THE SIMLESA Bulletin

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SUSTAINABLE INTENSIFICATION OF MAIZE-LEGUME CROPPING SYSTEMS FOR FOOD SECURITY IN EASTERN AND SOUTHERN AFRICA

CIMMYT MR
International Maize and Wheat Improvement Center

Australian Government
Australian Centre for International Agricultural Research

SIMLESA progressing and Integrating Mid-Term Review Recommendations

Gift Mashango

Dr Fentahum Mengistu, Director-General of the Ethiopian Institute of Agricultural Research (EIAR) addressing participants at the SIMLESA Mid-Term Review in Addis Ababa, Ethiopia, October 2015. Photo: Johnson Siamachira/ CIMMYT.

SIMLESA program was reviewed (Mid-Term Review) in 2012 which provided a set of recommendations which were critical in making some adjustments of ongoing activities of phase I and determining the future and development of program focus for the second phase.

Phase II of SIMLESA commenced in July 2014 and will continue until 30 June 2018. This phase is a variation of the project design described in the original proposal, maintained the original five objectives with greater emphasis in each on delivering impact through adoption of technologies in the main five partnering countries, and spill over countries (Rwanda, Uganda and Botswana). The revised objectives incorporate a better multidisciplinary integration and with more emphasis on scaling out.

In 2015, another Mid-Term Review (MTR) was designed to assess the SIMLESA program transition from phase I to phase II and evaluate the efficacy over the three- year period since the 2012 MTR.

The SIMLESA Review team acknowledged that SIMLESA I and II is a complex program with many partner countries, agencies, science disciplines, and objectives. Despite that complexity, the MTR found the program on the whole to be well managed by CIMMYT, and the national agricultural research systems (NARS) partners had a strong sense of ownership of the program. It was very evident that the whole SIMLESA team is determined to meet the objectives of the program, to contribute and to work as a team. The MTR team members were generally impressed by the energy and commitment of the program's coordination team, the leadership of the various objectives and the national teams.

- MTR team came up with 12 recommendations (seven broad and five objective specific recommendations) to give direction to program activities in the last lap of phase II which are summarized on page three by thematic area. To page 3

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Program Data, Documentation and Management: SIMLESA, in conjunction with all partners, urgently develop and implement a data management policy that addresses quality assurance, archiving, annotation, ownership, and access to current SIMLESA partners and to the wider research community post-SIMLESA. The Project Management Committee (PMC) should ensure that it takes appropriate steps to support SIMLESA II to achieve its objectives by taking a more active role in the program management over the remaining life of the program.

Policy involvement and Monitoring and Evaluation: SIMLESA should approach policy practice as an 'action-learning' process, using SIMLESA data and agricultural innovation platforms to inform policy dialogue. The program's monitoring and evaluation should be built on defined outcome, adoption and impact indicators that reflect targeted impact.

Communication and Science: SIMLESA should develop and implement a revised communication plan as well as ensuring that SIMLESA website is continually updated to include the breadth of outputs and data coming from the program. The focus on science should be to complete field research and disseminate progress in peer-reviewed publications and extension reports especially where the findings directly underpin the sustainable intensification (SI) packages being recommended and associated policy implementation.

Partnerships: SIMLESA should put greater emphasis on engagement with the three associated ACIAR projects (FACASI, Adoption Pathways and ZimCLIFS) to assist it in refocussing some key research areas such as crop-livestock integration and mechanization. SIMLESA should strengthen partnerships beyond the research domain. These should include partnerships with ministries of agriculture and major development finance institutions (IFAD, AfDB, WB, EU, USAID, BMGF.)

SIMLESA technologies will be scaled up as per MTR recomendations. Photo: Johnson Siamachira/ CIMMYT

Message from the SIMLESA Project Leader

Mulugetta Mekuria
CIMMYT-SIMLESA project leader

It gives me great pleasure to write to you about the achievements and challenges of SIMLESA. Although the SIMLESA project is proud to have worked on sustainable intensification (SI) programs, particularly on maize-legume based cropping systems in eastern and southern Africa during the last five years, we are glad to streamline our work before the project concludes in June 2018 – with a number of activities which combine action at every level – from local community to global policy.

SIMLESA's power lies in the strength of its partners. This bulletin is a means to share our exciting and important work, but also to show how we combine our efforts for greater impact in key strategic areas.

One of SIMLESAS's beliefs is its unique approach to the value of agricultural research for development. It is what distinguishes itself from other organizations. SIMLESA has also renewed that commitment to agricultural research by engaging stakeholders in its countries of operation – local communities, private sector, governments and many others. I am personally and professionally proud that SIMLESA articulates and demonstrates its commitment to agricultural research.

As we move into another year, we are taking stock of successes and challenges of the last 12 months. This will help us to plot the path for the next year. We have now embarked on realigning the SIMLESA Mid-Term Review recommendations conducted in 2015. We see this as presenting opportunities in current and future work. Refocusing our work will enable us to support better national, regional and global activities, and to place ourselves more strategically with national agricultural research systems (NARS) and development partners.

SIMLESA is positioned to take its program work to scale as the results of our approach and investments over the past years become more evident. The main achievements of the past five years are a result of important, successful partnerships between partner governments, the private sector and non-governmental organizations (NGOs).

While taking stock on our achievements, we are aware that there are still major challenges to be overcome. We will achieve our targets if the NARS, NGOs, the private sector and smallholder farmers work together for a common goal. We now seek to extend our impact by learning from past and current work, case studies and trying new ideas, technologies and approaches.

Showcasing our program remains a significant challenge. Another challenge is changing the mindset to mainstream SI into planning, project development and resource mobilization at national and regional levels

We wish to thank the Australian Centre for International Agricultural Research (ACIAR) for its vital support and assistance throughout the years. We are proud and pleased that our partners and supporters are as engaged, committed and excited as we are. Our gratitude goes to you all the larger SIMLESA family for keeping the momentum going forward!

We will keep you informed of all the activities within SIMLIESA in future bulletins.

Conservation agriculture systems mitigate a bad season in Malawi

By Isaiah Nyagumbo, Johnson Siamachira, Amos Ngwira and Jefias Mataruse

Salim Masautso Gabriel (left), extension officer of Salima with CIMMYT cropping systems agronomist, Isaiah Nyagumbo in a moisture stressed maize crop. Photo: Jefias Mataruse/ CIMMYT

Malawi smallholder farmers can cope with drought and climate change, attain food security and get more income through sustainable intensification of maize-based farming systems. This was revealed during a recent field learning tour in that country when a SIMLESA team from CIMMYT-Harare and Chitedze Research Station, participated in the tour.

The annual field tour, ran from 17-18 March 2016 with mixed feelings because of the bad agricultural season in southern Africa. The objectives of the field tour was twofold: to examine how the new experiments under SIMLESA Phase II were progressing, and to gather farmers' feedback on some of the SI research interventions.

SIMLESA's farmer-tested improved maize–legume technologies were showcased during the field tour. Smallholder farmers interacted with the visitors and demonstrated the SIMLESA outscaling approach of using lead farmers and learning sites.

The field visit began at Kasungu District. Despite this being a high potential region, farmers' fields had been heavily devastated by the prolonged El Nino induced dry spells.

In the mid-altitude agro-ecological region of Malawi, new maize varieties have been introduced under SIMLESA Phase II as well as new groundnut and cowpea varieties, in addition to the previously tested soybean varieties in the core on-farm exploratory trials.

Conservation agriculture (CA) exhibited mixed fortunes and presented more opportunities for learning and information sharing. “Regardless of the poor rainfall distribution this farming season, I have the best crop from my CA plots this year since the program started in 2010,” said Dyles Kawasala, a smallholder farmer. She attributed this to crop rotations, good management, soil moisture gains through mulching and drought tolerant improved varieties. Compared to other plots, maize on the conventional ridge and furrow system was suffering most from the dry spell while the CA plots were not wilting. The same was echoed by fellow farmers. Kasawala had out-scaled more than an acre around the trial site with an improved maize variety that was also well mulched. The crop was green and healthy despite the dry spells experienced. Also, the farmers appreciated the role played by pre-emergent herbicides in reducing weed pressure and indicated that only one weeding event was done followed by simple spot uprooting of the weeds.

Amos Ngwira, SIMLESA - Malawi National Coordinator in smallholder farmer Carlos Kamoto's maize - legume rotation field, Kasungu. Photo: Jefias Mataruse/ CIMMYT

Out of the three maize varieties used in the trials, Pan 53 was outshining followed by MH26. MH31 was trailing behind across the six farms in Mtunthama community. MH31 was exhibiting signs of nitrogen stress compared to the other two with a lot of leaf die back, an effect usually attributed to nutrient translocation from the lower leaves to the upper leaves under nutrient stress conditions. Because of frequent dry spells, leaf diseases were not as bad as other seasons. What was also of interest to the team was performance of different legumes (soybeans, groundnuts and cowpea) following different maize varieties. All legumes in plot positions following a high yielding previous maize crop, looked weaker. One breeder attributed this to the fact that a heavy feeder variety mines the nutrients more than other varieties, subsequently leading to a poorer legume.

Farmers in Kasungu practising CA are more food secure than any other farmers around as evidenced by their crop stand.

The next stop was in Mitundu, Lilongwe District, where a similar pattern was evident. However, besides the severe wilting, the conventional ridge and furrow system, maize was also heavily attacked by termites. In Salima, a similar pattern of severe wilting from the conventional system was evident on all sites. From the visitors' point of view, the crop in Salima-especially under the CA systems, was the best ever since the program started in 2010. Maize varieties MH26 and DK8053, were the best while MH31 was the least yielding. The rotation effects were also clearly evident. In other seasons, big basin (15cm diameter) sizes showed negative and yield depressing effects on maize as the crop was choked by excess moisture. However, this season the crop in big basins was better than that in smaller basins because of erratic rains.

Termite damage and moisture stress was much more pronounced in conventional than any other system. There is also good pegionpea establishment in the area and the Chitedze team highlighted that they linked the farmers to competitive pegionpea markets through the National Association of Smallholder Farmers of Malawi and ICRISAT.

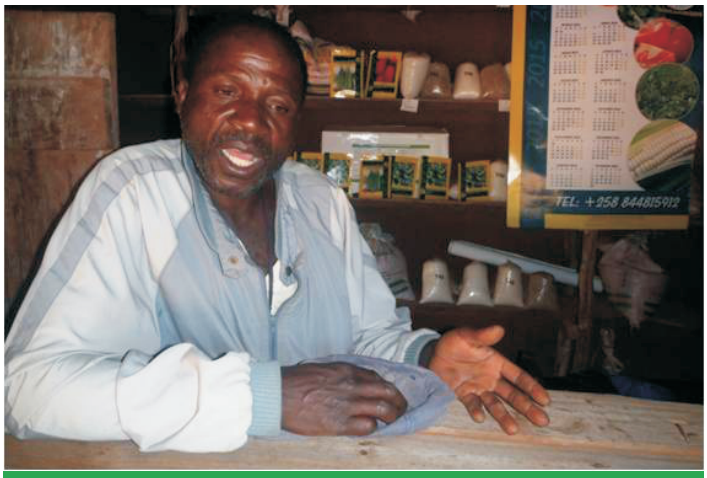
Key lessons on the tour were timely weeding, right maize–legume crop varieties, correct use of fertilizers, residue application and appropriate and safe use of agrochemicals.

Main points from the learning tour included:

- Cumulative effects of CA were very evident highlighting the need for CA studies to run for at least four seasons.
- Mulching has significant and positive effects on maize performance in dry seasons
- Maize yield increases due to legume rotations were also very clear
- Effects of basin sizes on maize performance vary with season quality
- Leaf disease prevalence is less in drier seasons such as 2015/16
- Herbicides are effectively contributing to reduced weed pressure, benefiting women and children.
- Good crop management pays off in the long- run from reduced weed pressure and increased yields over time irrespective of the cropping system employed.
- The conventional ridge and furrow system used in Malawi is more prone to termite attack than CA systems planted on the flat, unlike other conventional systems where CA suffers more from termite attack.

Financing Mozambique's Future

By Maria da Luz



Access to credit has enabled Gabriel Manuel Feijão to establish a small agrodealer business. Photo: Domingos Dias/ SIMLESA-Mozambique

In SIMLESA rural communities, access to credit for investments in agriculture is an especially difficult and sometimes onerous challenge. Many young farmers must seek employment on other farms to earn enough to support their families. Investing in their own production activities is often seen as an unreachable goal. There are few affordable credit options for rural farmers with limited or no assets as financial institutions see them as high-risk borrowers.

To address this problem, SIMLESA-Mozambique is linking smallholder farmers directly to rural financing services that provide affordable credit for agricultural activities.

Credit providers know that SIMLESA project-supported smallholders are receiving ongoing technical assistance to improve their agribusinesses. SIMLESA-Mozambique also helps link small-scale producers with buyers, ensuring they obtain fair prices.

In December 2011, the Opportunity Bank began offering loans to agrodealers in Sussundenga-sede.

Thanks to this initiative, Gabriel Manuel Feijão, of Cortina de Ferrow Village in Sussunenga-sede in Manica Province, borrowed a total of USD2,270 in three years and funded his agrodealer enterprise. The loan enabled him to invest in building an input shop and purchase agricultural inputs for sale. This investment, accompanied by technical assistance on the application of fungicide, insecticides, and chemical fertilizers, enabled other smallholder farmers in his area to increase their farm yields, and improve their food security and household income.

Feijão is one of SIMLESA's successful farmers. He has been participating in the project since its inception in 2010. Feijão has had good demonstration plots since the beggining of the project. He produces maize, common beans, and cowpea. As one of the lead farmers in the project, the local government recommended him to benefit from other opportunities in the community. A group of agrodealers in the community selected him to become an agrodealer.

The small loan has already yielded big results. Within six months Feijão's sales increased significantly. SIMLESA has also connected him with reliable local buyers.

As a result of the higher sales, Feijão quickly paid off his loan. "The loan has pulled me out of poverty," he said. Before diversifying into agrodealership, he used to earn about USD674 annually from the sale of his farm produce. Now, he earns about USD2,247 during the same period from the sale of both farm produce and agricultural inputs.

SIMLESA is working with more than 24,000 smallholder farmers in this province, mostly using existing innovation platforms.

"Strengthening smallholder value chains is really about helping farmers move from being subsistence-based to enabling them to make a better profit," said Domingos Dias, SIMLESA-Mozambique National Coordinator.

Dias says the role of donor organizations is starting to change: he sees them playing more of a temporary role in facilitating trade between small-scale producers and the private sector. Once the supply chain links are in place, he says, "the donors will shift to being a watchdog."

The SIMLESA-Mozambique/Opportunity Bank partnership is proving that this commercialization model can be profitable to both smallholders and private companies.

Gabriel Manuel Feijão showing his agriinputs, thanks to the agribusiness loan. Photo: Domingos Dias/ SIMLESA-Mozambique.

Empowering Agriculture through the Innovation Platforms Model

Johnson Siamachira, Michael Misiko and Michael Waithaka

Mariani innovation platform members (Kenya), in one of their planning meetings. Photo: Alfred Micheni.

Ineffective agricultural practices are a major challenge to smallholder agriculture development in eastern and southern Africa. This trend has left many small-scale producers on their own at a time when they badly need advice on how to improve their crop production and marketing systems.

Without a basic understanding of good agricultural practices, most smallholder farmers cannot grow sufficient crops to move past subsistence farming.

Despite these challenges, smallholders – with effective training and technical assistance – can earn significant income from growing crops commercially.

SIMLESA is using an innovation platforms approach that raises efficiencies in crop production systems; provides access to credit; links producers to buyers; and trains farmers to adopt good agricultural and business practices.

Innovation platforms are channels where farmers and other relevant stakeholders meet to discuss and share knowledge on agricultural development. “We used to grow crops randomly as we did not apply good agricultural practices,” said Calmen Kaaria, a lead farmer in Kyeni, Embu in esatern Kenya. Calmen, who is also a member of the local innovation platform, said when she joined the SIMLESA project in 2010, she did not trust that crops could do well when planted on un-tilled land, a part of the conservation agriculture technology.

Calmen has witnessed her fortunes blossom using conservation agriculture and working through innovation platforms: She has enough food to feed her family, and surpluses to give to her neighbours. She also has no problems with paying school fees for her family as she is getting income from the sale of her farm produce.

By August last year, fellow smallholder farmers had tripled their maize production from 1 to 4 tonnes per hectare by incorporating good agricultural practices they learned from innovation platforms and lead farmers, such as Calmen.

Before SIMLESA, the average yield of maize in Embu was less than 1.8 tonnes per hectare as opposed to research yields of over 7 tonnes while that of beans was about 0.45 tonnes per hectare compared to 1.2 tonnes per hectare, using good agricultural practices.

The innovation platforms approach enhances linkages of producers to a range of business and input services and products. SIMLESA is facilitating 56 agricultural innovation platforms in participating countries.

Research evidence from the SIMLESA project sites shows that farmers who operate collectively are more likely to use sustainable intensification practices.

Agricultural innovation platforms account for more than 75% of information accessed to enhance adoption among smallholders. They are critical for sustainable and effective scaling up among hard-to-reach populations.

“Innovation platforms are one of the ways to build social capital among farmers. They are virtual or physical multi-stakeholder fora that bring together a diverse range of actors along a prioritized value chain to exchange knowledge and take action to harness an opportunity, " said Alfred Micheni, SIMLESA-Kenya agronomist. He said: “Innovation platforms enhance social capital by strengthening collective action, networking and learning while reinforcing farmers' capacity to participate actively along the value chain.”

Through innovation platforms, partners are empowered to access and generate information that enables informed decision-making and innovation. Establishment of innovation platforms is flexible, iterative and interactive, and roles of partners change over time.

Based on SIMLESA's experience, successful agricultural innovation platforms are structured business-focused alliances of institutional actors to enable and sustain mutual benefits. Each of these actors derive clear benefits, based on their critical but unique roles: marketing, credit, investment, new agricultural technologies, reduced input costs, and interact with policy/ decision makers. Their collaboration results in customised solutions that simultaneously address farming problems. For example, Gataraga Innovation Platform in Rwanda has successfully increased potato supplies to Kigali.

Farmer groups are small, with preferably 10-30 members. Small groups enhance face-to-face interaction, limits coordination and management costs, reduces scope for conflict, facilitate dispute resolution, and encourages equitable and active participation of all members.

To strengthen this part of the work, governments should support mainstreaming and up-scaling of collective action using, for example, the innovation platform approach. Central and local governments can enhance wide-scale collective action from the small pockets of success to empower more farmers. This would in part require equipping extension workers to enhance their capacity for innovation platform facilitation; mainstreaming the innovation platform approach in the budgeting and planning process; strengthening the legal framework for collective action and reviewing the agricultural education curricular to ensure capacity building in innovation platform approaches.

Local and central governments should: provide budgetary support to facilitate formation and operation of innovation platforms at the grassroots; and foster social capital formation for sustainability, for instance, through partnerships with non-governmental organizations; and strengthen extension skills through structured mentoring.

SIMLESA: Enhancing Integration, Innovation and Impact

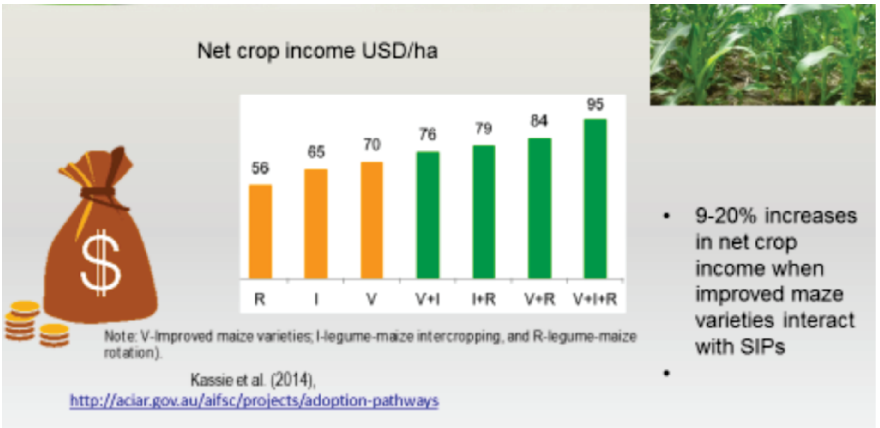
The main thrust of the SIMLESA project is increasing farm-level food security, productivity and incomes through promotion of maize-legume intercropping systems, in the context of reduced climate risk and change. Through participatory research and development with farmers, extension agencies, non-governmental organizations, universities and agribusinesses along the value-chains, the program aims to improve maize and legume productivity by 30% and to reduce the expected downside yield risk by 30% on approximately 650,000 farm households by 2023.

The project has laid down the foundation for developing CA-based sustainable intensification options, including integration of improved maize and legume varieties identified for their compatibility in CA practices; promoting technology adoption by both female and male farmers; capacity building for national agricultural research systems (NARS) of partner countries; the creation of enhanced partnerships and collaboration with established innovation platforms for a coordinated scaling out SIMLESA generated options and practices

- Key highlights from the SIMLESA project:
- SIMLESA, in collaboration with sister projects like DTMA and ICRISAT/Tropical Legumes-II and private companies in respective countries, facilitated the release of 40 new maize varieties, which have yield advantages of 10 to 30% when compared to existing commercial varieties in its program countries.
- A total of 378 legumes based participatory varietal selections (PVSs) were conducted across the five program countries.
- Farmers had a chance to incorporate their criteria into the variety selection processes, giving a sense of the ownership of the results and therefore improving scaling out and adoption of the community endorsed varieties.
- A total of 64 legume varieties across the five program countries positively met PVS team's criteria and therefore were selected for official release.

- SIMLESA activities also led to the identification of maize varieties compatible with intercropping systems, water conservation and labour savings from CA technologies were made apparent while superior maize and legume yields from rotations in CA were realized in all five countries across ESA. The positive impacts of CA practices on risk, incomes and the environment were also analysed and disseminated while innovation platforms contributed to scaling out and sustainability and reaching maize-legume technologies to over 46,000 (17,000 female, 29,000 male) farmers by 2014.

Sustainable intensification practices (SIPs) interaction with germplasm provide higher additional income - Malawi.



Sustainable intensification practices help to move farmers from subsistence farming, and access better incomes.

SIMLESA is considered as a flagship program and is being adopted by donors as a framework for sustainable intensification. SIMLESA has significantly contributed to the generation and adoption of user-preferred maize and legume varieties, as well as providing information and knowledge that improve system productivity and profitability of target farming systems. SIMLESA's unique contributions, in terms of resource allocations; developing human capacity and research facilities to improve the efficiency and impact in agricultural research is highly recognized by the project's NARS partners.

Monitoring and Evaluation for Program Impact

Monitoring and evaluation (M and E) is critical in tracking program performance. The SIMLESA M and E unit realized the need to strengthen the M & E systems in all the participating countries by undertaking support visits, updated designed indicator templates and shared data collection tools feeding into the overall program M and E system, particularly the indicator tracking system.

The indicator tracking system should be able to provide almost real time data on SIMLESA program performance. This was done as a follow-up to the ASARECA–facilitated M and E work during SIMLESA Phase I.

As part of taking the work to scale, the SIMLESA M and E Specialist, Sebastian Gavera, organized support visits to Malawi and Mozambique beginning December 2015, and spilling over to mid-January 2016 respectively, to assist the two countries to improve the data management processes as pilot and share the experiences across the other countries when rolling out the strategy. The country coordinators, in-country M and E focal persons and all objective leaders attended the meetings to update and adjust indicators in their work plans.

Both trips managed to achieve the following:

- Populated and updated indicators in the SIMLESA indicator tracking system with clear modalities of administering the system in future, providing almost real time data for the M and E database.
- Agreement on the SIMLESA data flow and design data management protocols at country level acknowledging the existence of different objectives as separate areas of work
- Shared data collection tools to routinely support the M and E system
- Agreed and shared M and E work plan for the future

SIMLESA M and E will then visit the remaining three countries to carry out similar activities to strengthen the program.

In response to the SIMLESA Mid - Term Review recommendations, the M and E unit in February this year produced a revised M and E Plan which will be finalised based on the outcome of SIMLESA sixth Annual Review and Planning Meeting to be held in Lilongwe, Malawi on 6-8 April 2016. The meeting seeks to realign and prioritise activities based on the available resources before the conclusion of program activities in June 2018.

Successful out-scaling of SIMLESA technologies start with good agronomic practices

Joe Eyre

SIMLESA out-scaling trials in Sussundenga, Mozambique, demonstrated that big yield gains are still achievable by optimising the fundamentals of agronomy, even though there was a severe drought. Throughout 2015 and 2016, a team from IIAM, ISPM and QAAFI applied the results from the analysis of typologies to support scaling-out activities. Demonstration plots showed how technologies could be targeted to individual farmers' circumstances.

Three case study farmers were identified in March 2015 from three contrasting groups of farmers identified in the analysis of typologies, basically, representing different levels of resource endowment. During farm visits IIAM, ISPM and QAAFI researchers and extension officers discussed with the farmers their present allocation of resources and levels of performance, as well as their vision for the future (5-10 years), goals and aspirations.

Jacinto Oliveira, his wife and eight children (three to 24 years) were identified as a highly vulnerable family. Jacinto's family manages 3 hectares of recently cleared land with severe labour limitations, so that means only one quarter of the farm area is cropped. Currently, the family is food secure for only four months of the year (from maize harvest in May to August). A primary goal of Jacinto is to become food secure. Jacinto has a small orchard and owns poultry.

Joana Joaquim, a widow, lives with his son, wife and 11 children. The family is food secure throughout the year. Joana's son manages the 9-hectare of mixed cropping (maize, beans and vegetables) and cattle farm. Both Joana and her son had aspirations to invest farm profits in off- farm enterprises including a bakery and a taxi.

Luis Fazenda Mambucha is a farmer and businessman whose household consists of 16 people. Farming is a secondary activity due to its low profitability. But, he continues farming activities as a promotional tool for his agribusiness and to teach agriculture to his family.

All farmers identified weed control as a major limitation in terms of yields gains. Jacinto's family perceives weeds as yield limiting, though because of family labor limitations his maize crops are only weeded twice every season. A weedy fallow persists throughout the dry season and continuously produces weed seeds. Joana appeared to have the largest potential to increase farm profits through crop and livestock intensification, and also identified weed control as a farm constraint. However, both Joana and her son were reluctant to accept that increased maize weeding or growing forages to suppress weeds and feed cattle could increase yields and profits.

Jacinto's demonstration plot in July covered with 3-4 tonnes/ha of Melinis repans and 5-10 mm of weed seed prior to clearing. Photo: Joe Eyre.

Weed control is Luis' main cropping expense, and he has experienced the effectiveness of residual herbicides, but can only source glyphosate for stocking his store, thus labour for weeding is still a big on-farm expense.

The research team visited the farmers again in July prior to land clearing to evaluate dry season plant growth and quantify the weed seed bank. Woody weeds were prevalent in recently de-forested land and grasses dominated in-fields continuously cropped for more than five years. Woody weeds, cassava, pigeonpea and volunteer legumes forages were all actively growing but grasses had senesced. Up to a 5 mm deep layer of weed seeds covered the soil in some fields. The farmers associated this seed with problem weeds during the cropping season and were all interested to learn about methods for managing the weed seed bank.

After land preparation and before maize sowing, farmers and researchers co-developed a series of interrelated demonstration trials to evaluate weed management technologies appropriate for each farmer's circumstances and production goals. Demonstrations were refined based on local knowledge, crop modelling and literature.

Cowpea was sown at a very high population density into standing maize during the first or second weeding with the intention of out-competing weeds during grain filling and dry season for Jacinto. These demonstrations targeted destruction of the weed seed bank using available technologies that have minimal cost and labour requirements.

Manure was added to all demonstrations for Joana with the view to grazing cowpea during the dry season. The businessman Luis grew demonstration plots of grain and forage crops that were identified as suitable for weed suppression, grazing and supplement food for human consumption during the dry season. Luis will hold a field day highlighting the demonstration plots and evaluate local farmer interest. He then intends to collect seed of suitable crops and sell it through his store.

During 2014/2015 the region suffered a devastating drought, but the demonstration plots looked great, thanks to improved crop management. The effects of the drought were evident in maize crops sown on-farm and on-station across Manica province. Rains arrived late in Mozambique and stopped through January. Most crops were sown in late December following good rains but suffered from severe drought during January. Maize was sown in Jacinto's demonstration plots during the ideal November sowing window that was identified by the IIAM team and supported by crop modelling.

The maize seed was placed in contact with minimally disturbed moist soil thereby ensuring good crop establishment. These demonstration plots were more able to capture the late December rains and tolerate the January dry spell. Due to the ideal sowing method and good weeding, the maize canopy is now so large that it is able to shade out weeds and sowing of cowpea into the standing maize is not required. Therefore, the treatments were modified to evaluate potential for alternative grain and forage crops double cropped on other areas of the farm were maize failed.

The focus during 2016 will be to facilitate farmer-to-farmer out scaling to reach targets of more than 100 households within each target community. The research team will also focus on simplifying the targeting process and exploring modalities for expanding the number of target communities to more than 1,000 across those demonstration plot in July covered with 3-4 t/ha of Melinis repans and 5-10 mm of weed seed prior to clearing.

Maize trials sown in late December 2015 at ISPM suffering from drought. Photo: Joe Eyre.

Promoting sustainable intensification in agriculture

Embu Innovation Platform members promoting sustainable intensification practices at Geeto Primary School in eastern Kenya.
Photo: Johnson Siamachira/ CIMMYT

More food needs to be produced to avert hunger due to increasing populations in eastern and southern Africa. The challenge of feeding growing human populations comes at a time of unprecedented global challenges including climate change, dwindling water and land resources, and shifts in consumption patterns that are putting unprecedented pressures on agricultural resources.

Two critical choices have to be made: either increase food production by bringing more land into agriculture or find ways of increasing yields on existing agricultural land while protecting the natural resource base and environmental services.

The first choice presents a course of least resistance but is fraught with many bottlenecks because supply of land is finite. Moreover, fragile ecosystems and biodiversity need to be protected, imposing a tight constraint on new cultivable land. The second choice is the most viable option and calls for 'sustainable intensification' of agriculture. This option increases crop yields without exerting negative environmental impacts and without expanding the agricultural frontier.

Sustainable agricultural intensification requires adoption of production practices that enhance crop yields and contribute to reducing the environmental risks to crop production. These practices include soil-conserving tillage methods, crop diversification and stress tolerant but high yielding crop varieties, use of fertilizers and investments in soil and water resources management.

Although the benefits may be obvious, sustainable agricultural intensification requires a major policy rethink. Part of this rethink involves investments in natural resources management in agriculture and high standards of agronomy. Practices such as water and soil conservation and integrated soil fertility management are integral to sustainable intensification. This should then be accompanied by concomitant and strong investments in fertilizer and seed supply chains.

Research under SIMLESA and other projects has shown that the best outcomes in terms of income were related to simultaneous adoption of sustainable agricultural intensification practices. The following are a summary of policy highlights that have emerged from SIMLESA research:

Increase frequency and access to extension information: Sustainable agricultural intensification practices are knowledge intensive: strong, consistent and high quality extension services are a must. Some experts have suggested 33 frontline extension workers for

every 10,000 farmers to be a minimum required for an effective extension system.

Research evidence generated under SIMLESA shows that availability of extension services produce some of the strongest effects in predicting the adoption of better agronomic practices. Policy attention from governments should therefore, focus on increasing the frequency and the amount of information available to farmers to enhance adoption of sustainable agricultural intensification practices. Governments can support the institutional and human capacity of a diverse set of actors to provide extension services.

Improve market access, lower costs of inputs and make inclusive finance available: High cost of inputs is a deterrent to the adoption of good agricultural practices and technologies. SIMLESA research has shown that input subsidies have powerful effects in predicting adoption of sustainable intensification agricultural practices. Setting input subsidy expenditures at levels comparable to those recently observed in Malawi, increased adoption by more than 100% in Ethiopia and Kenya, and by about70% in Tanzania. The powerful effect of subsidies is a result of their cost-reducing nature.

The basic premise behind this is as follows: reducing cost of inputs across the board is paramount for agricultural progress. Therefore, in terms of sustainable options for improving farmers' access to inputs, the following principles should be considered. In the short term, to increase the reach and targeting of much needed micro-finance to farmers, the use of innovative mobile money platforms should be considered. In the medium term, governments should target delivery of smart subsidies for inputs.

These can be based on selection mechanisms such as verifiable adoption of resource improving practices that require only family labour. In the long run, efficient input supply chains built on sound infrastructure provides one of the most durable solutions. Related to subsidy policies is the role of safety nets in agricultural development. Available research information shows that perceived support from government provides some assurance to farmers to try new technologies. This means that providing safety nets can help build farmers' confidence to try new crop varieties and agricultural practices.

Support integrated approaches to technology development and dissemination: Research under SIMLESA and related projects has shown that the best outcomes in terms of crop income were related to simultaneous adoption of combinations of recommended practices.

New Intercrop, New Earning Potential

Felista Mateo, "My yields have increased so much that I'm going to build a larger granary for my harvest." Photo: CIMMYT.

Felista Mateo, a divorce smallholder farmer from Kilima Tembo Village in Tanzania, had been living off subsistence maize farming for years. The traditional agricultural methods she'd been following resulted in low harvest and little income. Further jeopardizing her situation was her separation with her husband, leaving her to fend for their children on her own.

In addition, one of smallholders' major impediments to commercial farming is a lack of access to reliable and lucrative markets. Local rural markets are small, and trading in distant urban markets is not profitable because of high transportation costs.

SIMLESA is working with small-scale growers through an integrated approach that raises efficiencies in maize-legume crop production systems, links producers to buyers; and trains farmers to adopt good agricultural and business practices.

With support from SIMLESA, local researchers from the Tanzanian Ministry of Agriculture, Food Security and Cooperatives, and private companies, smallholder farmers are applying improved maize-legume cropping systems to grow more food and make money. Felista is one such farmer. In 2013 Felista planted a hybrid maize seed together with a tasty, early-maturing variety of pigeonpea. The pigeonpea had never been seen in the area. This paid off as Felista grew enough maize to feed her children and had surplus to sell. “My yields have increased so much that I'm going to build a larger granary for my harvest.” Since then, she has never looked back.

Felista accessed pigeonpea exports markets to India through bulk marketing with other Tanzanian farmers. Through group buying, Felista is able to bargain for lower prices on inputs such as seed and fertilizer. Working with the SIMLESA project, she wants to try new seed, different crops and alternative farming methods. With SIMLESA her life has never been the same because she has benefited both in food and income security because of her adopting sustainable intensification technologies.

Access to herbicides changing smallholder farmers' fortunes

Maize pegion pea intercrop in Salima, Malawi: The benefits of using herbicides can only be realized if farmers can access the herbicides easily and at affordable costs. Photo: Jefias Mataruse/ CIMMYT.

The use of herbicides in conservation agriculture reduces labor required for land preparation and improves timely planting of crops at the onset of the rains. Use of herbicides alone increased yields by 30–133 % in Malawi and saved labor by 20 -35%, equivalent to 19 person days per hectare. Similar yield benefits were also observed in Tanzania.

Currently, the use of herbicides in eastern and southern Africa is very low. Based on consumption data for the period 1990 to 2013, Kenya, Zimbabwe and Ethiopia are the highest consumers at 8, 12 and 14% respectively.

Conservation agriculture is a sustainable intensification technology premised on minimum soil disturbance, provision of permanent soil cover and the use of crop rotations. Conservation agriculture provides farmers with a strategy for saving labor, reducing erosion-induced soil degradation and mitigating against long dry-spells.

"However, initial high weed infestations usually caused by switching to conservation agriculture and the drudgery associated with manual weeding pose serious challenges for farmers, "said SIMLESA cropping systems agronomist, Isaiah Nyagumbo.

Evidence from Zimbabwe shows that delayed planting of maize beyond the optimum planting dates as a result of labor bottlenecks reduced yields by 32% while early planting accompanied by the use of herbicides and ripping techniques, increased yields by 72%. It is estimated that farmers lose 5% of the total yields for every week delayed in planting.

Use of herbicides also reduces drudgery in crop production, making farming more attractive to the youths who shun farming; and shifts gender roles from women and children to men who do most of the herbicide spraying thereby allowing women to divert their labor to other activities.

“Herbicide use in SIMLESA sites in the five countries increased over the three-year period, 2010 to 2013. The highest users were Ethiopia and Kenya at 43% and 52% respectively,” Nyagumbo said.

The increases were influenced by farmer training and ease of access. In Malawi, for example, farmers perceive labor savings as the most important benefit they derive from using conservation agriculture. Prior studies showed that the use of herbicides among farmers practicing conservation agriculture rose from 12% in 2004/2005 to 97% by 2009/2010 when farmers accessed credit to buy herbicides.

The benefits of using herbicides can only be realized if farmers can access the herbicides easily and at affordable costs. Over 90% of the farmers using conservation agriculture in Malawi cite high cost as one of the main impediments to use of herbicides.

Nyagumbo advised that ministries of agriculture and institutions tasked with the regulation of importation and distribution of herbicides should simplify approval for importation and marketing of herbicides in the region. Also, he said, they should regulate the packaging of herbicides to quantities required by smallholder farmers and control proliferation of non-standard products.

“Governments and extension services providers should train farmers and agrodealers on the safe use and handling of herbicides to increase efficiency, clear the myths and misconceptions about herbicides; and facilitate the setting up of technical service spraying units, " Nyagumbo added.

The use of herbicides was top on the agenda at the SIMLESA high-level policy forum held in Entebbe, Uganda in October 2015. The forum, whose theme was Mobilizing policy action to scale-up best agricultural practices was attended by representatives of ministers for agriculture from Kenya, Mozambique, Rwanda and Tanzania.

To mulch or to munch? Modelling the benefits and trade offs in the use of crop residues in Kenya

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1 Introduction

In low-income countries from Sub Saharan Africa, crop residues are a valuable household resource- livestock feed, energy source, or sold in the market. Quantifying the benefits and trade-offs from these alternative uses has been high on the agenda of those interested in the sustainability and food security of smallholder farming. However, so far the existing diversity in farmers' levels of endowment and sources of livelihoods, and the lack of dynamic and integrative analysis tools to quantify benefits and trade-offs from alternative farming systems designs, made answering what practices, tactics and strategies, suit what situation, a rather cumbersome exercise. Here, we present the results from simulations with a new whole farm model (APSFarm-LivSim) used to quantify the benefits and trade-offs from the alternative uses of crop residues across the diversity of households from eastern and western Kenya. Interfacing the model with a database of a household survey allowed us to parameterize and simulate each of the 600 households in the survey. This is a significant methodological improvement over previous attempts that only modelled single case study farms instead of populations of households and their representativeness across a whole country.

2 Materials and Methods

We used data from an extensive and homogeneous household survey collected by the SIMLESA program (http://aciar.gov.au/page/simlesa-program), across two contrasting agroecologies in Kenya to:

· describe the diversity of levels of resource endowment among farmers, and

· parameterize a newly developed whole farm model to quantify the benefits and trade-offs from alternative management of crop residues in mixed cropping and livestock smallholder farms. The whole farm model was derived from linking the APSFarm (Rodriguez et al., 2011) and LivSim (Rufino et al., 2009) models. Multivariate statistics were used to classify households into household typologies. Then the APSFarm-LivSim model was used to simulate all 600 households in the household survey (Fig. 1) over 30 years of available climate records. The model was run on a 200-core computer cluster for two simple treatments i.e. present residue management as in the baseline survey, and keeping crop residues as mulch on maize crops. Model outputs included measures of livestock and crop production as well as indicators of environmental impact. Changes from adopting residue retention practices were represented as changes in livestock bodyweight and soil erosion. Modelled results are presented for all the farms in each region, and for different household types.

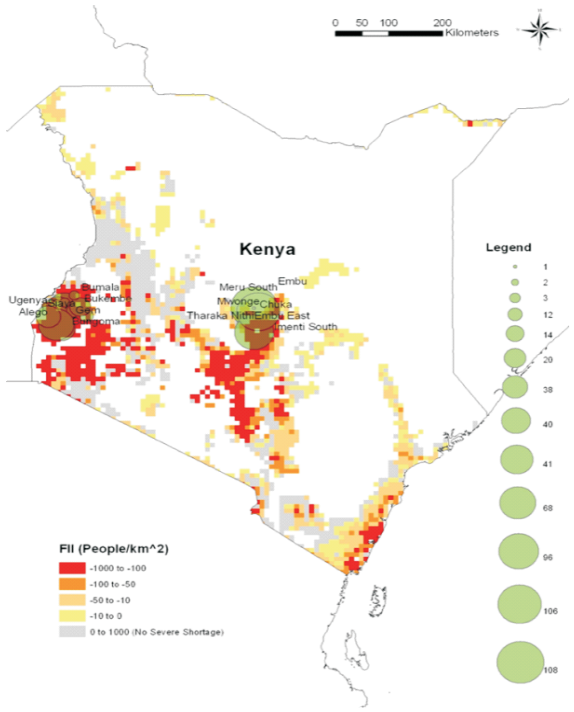

Figure 1. Map of the distribution of the surveyed farms in western and eastern Kenya (n=600), on a map showing a food insecurity index. The size of the circles indicates the number of households surveyed per village.

Three types of households were identified in each region based on the diversity in levels of endowment and sources of livelihood (Fig. 2). Most of the differences between household types shown in Fig. 2 were statistically significant, indicating large diversity in household levels of endowment and sources of livelihoods.

Density plots (Figure 3) showed a large diversity of simulated responses across regions and household types. When all the farms in the survey are plotted together (Figure 3a in western and eastern Kenya), keeping crop residues as mulch on maize crops reduced soil erosion by up to -20 and -10%, in western and eastern Kenya, respectively. Livestock body weight varied from +10 to -30%, both in Western and Eastern Kenya, respectively. Though most farms i.e. the highest concentration of households in the density plot (green areas), had a -10% and -5% reduction in soil erosion in the wetter (western) and drier eastern) regions, respectively, and no trade-off or bodyweight loss was observed. In the wetter western Kenya region no trade-offs were observed across the different household types. For the drier eastern Kenya region, differences were evident between poorly and better-endowed households. In the better-endowed households where livestock keeping was an important component of the farming system i.e. TLU>3 (Figure 1c and d in Eastern Africa) showed larger trade-offs between reductions in soil erosion and bodyweight change.

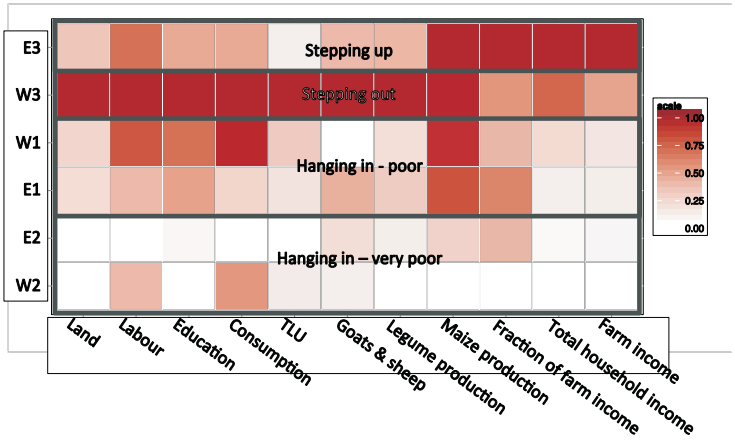

Figure 2. Heat map showing the diversity of household socioeconomic characteristics across eastern (clusters E1, E2 and E3) and western (clusters W1, W2 and W3) Kenya. The intensity of red ind icates the relative distribution of values for each characteristic. Groups of typologies were

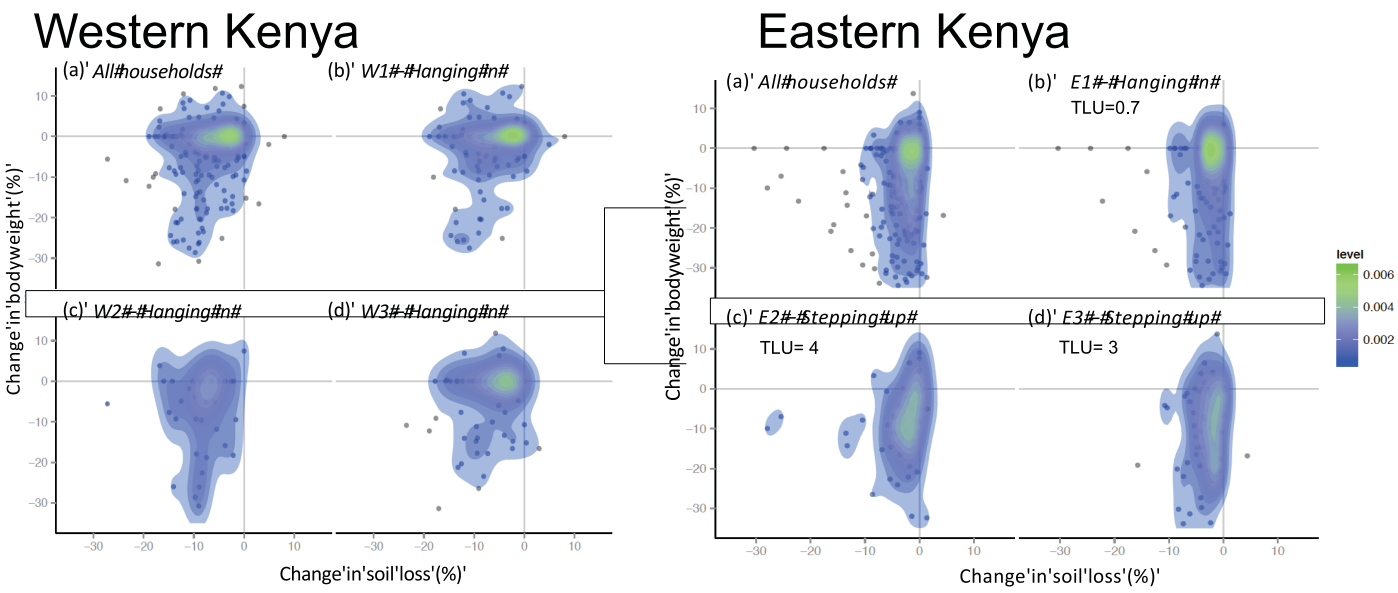

Figure 3. Density plots of simulated trade-offs between livestock bodyweights and soil erosion for each farm from western Kenya and eastern Kenya when crop residues were kept as mulch on maize fields. Simulations are shown for all the farms in each region (a), and when households were grouped according to an analysis of household typologies (b to d). TLU indicates the mean number of tropical livestock units in each household type. The colour scale indicates the density of household i.e. green (blue) showing the highest (lowest) concentration of households.

4 Conclusions

We conclude that (i) due to the large diversity in farmers' levels of endowment and sources of livelihoods it is highly unlikely that single interventions will suit the large diversity of constraints and opportunities; (ii) as shown in the example above the use of crop residues as mulch in maize cropping is likely to affect differently households from different agroecologies and households having different levels of specialization in livestock keeping; and (iii) that the integration of socioeconomic and biophysical approaches provides the opportunity to quantify benefits and trade-offs from alternative interventions and farming systems designs in agriculture development programs.

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This research is part of the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA), funded by the Australian Centre for International Agricultural Research (ACIAR).livelihoods it is highly unlikely that single interventions will suit the large diversity of constraints and opportunities; (ii) as shown in the example above the use of crop residues as mulch in maize cropping is likely to affect differently households from different agroecologies and households having different levels of specialization in livestock keeping; and (iii) that the integration of socioeconomic and biophysical approaches provides the opportunity to quantify benefits and trade-offs from alternative interventions and farming systems designs in agriculture development programs.

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CIMMYT MR
International Maize and Wheat Improvement Center

About CIMMYT

CIMMYT - the International Maize and Wheat Improvement Center - is the global leader on public funded maize and research, and on farming systems that include these crops. Headquartered near Mexico City, CIMMYT works with hundreds of partners throughout the developing world to sustainably increase the productivity of maize and wheat cropping systems, thus improving global food security and reducing poverty. CIMMYT is a member of the CGIAR Consortium and leads the CGIAR Research Programs on MAIZE and WHEAT. The Center receives support from national governments, foundations, development banks and other public and private agencies.

SIMLESA Geographic Focus Map

About SIMLESA

The International Maize and Wheat Improvement Center's Sustainable Intensification of Maize–Legume Based Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) project was launched in 2010. Funded by the Australian Centre for International Agricultural Research (ACIAR), SIMLESA aims to improve the livelihoods of smallholder farming communities in Africa through productive and sustainable maize–legume systems and risk management strategies that conserve natural resources. It is managed by CIMMYT and implemented by partners in Ethiopia, Kenya, Malawi, Mozambique and Tanzania. From gains and lessons learned in these project countries, there are benefits for three spillover countries — Botswana, Rwanda and Uganda.

Through participatory research and development with farmers, extension agencies, non-governmental organizations, universities and agribusinesses along the value chains, the project aims to improve maize and legume productivity by 30 %, and to reduce the expected downside yield risk by 30% percent for an approximate additional 650,000 households by 2023.

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