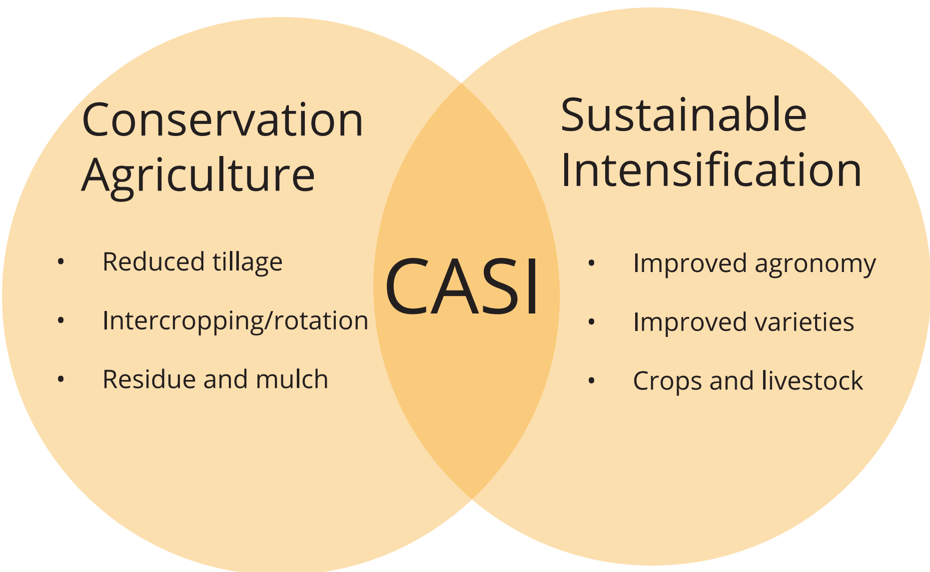
Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) was a project implemented between 2010 and 2018 in five African countries (Ethiopia, Kenya, Malawi, Mozambique and Tanzania) and two spill-over countries (Rwanda and Uganda). The project's goal was to increase African smallholders' food security, productivity and income levels by integrating sustainable intensification practices to increase productivity, while simultaneously protecting the natural resource base. The particular mix of technologies developed by SIMLESA are known as "conservation agriculture-based sustainable intensification," or CASI (Fig. 1). By utilizing these technologies, SIMLESA sought the dual outcomes of sustainably raising yields by 30 percent, while decreasing the risk of crop failure by 30 percent. In short, SIMLESA focused on and promoted maize and legume cropping systems to improve food and income security and resilience to climate change on African farms.

The project — financed by the Australian Centre for International Agricultural Research (ACIAR) — was led by the International Maize and Wheat Improvement Center (CIMMYT) in collaboration with numerous partners, including national agricultural research institutes (NARIs), in this case, Department of Agricultural Research Services (DARS); CGIAR centers, such as the International Center for Tropical Agriculture (CIAT), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the International Livestock Research Institute (ILRI); and the Queenland Alliance for Agriculture and Food Innovation (QAAFI) of the University of Queensland, Australia.

Project Overview

SIMLESA undertook onfarm research in different agro-ecological zones to assess the benefits of conservation agriculture-based sustainable intensification and to develop appropriate technology packages for smallholder farmers. The project succeeded in increasing the range of maize, legume and fodder/forage varieties available, and involved farmers in seed-selection trials so they could identify their preferences. SIMLESA helped establish agricultural innovation platforms (AIPs) to progress members — including farmers, seed producers, agro-input dealers, nongovernmental organizations (NGOs) and extension workers — along the value chain. The platforms serve farming communities, help mobilize resources, and support up- and out-scaling. SIMLESA also provided training and capacity strengthening for national agricultural research systems and worked with government, business and civil society organizations to provide an enabling environment for the benefits of the newly introduced technologies to be realized by farmers.

Figure 1. Conservation agriculture based on sustainable intensification



Source: SIMLESA-Malawi.
Note: Improved agronomy includes the use of fertilizer and herbicide; crops and livestock include fodder and forage.

SIMLESA-Malawi

Malawi's main food crops are maize, groundnuts, cassava, sweet potatoes, beans, soybeans, pigeon peas, rice, sorghum, millet, vegetables and fruit. The majority of farmers still use traditional methods, which leaves households vulnerable to food insecurity in times of shocks, such as price fluctuations and weather variations [11]. Low investment in soil-fertility improvement and increasing climate variability over the past five decades have further compounded this problem [12]. More than 90 percent of maize is produced under (often erratic) rainfed conditions [13]. In addition, most soils have lost their inherent fertility and do not yield well. SIMLESA-Malawi offered adaptation pathways for farmers facing the consequences of climate change and other challenges.

Strategic Approach

Six farmers at each Extension Planning Area (EPA) conducted onfarm trials to test the new technologies, making a total of 36 farmers. Chitala Research Station undertook the long-term on-station trial. Thereafter, CASI approaches were scaled through government agencies and the extension services system, which provided a conducive environment for public–private partnerships. SIMLESA-Malawi also utilized AIPs to organize and plan scaling activities. Farmer-managed onfarm trials provided an opportunity for farmers to test and choose the best practices. Demonstrations, field days, exchange visits and farmer field schools provided avenues to popularize and promote the new approaches among farmers. Informational materials — such as leaflets, flyers, posters and brochures — complemented extension efforts. In addition, initiatives such as the Sustainable Agricultural Production Programme and Agricultural Productivity Program for Southern Africa enabled the new technologies to be promoted beyond the project's sites. In the 2016/17 season, two NGOs were commissioned via a competitive grant process to assist in the dissemination of the new approaches, which created widespread awareness and increased adoption.

Project Sites

SIMLESA-Malawi operated in six districts representing two major maize- and legume-growing areas: the low-altitude and mid-altitude agroecological zones (Fig. 2). The low-altitude zone is characterized by low rainfall levels and high temperatures, but highly fertile soils: the Salima district at the Tembwe EPA, the Balaka district at Rivirivi EPA and parts of the Ntcheu district at Nsipe EPA. The mid-altitude zone is the location of the bulk of the country's agricultural activities: the Lilongwe district at Mitundu EPA, the Kasungu district at Mtunthama EPA and the Mchinji district at Kalulu EPA.

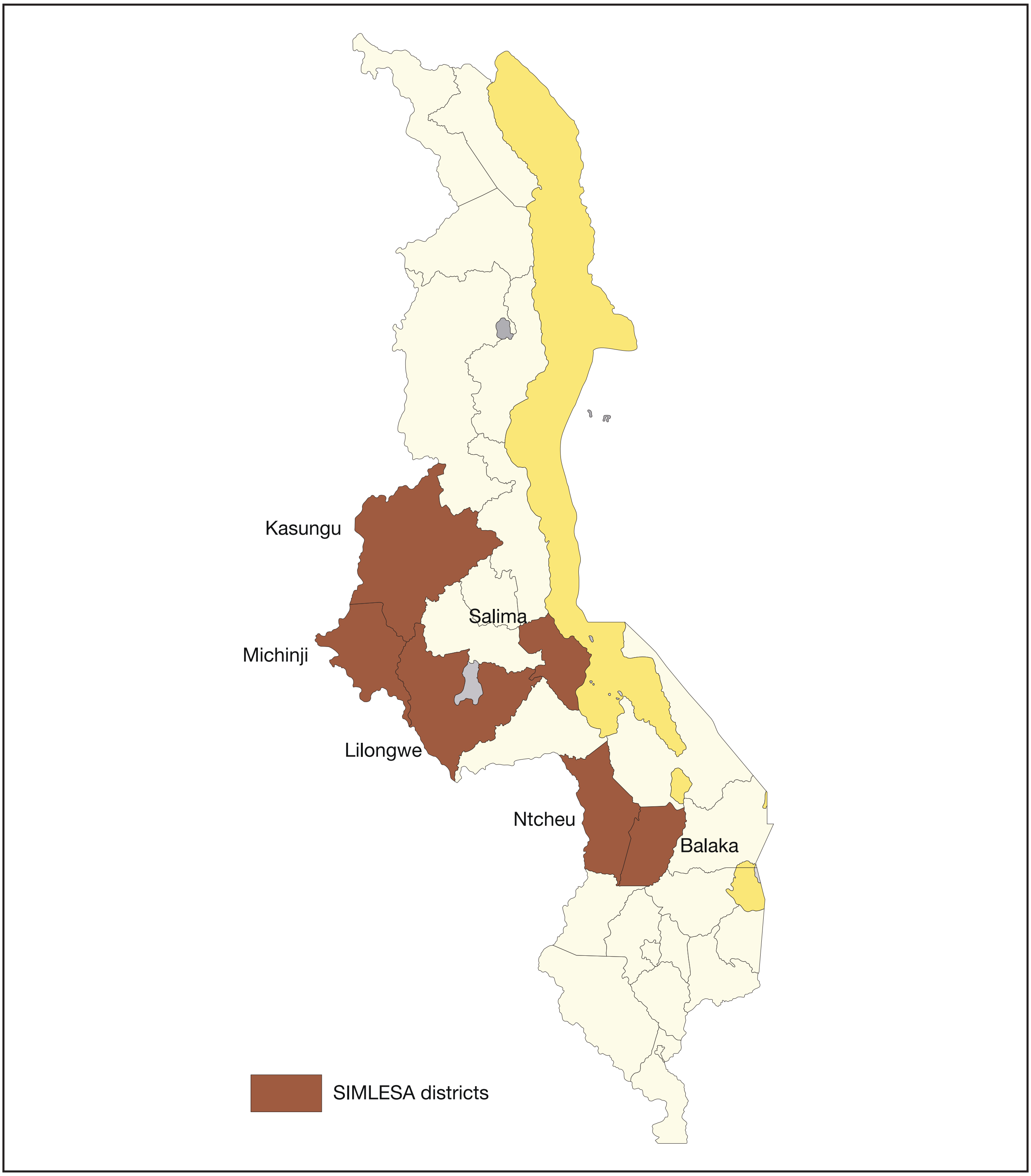
Despite differences in agroecologies, all the districts are characterized by rainfed maize-legume cropping systems, which makes them vulnerable to climate change and climate variability.

More than

90%

of maize is produced under (often erratic) rainfed conditions.

Figure 2. SIMLESA-Malawi's project sites



Source: SIMLESA-Malawi.

Partners

SIMLESA-Malawi's primary implementing partner was DARS, along with the Department of Agricultural Extension Services (DAES). Other major partners included the National Association of Smallholder Farmers in Malawi, Farm Radio Trust, Total Land Care, the Catholic Development Commission in Malawi and private seed companies.

KEY FINDINGS

This section summarizes SIMLESA-Mozambique's key cross-cutting research findings in the context of the following questions:

How can CASI increase the farm-level food security, crop yields and incomes of smallholder farmers?

In what ways do CASI approaches contribute to increasing the resilience of farming systems, protecting the natural resource base and mitigating the risks associated with climate change?

What key factors in terms of government policies, agricultural programs, rural institutions or market arrangements would enable the diffusion of CASI methods among farmers?

Does CASI contribute to a balanced approach to agricultural progress for both men and women, and how might resource-poor farmers — in particular — benefit from these technologies?

What market enhancements, including seed systems and value chains, are needed to encourage the adoption of CASI practices?

The project's findings were complex. The new approach works by integrating multiple technologies with synergistic effects over different time horizons. In addition, CASI was purposively implemented across a range of agroecologies, which makes it challenging to directly compare results from one region to another. Other challenges included erratic rainfall distribution resulting in poor performance of some trials, outbreaks of maize pests and diseases (such as fall army worms), inadequate parental materials for seed production and unreliable irrigation. The key findings that emerged are described below.

Farm-level Food Security and Productivity and Incomes

During 2012–2017, the conservation agriculture practice of direct seeding outperformed conventional planting methods, with maize yields rising by 18 percent in the low-altitude areas and by 37 percent in the mid-altitude areas (Figs. 3–5). These results are largely attributable to the use of maize-legume rotations combined with improved agronomic practices. Evidence from adoption surveys suggests that, on average, maize yields in the study communities increased significantly over time compared with local levels: from 1.2 metric tons per hectare (t/ha) in 2010-2011 to 3.8 t/ha by 2016-2017 season.

Increase in maize yield under conservation agriculture (direct seeding)

2012–2017

18% in the low-altitude areas

37% in the mid-altitude areas

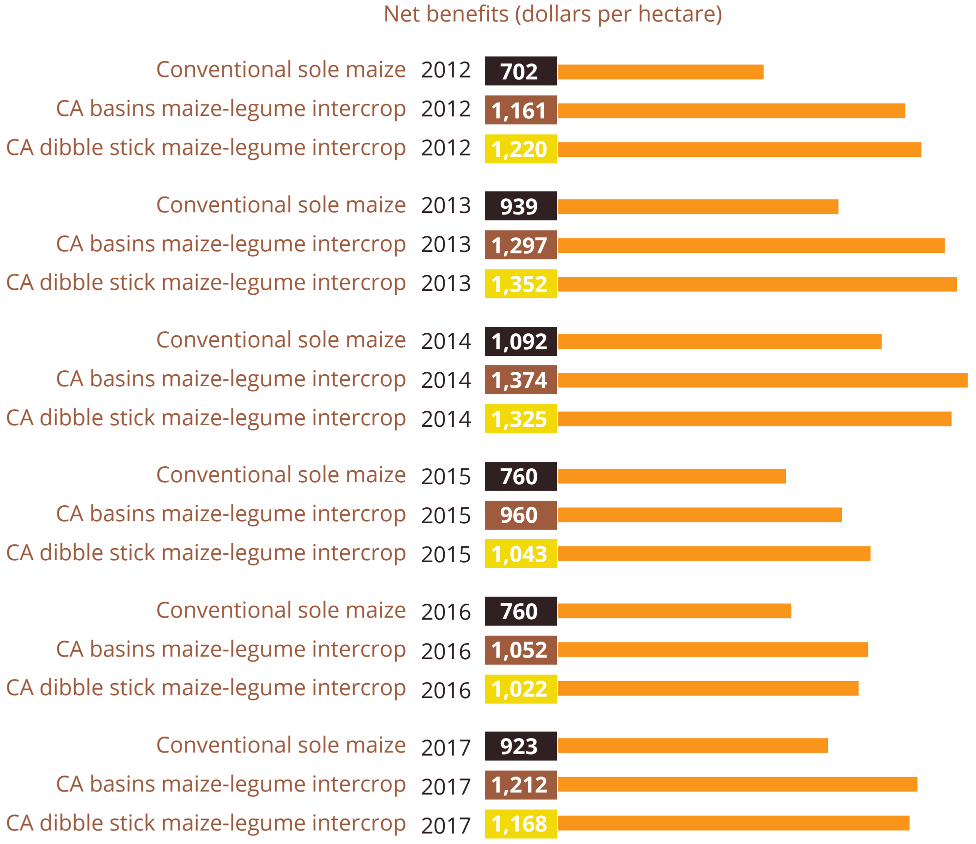
Increase in maize yield in study communities

2010: **1.2** metric tons per hectare

to

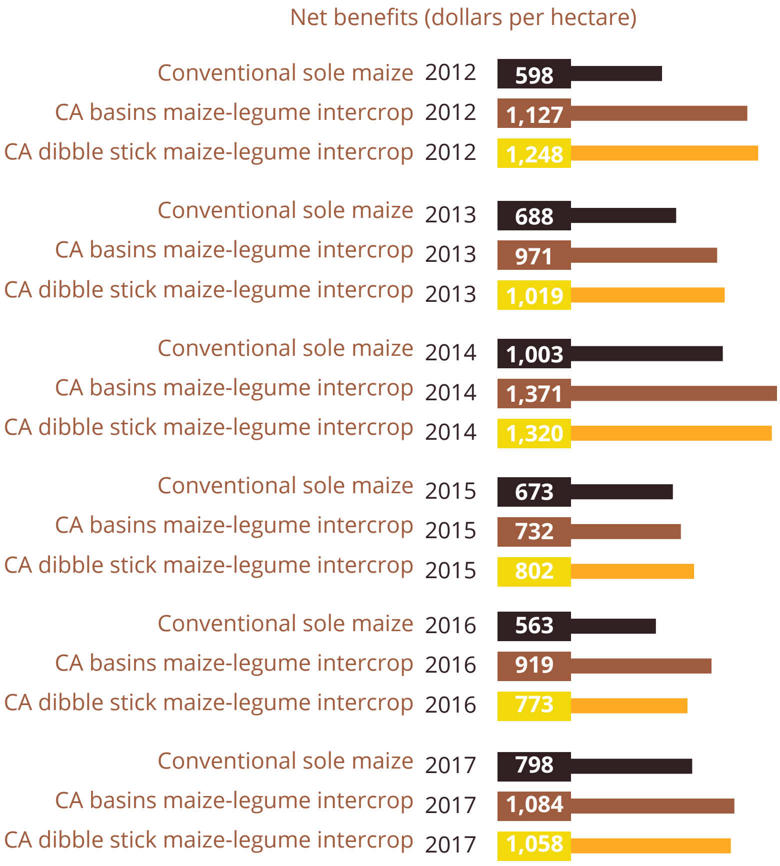
2016: **3.8** metric tons per hectare

Figure 3. Total net benefits of the new approaches, 2012–2017



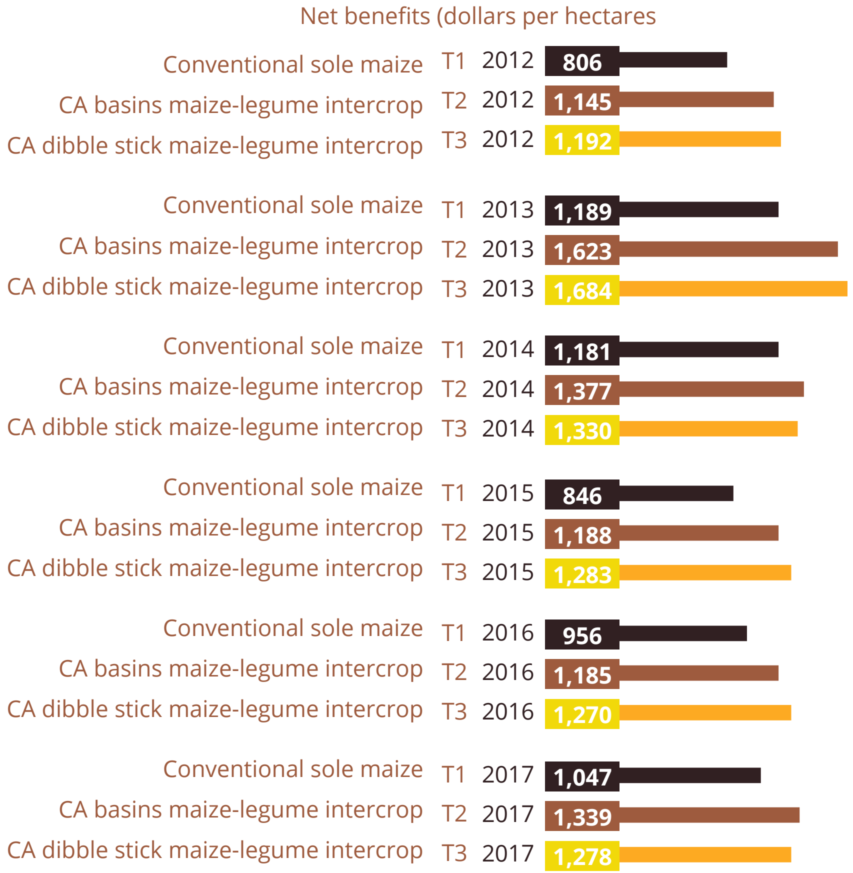
Source: SIMLESA-Malawi

Figure 4. Net benefits of the new approaches in low-potential areas, 2012–2017



Source: SIMLESA-Malawi

Figure 5. Net benefits of the new approaches in high-potential areas, 2012–2017



Source: SIMLESA-Malawi

Resilience, Risk Mitigation and Protecting Natural Resources

Soil organic carbon analysis suggests that conservation agriculture approaches lead to significantly higher organic carbon levels in top soil compared with conventional methods. For example, at mid-altitude in the Kasungu district, growing maize on its own without herbicide or growing maize and soybeans in rotation led to higher levels of organic carbon in top soil. Similarly, in the lowlands, intercropping maize and pigeon peas or rotating maize and groundnuts also increased organic carbon levels in the top soil. Such increases, however, were not evident in some sites, such as Lilongwe. These findings align well with other studies indicating that conservation agriculture practices improve soil carbon long term, but results depend on biomass production and residue cover application rates, soil texture, rainfall and temperature conditions, and other management factors [14, 15]. Legumes incorporated into such systems through intercropping or rotation also fix nitrogen, thereby increasing maize yields.

Permanent planting cover in the form of mulch facilitates water infiltration into the soil, thereby increasing soil moisture levels, reducing surface water ponding, water runoff and soil loss, all of which contribute to soil degradation. Assessments of water infiltration showed that it took significantly longer for water to pond when using CASI practices compared with conventional ridge and furrow systems [16].

Permanent planting basins are another conservation agriculture method to increase water delivery to plants in dry-prone areas or during dry spells. Basins are dug by hand approximately 15 centimeters wide and 15 centimeters deep. Basins are not effective in areas with high rainfall because they can lead to waterlogging [17], but they increase maize yield in areas where rainfall is low or erratic, such as Balaka [18].

Gender and Equity

In the communities in which it operated, SIMLESA-Malawi educated farmers on the benefits CASI practices offer smallholders, and women in particular. The project's 2016 adoption monitoring survey found higher levels of adoption of the new practices among female-headed than male-headed households, although the reasons for this were unclear. The focus on combining maize with legumes—a crop typically produced by women — is likely to be a factor; the project's success in targeting women may be another. Male-headed households were more likely to adopt herbicide use, suggesting that lack of financial resources prevents women from adopting some of the new technologies. Male-headed households were also stronger adopters of maize-legume intercropping and use of hybrid seed. Although couples jointly sold some crops, husbands more commonly sold maize (50 percent), soybeans (46 percent) and groundnuts (43 percent), whereas wives more commonly sold common beans (43 percent) and pigeon peas (46 percent). This supports the inference that SIMLESA-Malawi's focus on legume production using the new practices contributed to empowering the country's women. Both male- and female-headed households tended to recycle either their own or others' seed more than purchasing new seed, although households headed by men were more likely to purchase seed than those headed by women, once again potentially indicating women's lack of financial resources.

Markets and Value Chains

The input supply system is more developed for maize than it is for legumes. And although formal standards exist, consistent grading and standardization of maize and legumes is lacking. The need to adhere to standards would help farmers grade products before sale and provide them with an incentive to improve the quality of their products. The majority of crops are sold at the farm gate to traders (about 59 percent of maize, 64 percent of pigeon peas, 54 percent of groundnuts and 76 percent of cowpeas). Farm gate prices for maize and most common legumes are very low and do not encourage production for the market.

The majority of crops are sold at the farm gate to traders

ACHIEVEMENTS

Farmer Reach and Adoption

Between 2010 and 2016, SIMLESA-Malawi reached over 238,113 farmers with information about CASI practices. Of these, 46,113 were directly contacted through the project's partnerships with the National Smallholder Farmers Association of Malawi, the Catholic Development Commission in Malawi and Total Land Care. The Sustainable Agricultural Productivity Programme — funded by the Government of Malawi and the International Fund for Agricultural Development (IFAD) — reached an additional 192,000 farmers beyond the project's districts. In 2016, SIMLESA-Malawi initiated a competitive grant scheme to further enhance scaling activities. The grantees were Farm Radio Trust and the National Smallholder Farmers Association of Malawi, which, after one season, reached 240,245 farmers.

Findings from adoption monitoring survey indicate that more than 90 percent of the farmers contacted were made aware of SIMLESA-Malawi's portfolio of CASI technologies. The survey further showed that about 63 percent of those farmers had experimented with the technologies on their own plots or fields, and that — of those — 78 percent had adopted the technologies. In 2013, about 27 percent of farmers had adopted at least one conservation agriculture practice in Malawi's low-altitude zones, and by 2016 this rate had risen to 56 percent. Similarly in the country's mid-altitude zone, in 2013 the rate of adoption of at least one technology was about 20 percent, and by 2016 this had risen to about 47 percent. The adoption of the complete portfolio of conservation agriculture practices (intercropping or rotating maize and legumes, minimum tillage and herbicide use) rose during 2013–2016 from 9 to 28 percent in the low-altitude zones and from 9 to 13 percent in the mid-altitude zones. SIMLESA-Malawi's partners also established six AIPs, one in each of the project's districts.

90%

of the farmers contacted were aware of technologies being promoted by the program

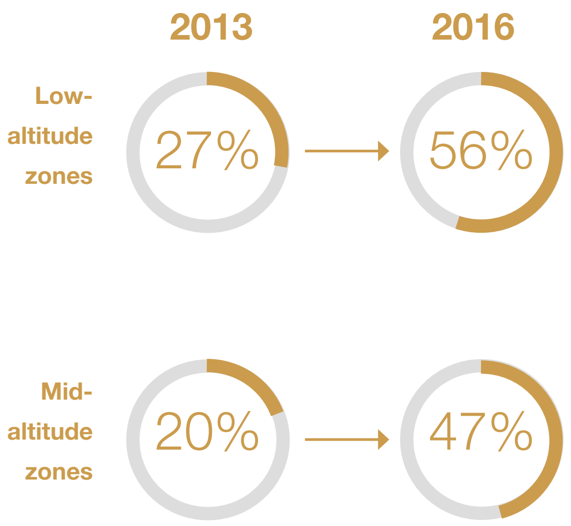
63%

of farmers had actually tried CASI technologies in their own plots and fields

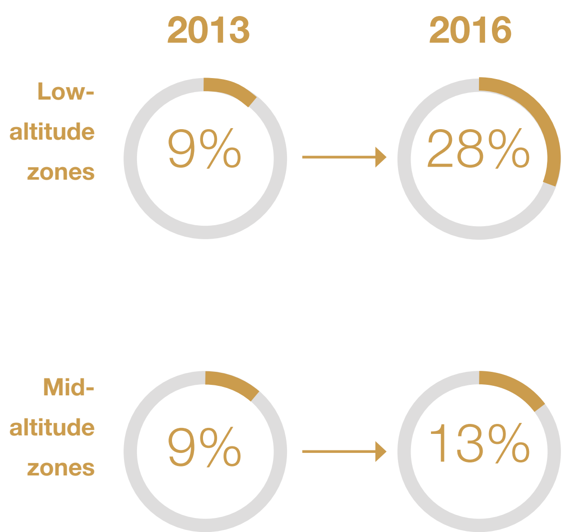
78%

of farmers who had tried the technologies adopted them

Adoption of least one CASI technology



Adoption of a complete package of conservation agriculture practices, including intercropping, crop rotation, minimized tillage, and herbicide use



Release of Improved Varieties

SIMLESA-Malawi identified 18 improved varieties of maize, including hybrid, open-pollinated and climate-resilient varieties, and 12 improved legume varieties for release to farmers.

Training and Capacity Strengthening

SIMLESA-Malawi provided numerous training opportunities both in the form of degree-level and short courses (Fig. 6).

Fig 6. SIMLESA-Malawi's capacity building initiatives, 2010–2018

SHORT COURSES BY SUBJECT

5 in gender mainstreaming — **40% women**

5 in agricultural production systems simulator modelling — **20% women**

18 in gender mainstreaming for project implementers — **44% women**

4 in conservation agriculture, soil health, and innovation platform skills — **100% men**

4 in agronomy — **25% women**

2 PhD degrees — **50% women**

3 MSc degrees — **100% men**

Source: SIMLESA-Malawi

OPPORTUNITIES FOR INTEGRATING THE NEW APPROACHES INTO MAIZE FARMING SYSTEMS

Packages for Farmers

Recommendations for farmers vary depending on the agroecological context and available resources. Technologies form "a basket" from which farmers can choose depending on their socioeconomic and biophysical environment. Prescriptions can be fully adopted or farmers can select the combinations they deem most suitable to their circumstances. In addition, the use of good agricultural practices is key to success.

SIMLESA-Malawi identified the following as key factors supporting the adoption of the new technologies by farmers:

1. **Increased productivity and yield stability.** The use of improved crop varieties combined with good agronomic practices improved yields over time, while at the same time increasing farmers' resilience to climate variability.

2. **Reduced soil degradation.** Continuing soil degradation in Malawi necessitates farmers' use of purchased inputs; however, CASI practices have proved to be effective in improving soil fertility by reducing soil erosion and run-off. Retaining crop residues for use as mulch builds organic matter in the soil over time, thereby further improving soil fertility. Practical demonstrations provided farmers with first-hand evidence of the positive impact of the new approaches compared with the rapid soil degradation occurring under conventional systems.

3. **Reduced labor requirement.** Farmers saw the benefit of herbicide use in reducing the labor needed to prepare land for planting, and of herbicide use and mulching with crop residues to reduce the labor associated with controlling weeds after planting.

Based on these findings, a number of packages are proposed for the agroecological contexts in which SIMLESA-Malawi operated (Tab. 1).

Table 1. Summary of CASI options for two of Malawi's agroecological zones

	Low-altitude areas		Mid-altitude areas	
Type of agricultural practice	**Low-input**	**High-input**	**Low-input**	**High-input**
Conservation agriculture				
Reduced tillage	Using a dibble stick, permanent planting basins	Using a dibble stick	Using a dibble stick	Using a dibble stick
Crop diversity	Intercropping	Intercropping/rotations	Intercropping/rotations	Intercropping/rotations
Mulch	Using crop residues as mulch	Using crop residues as mulch	Using crop residues as mulch	Using crop residues as mulch
Sustainable intensification				
Plant density	Varies by crop, but generally higher	Varies by crop, but generally higher	Varies by crop, but generally higher	Varies by crop, but generally higher
Planting date	Early	Early	Early	Early
Shallow Weeding	X	X	X	X
Fertilizer	Organic, rhizobia, inoculant	Inorganic, rhizobia, inoculant	Organic, rhizobia, inoculant	Inorganic, organic, rhizobia, inoculant
Herbicide for weed control		X		X
Improved varieties				
Maize	Open-pollinated and drought-tolerant varieties	Hybrid and drought-tolerant varieties	Open-pollinated and drought-tolerant varieties	Hybrid and drought-tolerant varieties
Legumes	Cowpeas, groundnuts	Pigeon peas, groundnuts, cowpeas	Cowpeas, groundnuts	Soybeans, groundnuts, pigeon peas, cowpeas
Forage	Not applicable	Not applicable	Not applicable	Not applicable

Source: SIMLESA-Malawi.

Low-Potential Areas

Areas requiring low resource investment. Farmers in these areas have limited land and resources, but because they tend to have large families, they potentially have a lot of labor. The main goal for this group of farmers is food security and improving resilience to risk, including climate change. Key CASI options highlighted for this group are described below:

1. Permanent planting basins are recommended in combination with maize-legume intercropping because labor is abundant for this group.
2. Increased use of organic fertilizer combined with improved, drought-tolerant seed would be economically advantageous.
3. Despite the popularity of herbicide, its use is not necessary in the mid-altitude areas; results indicate that the differences in maize yields with and without herbicide use in this zone are small.

Areas requiring high resource investment. Farmers in these areas have limited land, but they do have financial resources. They are commercially oriented, so the goal is to reduce vulnerability to climate risks and diversify their production systems. Key options highlighted for this group are described below:

1. Given available resources, this group can increase it resilience to risk by allocating less land to maize and legumes and diversifying into high-value crops, such as cotton and tobacco.
2. This group can also intensify its production by adopting the use of dibble sticks for planting.
3. Using fertilizer and herbicide, along with improved, drought-tolerant seed will increase yields.

High-Potential Areas

Areas requiring low resource Investment. Farmers in these areas have more land (with the exception of those located in Lilongwe), but their financial resources are low. The main goal for these farmers is food security. The key CASI options highlighted for this group are described below:

1. Use of open-pollinated varieties is recommended because these farmers may not be able to afford hybrid seed.
2. Increased use of organic fertilizer will improve yields.

Areas requiring high resource investment. Farmers in these areas have both the land and resources to diversify into other crops. They are usually commercially oriented. Key options highlighted for this group include the following:

1. Use of high-value legume crops, such as groundnuts and soybeans, is recommended to maximize profits.

Factors Preventing Widespread Adoption of CASI Technologies

Farmers face several constraints to adopting the new approaches, as described below.

1. **Use of crop residues.** Lack of sufficient crop residues can compel farmers to import mulch from distant plots, rendering its use labor-intensive and time-consuming. Crop residues are often burned to control fall army worm or in the process of hunting field mice. Misinformation can also lead farmers to believe that mulching with crop residues is labor-intensive. In addition, where bylaws are weak or not adhered to, uncontrolled livestock can consume crop residues. The rising economic value of pigeon peas in the mid-altitude region has led farmers to realize the need to manage their livestock after maize is harvested because pigeon peas mature later than maize. Local institutions need to be strengthened to enforce bylaws within communities. In addition, engaging youth in farming decisions will educate them on the value of farming both as an economic activity and for food security. The Ministry of Agriculture has taken steps to educate farmers on the appropriate control of fall armyworms. Guidelines for implementing conservation agriculture practices need to be scaled so that farmers have correct information regarding the use of crop residues and implementation of other practices.

2. **Pests and diseases.** Continuous monocropping of maize increases the incidence of pests and diseases, but because farmers strongly prefer to grow maize, it is difficult to convince them to allocate land to rotational crops. Farmers erroneously attribute pest infestations to conservation agriculture practices as opposed to monocropping and lack of other hygiene practices in the field. CASI recommendations incorporate good agricultural practices to break the cycles of pests and diseases. Improved market linkages and prices for other crops, such as legumes, can lessen farmers' preference for solely growing maize, but in most cases legume prices are too low to act as an incentive for farmers to diversify.

3. **Input and output markets.** The prevalence of poor-quality or counterfeit seed and other inputs in the market make it risky for smallholders to purchase inputs. Farmers rely on seed from their own harvest, resulting in substantially lower yields. Malawi also has limited the number of seed companies producing legume seed, and capacity challenges exist in producing high-quality seed. Poor market information and infrastructure prompt farmers to sell their produce to traders at exploitative prices, affecting their profits and ability to invest in CASI technologies. New seed policy has addressed the problem of fake seed by introducing higher fines and longer jail sentences for infractions.

In addition to these constraints, in the broader context, appropriate policies, programs and other interventions are instrumental in creating the environment and structures to enable farmers to adopt new approaches in the long term and become integrated into value chains. This involves both discrete and collaborative efforts by government, private enterprise and civil society organizations. The following interventions or enhancements are recommended to support the adoption of the new technologies by farmers.

Government Intervention

Policies. Malawi recently launched a National Seed Policy to address issues of poor seed quality, lack of access to seed and agricultural technologies, and farmers' rights. Further development of strong value chains through government support for rural infrastructure, microfinance, quality- and grade-based pricing systems and widespread market information will go a long way to ensuring strong market foundations for sustainable intensification. Proper enforcement of policy also needs emphasis.

Programs. Programs need to address lack of capacity in breeding legumes so that different combinations of legumes and cereals can be developed to suit the country's different agroecologies.

Input subsidies. In the 2004/05 growing season, to promote the agriculture sector and food security, the government of Malawi introduced a large-scale national subsidy program focusing on agricultural inputs for maize (mainly fertilizer and seed). The subsidy did not, however, include other legumes or pesticide and herbicide packages needed to assist smallholders in maximizing the use of CASI technologies. The subsidies need to be extended to legume crops such as soybeans, groundnuts and pigeon peas.

Training and Capacity Strengthening. The Farm Radio Trust initiative reached a significant number of farmers with CASI technologies. The key lesson from the competitive grant scheme is that conservation agriculture technologies can be promoted much more quickly using mass media (radio and SMS). Future efforts need to include more information on basic agronomic practices, such as planting density, weed control and timing of planting.

Markets and Value Chains

Input markets. Farmers' organizations, such as the National Association of Smallholder Farmers, could be mobilized to support the provision of herbicide, pesticide, and fertilizer in Malawi. Innovative input supply systems, such as contract farming, are also needed. Microfinance institutions need to provide low cost loans to enable farmers for purchase farm inputs.

Seed systems. Local production of foundation seed needs to be intensified, and access to certified legume seed improved. Seed companies need to be given greater incentive to market improved maize and legume varieties to farmers. Such incentives could include access to seed materials and loans for the development of infrastructure for seed production, processing and storage. Further research is also needed to identify where seed deterioration occurs along supply chains.

Output markets. Developing improved grading systems for legumes could help to improve the quality of marketed products, while enhancing farmers' linkages with agribusinesses through microfinance and agro-insurance. Local contract farming could foster market participation by farmers, thereby increasing agricultural output at national level. Private-sector marketing of contract-grown crops, as undertaken by the National Association of Smallholder Farmers, should be promoted and scaled to reach more farmers.

Multi-Sectoral and Social Innovations

Agricultural Innovation Platforms. SIMLESA-Malawi recognized that most of the country's smallholders have limited access to supportive services, such as market information and credit, and most rural stakeholders are marginalized in maize and legume value chains. SIMLESA-Malawi developed AIPs with the intention of promoting collective action and increasing farmers' empowerment, access to information and integration into value chains, among other benefits. SIMLESA-Malawi identified stakeholders for participation in the AIPs including Total Land Care, Save the Children, the United Nations International Children's Emergency Fund, N2 Africa, World Vision, agro-dealers, input suppliers and many more. A major factor to the success of SIMLESA-Malawi is its diverse and productive partnerships, not only with DARS and DAES but also with universities, civil society, and NGOs within Malawi, and international partners, such as QAAFI, ILRI, CIAT and South Africa's Agricultural Research Council. This approach is a powerful mechanism for building research capability.

Farmer and Social Groups. With declining government expenditures, the quality of public extension systems has declined, rendering them unable to provide adequate education and technical support for all farmers. SIMLESA-Malawi used a "farmer-to-farmer" approach to disseminate CASI technologies with the help of the extension workers, mounting demonstrations in all the project's districts.

Gender, Youth and Equity

Food Security. SIMLESA-Malawi's success in increasing the adoption of CASI technologies has also increased food security and economic opportunities among female-headed households, as well increasing women's empowerment more generally. The new approaches also make farming more viable for women because they offer options that reduce the time, labor and financial requirements associated with farm activities. Diversification of crop production into legumes, such as groundnuts, soybeans and pigeon peas, has also improved nutritional status among households, and especially female-headed households, which favor legume production.

Increased incomes. Increased adoption of hybrid maize and improved legume varieties has enabled female-headed households to substantially increase their crop yields and sell their maize surpluses. As a result, their household incomes and living conditions have improved, along with the viability of their operations. Fifteen of the project's female-headed households constructed new houses or upgraded their existing ones based on their increased incomes.

Reduced labor burden. Studies on gender and climate-smart agriculture in Kasungu and Lilongwe indicate that women typically spend 8 to 10 hours per day on agricultural tasks, and an additional 5 to 6 hours per day on household and other nonagricultural tasks [19]. CASI technologies have been proven to reduce the time and labor associated with preparing land for planting and controlling weeds, easing the time and burden, especially for women.

Successes to Date

1

The National Task Force for Conservation Agriculture developed national guidelines on conservation agriculture for all stakeholders, including farmers.

2

Research findings were shared at the national level through the National Climate Smart Agriculture Task Force, a national body charged with providing technical and policy recommendations addressing climate change in Malawi. In addition, CASI technologies formed an input into the National Guidelines on Conservation Agriculture developed through the Conservation Agriculture Tasks Force.

3

The IFAD–funded Sustainable Agricultural Production Programme allocated approximately US$40 million for the promotion of CASI technologies to 200,000 farm households in the districts of Lilongwe, Balaka, Blantyre, Chiradzulu, Nkhotakota and Chitipa.

4

The World Bank–funded Agricultural Productivity Program for Southern Africa, managed by DARS, built on SIMLESA-Malawi's work through further research and scaling of CASI technologies.

5

The Agriculture Sector Wide Approach-Support Project and Promotion of Rural Initiatives and Development Enterprises promoted CASI technologies in 11 additional districts of Malawi.

A SUSTAINABLE FUTURE FOR FARMING AND FOOD SYSTEMS

Scaling the New Approaches

The recommended next step would be to scale the dissemination of CASI approaches to at least 18 districts at high risk of climate and rainfall variability, but with high potential to increase crop productivity. This would represent about 55 percent coverage of the crop area devoted to maize.

WHAT IS AT STAKE?

Unless the new approaches are scaled across Malawi, soil degradation and water scarcity will worsen and continue to threaten the country's agricultural productivity and food security. Maintaining yields will require increasing levels of inputs, raising production costs over time. Adequately harnessing necessary ecosystem services, such as clean water, erosion control, carbon sequestration and nutrient cycling will not be possible without policy support for the new approaches.

CONCLUSION

SIMLESA-Malawi has contributed to broad acceptance and adoption of CASI practices in the country's farming systems and national programs. Rotations of maize with soybeans and with groundnuts significantly improved the yields of all crops. Where crop residues or other mulch was applied as recommended, water infiltration and soil moisture conservation improved. In well-managed systems, soil quality improved after four to five years of implementation. Compared with conventional practices, the new approaches reduced the requirement for labor in preparing land and controlling weeds, eliminating the drudgery associated with weeding by hand hoe. SIMLESA-Malawi also contributed to widespread testing of different maize and legume varieties, while providing farmers with first-hand experience of them. Perhaps most critically, adoption of the new practices and technologies will improve the livelihoods of Malawi's farmers and equip them with greater resilience to climatic shocks. It is imperative that the gains made through SIMLESA-Malawi be sustained and consolidated through supportive policies; improved markets, especially for inputs and improved seed; and more research and extension activities targeting CASI approaches.

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Ministry of Agriculture, Irrigation & Water Development

ETHIOPIAN INSTITUTE OF AGRICULTURAL RESEARCH

IIAM

KALRO Kenya Agricultural & Livestock Research Organization

NARO NATIONAL AGRICULTURAL RESEARCH ORGANISATION

RAB RWANDA

TARI

ARC • LNR Excellence in Research and Development

ASARECA Transforming Agriculture for Improved Livelihoods

CIAT International Center for Tropical Agriculture

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

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