FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

USAID
FROM THE AMERICAN PEOPLE

Soybean Innovation Lab
Feed the Future Innovation Lab for Soybean Value Chain Research

Activities & Impact Report 2020

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What is SIL?

The mission of the Soybean Innovation Lab (SIL), which began in 2013, is to establish the foundation for soybean development in Sub-Saharan Africa. We are a team of technical soybean experts with experience across the soybean value chain, from breeding, genetics, agronomics, and pest and disease management, to mechanization, food science, nutrition, and economics.

We accomplish our mission by first listening to the needs of our partners, then responding with the technical backstopping (evidence-based innovations, tools, technologies) to ensure their success. SIL works with those who work with farmers, including the private sector, development agencies, national agricultural research systems, and universities, who scale our technologies for broad uptake and impact.

Our Partners Drive Us

SIL has active partnerships with 93 companies, organizations, research institutes, and universities in 26 countries across Africa, Asia, Latin America, and Australia.

- Our partner needs drive us.
- Our success is dependent on our partners' success.
- We develop innovations and technologies through co-creation to meet partner needs.
- Partners are the key to successful and sustained soybean adoption.

ILLINOIS

MISSISSIPPI STATE UNIVERSITY

University of Missouri

SIL's Research for Development Approach: A Co-Creation Model

Soybean, as a non-staple, non-native, and commercial crop, is new to many in Sub-Saharan Africa. Therefore, development practitioners require technical backstopping and guidance to be successful in growing, processing, and utilizing soybean.

SIL fills this need by embracing a research-for-development (R4D) approach – first listening to the needs of our in-country partners, then responding with technical guidance and evidence-based solutions. In doing so, SIL puts the technical research 'horse' ahead of the development 'cart'.

By explicitly engaging in a research for development (R4D) approach, and co-creation with our partners, SIL solutions are inherently ready for uptake and scale.

SIL's R4D Approach

SIL's R4D approach employs an intentional strategy of productized technologies set within a five-stage process:

1) identification of bottlenecks (ideation)
2) design
3) beta testing
4) pre-commercial and network formation
5) commercial/scaled uptake

SIL departs from the traditional academic research model, which depends on an independent research process, thus is supply-driven. Instead, SIL operates using the industrial research model, which depends on the customer, thus is demand-driven.

Being demand-driven by design means that SIL as an organization is directly linked and dependent on its clients. SIL's R4D strategy involves significant capacity building, as the lab works through in-country partnerships to scale and sustain technologies.

Global challenges are immediate. Practitioner needs are urgent. Thus, SIL's R4D timelines are short, and innovations become operational quickly.

Networks: the Key to Sustainable and Successful Soybean Development

Why networks, why now?

- Scale technologies to achieve broad impact
- Economize on scarce resources
- Allow for peer-to-peer learning and mentoring
- Lower cost to delivering knowledge assets (via webinars, databases, courses)
- Reduce isolation among professionals
- Validate practices and minimize anecdotal guidance
- Enable self-reliance

SIL Active Networks

Pan-African Soybean Variety Trial (PAT) network
26 countries, 58 institutions (31 private, 27 public)

Soybean Breeder network (all active breeders)
5 countries, 4 institutions

Mechanization network
10 countries, 16 institutions (5 private, 11 public)

SMART Farm agronomy network
7 countries, 13 institutions (9 private, 4 public)

ICT Connectivity network
3 countries, 8 partners

Plant Breeder Education network
5 countries, 9 partners

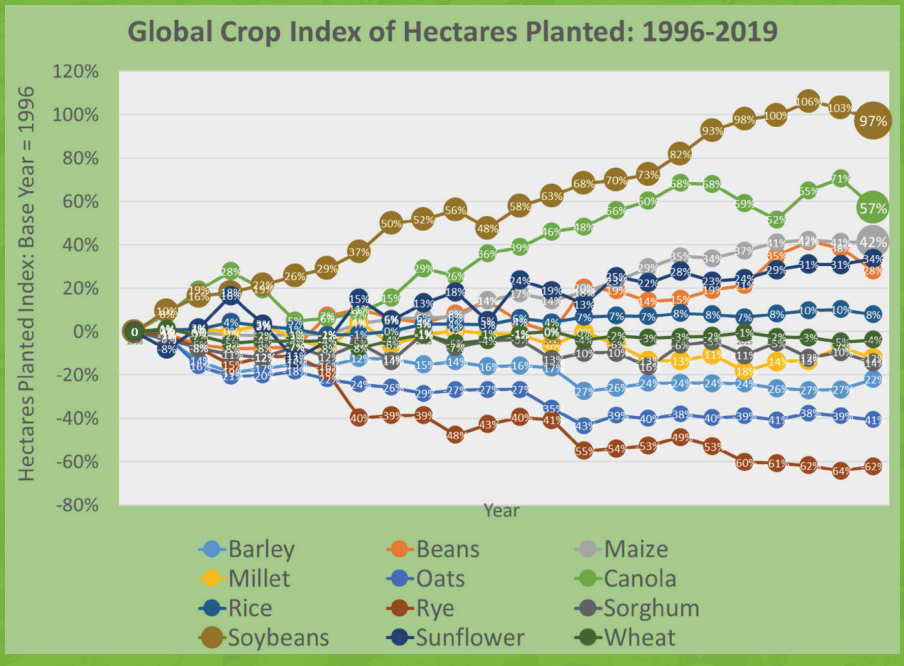
Soybean Pest and Disease network
8 countries, 14 partners

ICT Connectivity Supports All Networks
(online databases and information portals, continuing education series, open-access curriculum, communication channels (WhatsApp, Facebook, etc.), bi-monthly technical webinars)

There's a soybean revolution upon us...

Soybean is the fastest growing broad land crop in the world

Global soybean demand is projected to reach **an additional 70-80 million metric tons** over the next 10 years



Why? Yield

The potential economic multipliers of soy span the entire value chain from empowering women producers, to soy becoming the globalized standard in feed, food, and nutrition.

Yet, African producers supply less than 1% of the world's soybeans and are missing out on this growing demand.

While the global average for soybean yield hovers at...

2.76
Tons Per Hectare

African producers are averaging only...

1.28
Tons Per Hectare

The SIL 3-part solution:

Seed, Agronomics, Mechanization

With access to new, high-performing soybean varieties, inputs, and mechanization, African growers have the opportunity to **join the soy revolution**

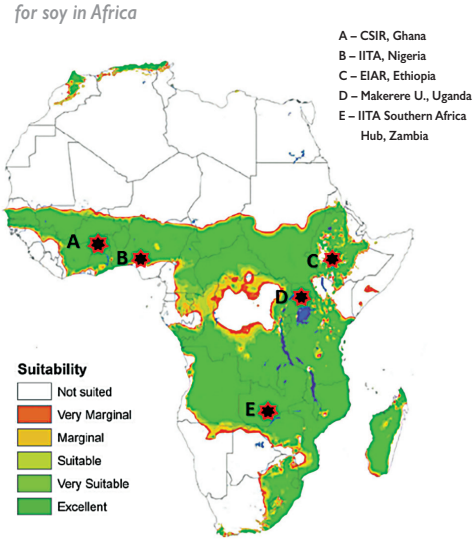
Breeder Productivity Improvement

CHALLENGE:

Varietal development for soybean rests primarily on the shoulders of African soybean breeders. They face extreme challenges from limited resources and professional isolation.

Breeder programs are small, constricting the varietal development pipeline. As a result, varietal release is slow and adapted varieties are limited, leading to lower farmer productivity.

SIL's African soybean breeder network overlaying suitability map for soy in Africa



SOLUTION:

SIL supports all the key breeding institutions of Sub-Saharan Africa with mentorship and training, equipment and infrastructure upgrades, field vehicles, germplasm introduction and continuing education to enable programs to increase the scale, output and efficiency of new varietal development.

SIL operates a network approach that reduces breeder isolation and enables active information sharing and relationship building to elevate the breadth, depth, pace, and output of SSA's soybean breeding programs.

African breeders also lack the benefit of line characterizations by which to guide their breeding programs. To fill this gap, SIL is working to genotype hundreds of soybean varieties used in the IITA program to provide a comprehensive database of pedigree information, disease resistance, and maturity data for use by the soybean breeding network of SSA.

"We are all excited about the planter. We are the first group in IITA history to implement mechanical planting for breeding trials. Looking forward to some uniform germination."

Dr. Godfree Chigeza (pictured below)
SIL partner and soybean breeder for IITA Zambia

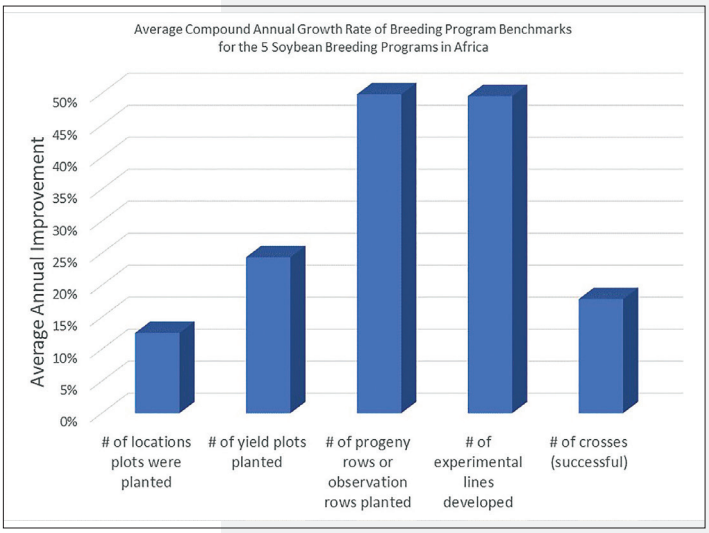
KEY IMPACTS

Breeder productivity and pace needs to accelerate to meet the growing needs of African soybean farmers looking for a continuous flow of high-yielding and well-adapted varieties.

The African soybean breeding network and SIL collaborate on technologies and practices that amplify the scope and accelerate the pace of their breeding programs. Since the collaboration began in 2013, the collaboration has effectively:

- Increased the number of progeny or observation rows planted at an annual rate of 49.85% (see figure below)
- Increased the number of successful crosses at an annual rate of 17.84% (see figure below)
- Implemented the first mechanized planting at IITA
- Implemented a Continuing Education Series and matched online curriculum for the breeder network, with courses to-date focused on:
  - Electronic data collection
  - Plot purity management
  - Inoculum use and effectiveness
  - Disease scoring and management

Dr. Godfree Chigeza (center, yellow shirt), SIL collaborator and IITA soybean breeder, with his team and new mechanical plot planter.



Educating the Next Generation of African Breeders

CHALLENGE:

Africa faces a human capacity gap of well-trained plant breeders who are capable of managing field trials and breeding operations for the African soybean seed system. This results in poor productivity on the part of public and private sector breeding programs and seed companies due to a lack of qualified human capital.

Training opportunities for African breeders do reside overseas but present two limitations. First, overseas education results in a lack of sustainable capacity building within the local education system in Africa. Second, overseas education leads to a brain drain as graduates often do not return home to practice their profession.

SOLUTION:

SIL has partnered with African universities to develop quality MSc and PhD degree programs in Plant Breeding, including:

- Curriculum review and assessment
- Course and curriculum development
- Faculty training to deliver curriculum
- Networking Africa's graduate level educational programs to share resources and best practices

West Africa Centre for Crop Improvement (WACCI) faculty, like Dr. Beatrice Ifie, serve as mentors to other African faculty seeking to develop master's degree programs in plant breeding.

KEY IMPACTS

- African plant breeding instructors now effectively use an open-access MS curriculum from the **Plant Breeding E-Learning in Africa** (PBEA) platform. SIL, with collaborators at Iowa State University and the West African Centre for Crop Improvement (WACCI), then developed matching Instructor Guides for each PBEA course, using a "flip-it style" classroom. Instead of a classroom lecture followed by homework to reinforce learning, students are assigned "pre-work" prior to attending class to familiarize themselves with the subject matter that will be covered. Classroom time is then devoted to discussion, practice, and application of the concepts.

PBEA
PLANT BREEDING E-LEARNING IN AFRICA

- Local capacity has been developed where **WACCI faculty** can now serve as mentors to other African faculty seeking to develop or enhance graduate programs in plant breeding.

WACCI WEST AFRICA CENTRE FOR CROP IMPROVEMENT

- African soybean breeders and junior faculty in plant breeding now attend local professional development and continuing education platforms like the UC-Davis **African Plant Breeding Academy** (AfPBA), an intensive 6-week review of genetic concepts and principles, experimental design and statistical data analysis led by world-class experts in these areas.

UCDAVIS
Plant Breeding Academy

- WACCI, with SIL support, facilitated planning and launch of the **African Plant Breeder Association,** which serves as a powerful institution supporting the emergent soybean plant breeder network.

APBA
African Plant Breeders Association

The Pan-African Soybean Variety Trial (PAT) Program: Fast-tracking varieties to the market

CHALLENGE:

Farmer yields in Sub-Saharan Africa are less than half the average of yields worldwide. One reason is the limited quantity and poor quality of soybean varieties available to farmers. Public sector breeders struggle due to lack of resources and are unable to release improved and locally adapted varieties on a regular basis. Private sector breeders do not develop new varieties because they lack intellectual property protection.

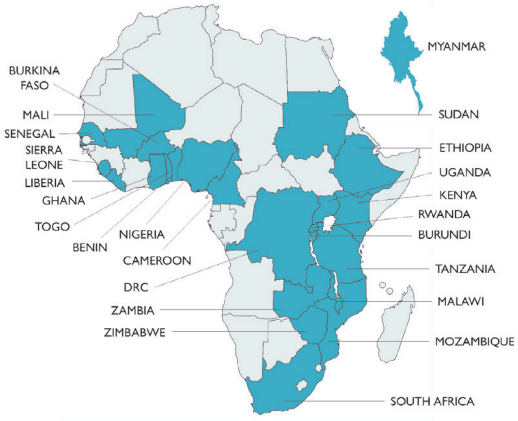
SOLUTION:

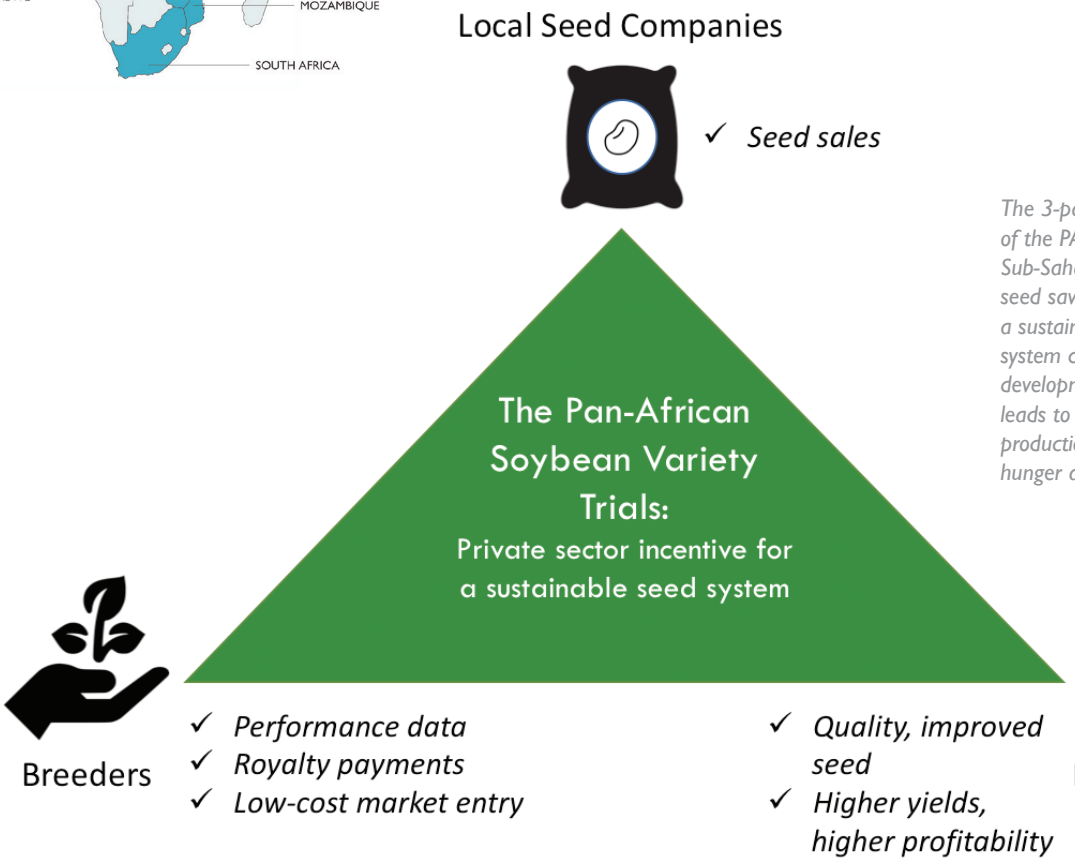
SIL's Pan-African Soybean Variety Trials fast-track the introduction and testing of commercial soybean varieties sourced from across Africa, the U.S., Australia, and Latin America to provide the private sector, farmers, and processors with access to a broader selection of seed than what is currently available. SIL leverages its role as an independent third party and its unique access to international, regional, and national supplies of high-yielding and disease resistant germplasm to swiftly bring new varieties to market.

Starting in 1 country and 4 locations in 2016, demand for the trials have pulled the PATs into 24 countries across 113 locations today. A network of 59 public- and private-sector partners now support the trials. In a short time, the PATs have already been successful in bringing 7 new soybean varieties to farmers in Ghana, Ethiopia, Malawi, Mali, and Uganda, with 10 more in the registration pipeline in Cameroon, Ethiopia, Kenya, Malawi, and Zambia.

Local seed producers now have access to many varieties for registration, multiplication, and commercialization, rather than just one or two aged, national varieties. Breeders and seed companies understand that seed contracts and royalties are central to commercialization. Public breeders now see a new revenue source for their breeding programs. Private breeders see new markets, and a low-cost way to enter these new markets. Local seed producers see a way forward to improve farmer productivity.

SIL's Current Pan-African Trial network





The 3-part incentive-based structure of the PATs enable countries across Sub-Saharan Africa to shift away from seed saving practices and towards a sustainable private sector seed system complex that drives soybean development. This incentive-based system leads to higher yields, profitable soybean production, and reduced poverty and hunger across the African continent.

Pan-African Trial Network
Key Impacts

NETWORK (2015-2020)
(INSTITUTIONS: SEED SUPPLIERS & TRIAL OPERATORS)

- **59 Institutions**

31 Private Sector + 28 Public Sector

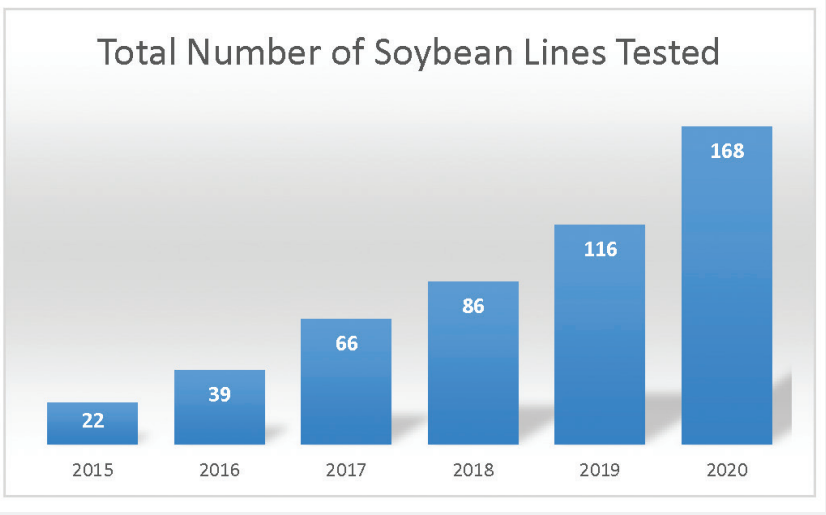
- **24 Countries**

Benin	Ethiopia	Mali	Senegal	Togo
Burundi	Ghana	Mozambique	Sierra Leone	Uganda
Burkina Faso	Kenya	Myanmar	South Africa	Zambia
Cameroon	Liberia	Nigeria	Sudan	Zimbabwe
DRC	Malawi	Rwanda	Tanzania	

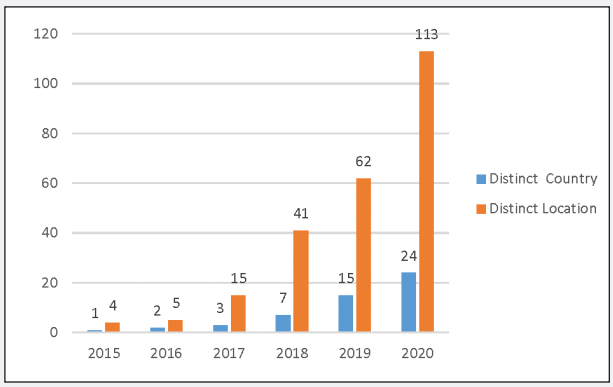
- **118 Partners**

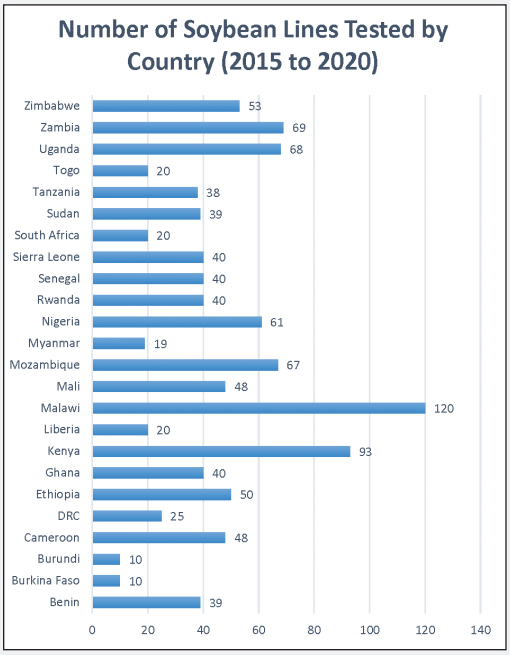
118 distinct partners
109 Trial Operators + 17 Seed Suppliers

- **17 Varieties**
- **168 Lines**



COUNTRIES AND LOCATIONS





SUCCESS STORY

ACROSS AFRICA

Pan-African Trials Bring New Varieties to Growers

Pan-African Soybean Variety Trial (PAT) partners in Cameroon, Ethiopia, Malawi, Mali, Nigeria, Kenya, Uganda, and Zambia are now registering and releasing new, high yielding soybean varieties for their growers thanks to SIL's PAT program currently underway in 24 countries across 113 locations in Africa.

In Malawi, the PATs led to the registration of a new soybean variety from IITA in Zambia, the first new soybean variety for the Malawian market in 9 years. The new line, TGX 1991-22F, achieves higher yields than local materials including the current highest yielding commercial variety, Tikolore.

In Cameroon, PAT operators at the Institute of Agricultural Research Institute (IRAD) identified a high-yielding soybean variety originating from private-sector partner Semillas Panorama in Colombia. This variety, along with 9 others from Zimbabwe, Ghana, Uganda, and Zambia, are in the on-farm trial stage of the registration process.

In Uganda, data generated from the PATs supported the identification of three new high-performing soybean lines from private sector partner Seed Co in Zimbabwe. In 2019, these became the first private-sector soybean varieties to be registered and made available to growers in Uganda and represent the first varietal releases since 2017.

In Mali, the Ghanaian variety Jenguma from the Savanna Agricultural Research Institute (SARI) performed better than local lines and can be released to growers as part of the ECOWAS harmonization agreement in West Africa.

In Nigeria, PAT partners at IITA selected 10 high-performing lines from Uganda, Colombia, Ghana, Zimbabwe, and Zambia to test in multi-location trials. If successful, the potential to register 10 new soybean varieties at once could provide an investment opportunity for private-sector partners interested in commercializing these materials.

In Kenya, PAT partners at the Syngenta Foundation for Sustainable Agriculture (SFSA) have begun the process to register an EMBRAPA soybean variety from Brazil that performed well across various PAT locations in Kenya.

In Ethiopia, the Ethiopian Institute of Agricultural Research (EIAR) recently registered a new variety, JM-CLK/CRFD-15-SD.

The PAT network of breeders, agronomists, seed companies, and processors across Africa work together to register, release, and commercialize new, high-yielding soybean varieties for African growers. The PAT network members represent 59 institutions across 24 countries, with over half of network members coming from the private sector.

"The last commercial soybean variety to be released in Malawi was Tikolore in 2011. Through the Pan-African Trials we are identifying new soybean varieties that consistently perform well. Getting TGX 1991-22F into the hands of Malawian farmers is just the beginning of many more to come."

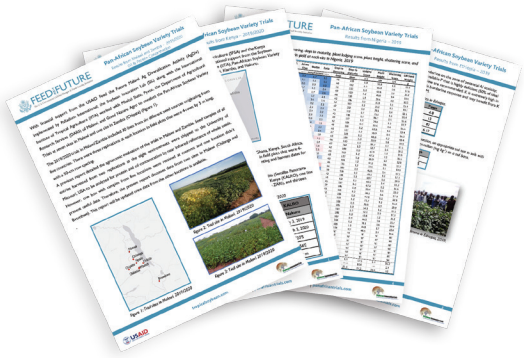
Florence Kamwana Ngwira
Legume Agronomist, DARS, Malawi
(pictured in photo at bottom right)

SIL PAT Program Manager, Dr. Michelle da Fonseca Santos (top, center) with PAT operators Christabell Nachilima (top, left) from IITA in Zambia, Ronica Makuro (top, right) with the Crop Breeding Institute in Zimbabwe, Mathilde Uwizerwa (front, left) with the Rwanda Agriculture Board, and Florence Kamwana Ngwira (front, right) with the Department of Agricultural Research Services in Malawi at SIL's 2019 Soybean Kick-off event in Ghana.

The PAT Network: Delivering Value Beyond the Field

CHALLENGE:

African breeders and seed companies face two distinct challenges. One results from isolation, which limits access to new materials and practices to achieve sustainable levels of breeding program productivity. The other results from the lack of data and subsequent understanding of genotype by environment (GxE) interaction, which limits the breeder from developing the next generation of improved and adapted soybean varieties.



The Pan-African Trial (PAT) program produces Industry Extension Reports for operators following every season with information on trial establishment, management, weather data, phenotypic data, and protein and oil concentration of all tested varieties.

SOLUTION:

The PAT network produces a new and unique database for the research community.

SIL's rich dataset involves a cross-section of 113 locations and 168 varieties with critical replicated data on yield, phenotype, disease, protein, and oil concentration with associated data on weather, soils, latitude, and elevation.

This robust dataset is used to:

- Define maturity groups, allowing farmers to select the right variety for their location, which reduces variability and improves productivity, and allowing seed companies to effectively market their products
- Allow processors to better understand how variety and location impact protein and oil concentration, critical metrics for their sourcing needs
- Identify rust-resistant soybean varieties and serve as an early warning system for emerging diseases and threats due to the year-round planting and harvesting nature of the PAT network

KEY IMPACTS

- 70-member and growing peer-to-peer learning WhatsApp and Facebook groups
- Web-based continuing education platform and matching online curriculum – self-paced, certificate-based, courses:
  - Electronic data collection
  - Plot purity management
  - Inoculum use and effectiveness
  - Disease scoring and management
- 35 (to-date) Industry Extension Reports on varietal performance and protein/oil concentration
- Online searchable and downloadable database containing all PAT data housed on the **Tropical Soybean Information Portal**
- Conversion to electronic data collection by PAT operators using the free Field Book app

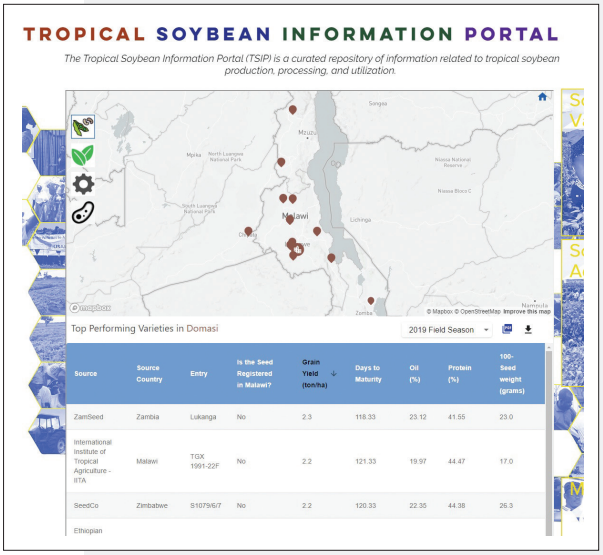
Field Book app for electronic field data collection by PAT network

A snapshot of a protein and oil Industry Extension Report generated by SIL for every season of the PAT program. SIL has produced 35 Industry Extension Reports to-date. Protein and oil concentration information is critical to the soybean industry to support processor needs.

Name	Source	Across locations			Bvumbwe	Chilanga	Bvumbwe	Chilanga
		Tons/ha	Protein (%)	Oil (%)	Protein (%)		Oil (%)	
TGX 2002-9FM	IITA (Zambia)	3.1	NT	NT	40.4	NT	20.8	NT
TGX 1987-62F	IITA (Zambia)	3.0	40.2	20.0	38.7	41.8	20.4	19.5
TGx 1991-22F	DARS (Malawi)	2.8	39.7	20.2	38.8	40.7	20.4	20.0
TGX 2014-43FM	IITA (Zambia)	2.7	41.9	19.3	40.8	43.0	19.5	19.1
SC SEMEKI	SeedCo (Zimbabwe)	2.7	40.7	19.9	40.7	40.7	19.1	20.6
S1180/5/54	SeedCo (Zimbabwe)	2.7	40.8	19.7	41.3	40.3	19.6	19.8
TIKOLORE	DARS (Malawi)	2.6	40.8	19.7	40.1	41.4	19.9	19.5
SC SIGNAL	SeedCo (Zimbabwe)	2.6	39.7	19.6	40.8	38.6	19.4	19.8
SC SQUIRE	SeedCo (Zimbabwe)	2.5	39.6	21.0	39.0	40.2	20.5	21.4
TGX 2002-3FM	IITA (Zambia)	2.5	39.2	20.9	39.5	38.9	20.9	21.0
SC SPIKE	SeedCo (Zimbabwe)	2.5	39.0	20.4	39.4	38.6	20.1	20.6
TGX 2014-16FM	IITA (Zambia)	2.4	41.1	20.4	40.8	41.3	20.1	20.8
TGX 2001-13DM	IITA (Zambia)	2.4	42.3	18.9	41.4	43.1	18.7	19.2
S1150/5/22	SeedCo (Zimbabwe)	2.3	41.5	20.4	40.8	42.3	20.4	20.3
TGx 2002-14DM	IITA (Zambia)	2.3	40.2	20.3	40.5	39.9	20.4	20.2
GAZELLE	KALRO (Kenya)	2.3	38.5	20.8	38.7	38.3	20.1	21.4
SC STATUS	SeedCo (Zimbabwe)	2.3	38.7	21.2	38.3	39.1	21.5	21.0
S1079/6/7	SeedCo (Zimbabwe)	2.3	41.3	19.4	41.2	41.3	18.8	20.1
NASOKO	DARS (Malawi)	2.2	42.3	18.4	42.7	41.9	18.2	18.5
TGx 2001-3FM	IITA (Zambia)	2.2	39.6	19.9	38.9	40.4	19.6	20.1
SC SAGA	SeedCo (Zimbabwe)	2.1	39.3	21.1	38.7	39.9	21.0	21.2
MAKWACHA	DARS (Malawi)	2.0	40.6	19.0	41.2	40.0	18.6	19.4
TGX 2001-8DM	IITA (Zambia)	2.0	41.4	19.7	41.3	41.4	19.2	20.2
KALEYA	ZamSeed (Zambia)	2.0	41.2	20.4	41.8	40.7	21.1	19.7
NYALA	KALRO (Kenya)	2.0	41.3	20.4	40.5	42.1	20.7	20.2
TGX 2014-5GM	IITA (Zambia)	1.9	40.1	20.0	40.3	40.0	19.6	20.4
TGX 2001-11DM	IITA (Zambia)	1.9	38.6	21.6	40.3	36.8	20.9	22.2
S1146/5/25	SeedCo (Zimbabwe)	1.9	41.0	20.1	43.6	38.5	18.6	21.7
MAKSOY 5N	Makerere U. (Uganda)	1.7	43.6	18.5	44.4	42.8	17.9	19.1
LUKANGA	ZamSeed (Zambia)	1.7	38.0	20.6	39.3	36.7	20.1	21.1
Mean		2.3	40.4	20.1	40.5	40.4	19.9	20.3
LSD		0.9	2.3	1.3	1.9	3.4	2.5	2.6
CV		25.5	3.0	3.0	1.9	3.4	2.5	2.6
Genotype significance		**	**	**	**	**	**	**
G x E significance		ns	*	**	-	-	-	-

NT - Not tested

*, ** There is significant differences between sources of variation at 5% and 1% level of probability; ns: not significant



The **Tropical Soybean Information Portal** houses all PAT data for use by network members and researchers.

SMART Farms Generate Custom Input Bundles to Maximize Farmer Profits

CHALLENGE:

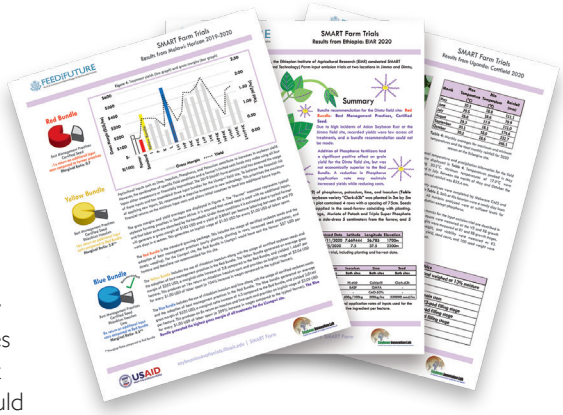
The path to high yielding soybean in Sub-Saharan Africa (SSA) is not simple or straightforward. Soybean as a commercial crop is new for African farmers, researchers, and agribusinesses. As a result, agronomic practices are not well understood, guidance is mixed, and best management practices do not consider different farmer budgets. For example, what is the first investment a farmer should make given a $50 budget? That is, what achieves the greatest return for the least investment? Without this guidance, soybean yields and profitability remain low, and farmers do not sustain adoption.

SOLUTION:

To address the challenges of low yield, low profitability, and dis-adoption, SIL leverages Liebig's Law, the Law of the Minimum, that advises farmers on the first step they should take to ensure the best return on their investment. This stepwise approach identifies the minimum input costs that generate the maximum financial return, allowing initial success to feed into additional future inputs.

SIL SMART (Soybean Management with Appropriate Research and Technology) Farms generate unique, stepwise bundle recommendations for growers that translate to high returns on their input costs and profitable soybean production.

The system begins with a **red bundle** that includes certified seed and good agronomic practices, then steps up to the **yellow bundle** that adds inoculum, and finally to the **blue bundle** and **green bundle** that add phosphorous fertilizer and lime, respectively. With SIL's help, growers identify the bundle that works best for their budgets, environment, soil and growing conditions.



Site-specific SMART Farm Industry Extension Reports are generated for operators after every season.

The SMART Farm replaces anecdotal guidance with regular, formal, and scientifically produced guidance for growers in Africa and for the industry, while simultaneously engaging in deep capacity and institution building with its in-country partners.

SMART Farms also serve as hubs for private sector collaboration related to seed quality, soil improvement, and nodulation, as well as offering transparent and reliable testing for agricultural products, innovations and technologies for the industry. Current public-private partnerships include trialing Calciprill, a low-bulk liming product, for Omya and trialing herbicide and inoculum products for BASF.

SMART Farm site operated by private sector partner Japan Tobacco International (JTI) in Malawi.

"Using the SMART Farm approach, we can end hunger in our lifetime by providing farmers with access to high performing seed, the best agronomic practices, and the most effective inputs."

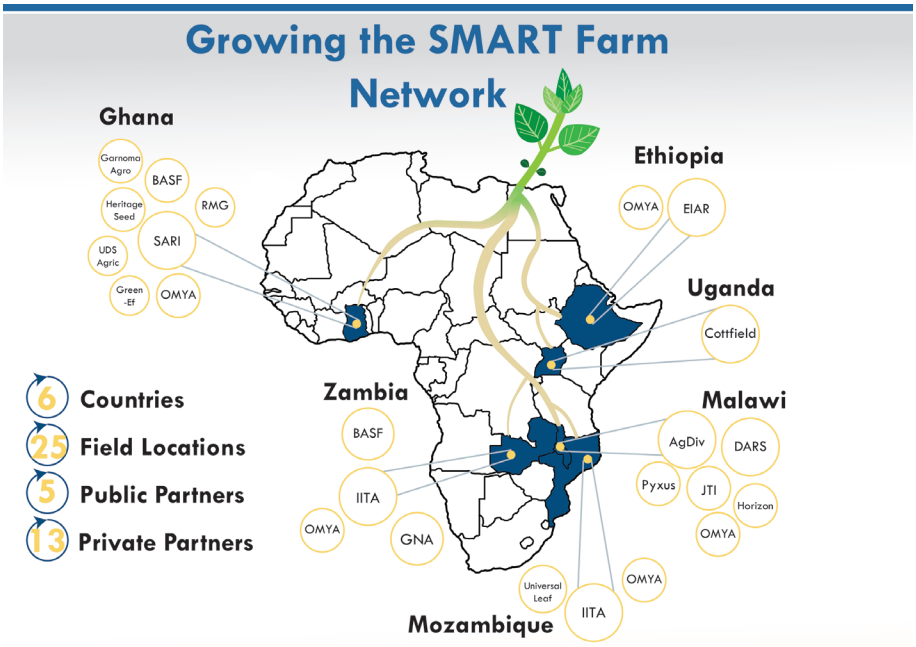
Andrew Goodman, Director of Farm Operations
Horizon Farming Limited, Malawi

"We implemented a SMART Farm because we saw input bundling as a way to offer a practical, scalable solution to smallholders who are our main suppliers of raw materials. In practice, the trials provided value even beyond this, leading us to question commonly held assumptions about soy agronomy in Uganda and helping chart new paths towards improving farm yields."

Pavel Kuzmenko, Director of Finance
Cottfield Group, Uganda

"The SMART Farm journey has been a great starting point in using applied soybean production research to support the livelihoods of our contracted growers. Soybean is a new crop for us, and the SMART Farms provide a strong evidence-based foundation to maximize the productivity of our growers while tackling the economic, financing, technical, and long-term sustainability questions we had surrounding small scale grower soybean production in Malawi."

Lars Gruner, Agronomy Director
Japan Tobacco International (JTI), Malawi



SMART FARM NETWORK EFFECTS

SIL supports a network of SMART Farm operators including processors, seed companies, nucleus farmers, and national agricultural research stations to identify the unique bundle of inputs most appropriate for their growing conditions and budgets. This network spans:

- 6 countries
- 25 trialing sites
- 13 private sector partners
- 5 public sector partners

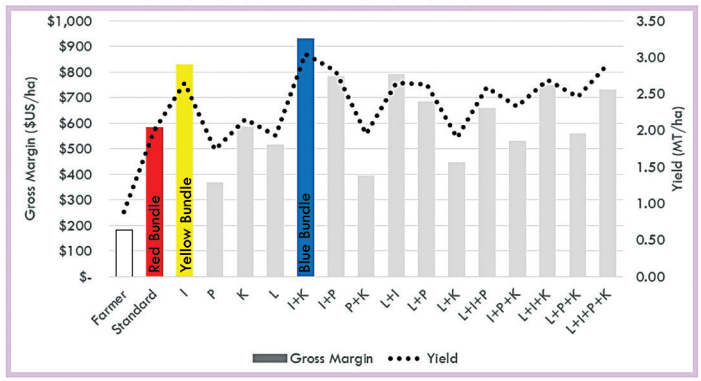
SIL provides the SMART Farm network with tailored, agronomic Industry Extension Reports and technical manuals specific to their growing environment and local conditions. Network members include both private sector partners like

- Good Nature Agro (GNA) in Zambia
- Mozambique Leaf Tobacco (MLT) in Mozambique
- Horizon Farming Limited in Malawi
- Cottfield Group in Uganda
- Japan Tobacco International (JTI) in Malawi

And public sector partners like:

- International Institute of Tropical Agriculture (IITA) Southern Africa Hub in Zambia
- Savanna Agricultural Research Institute (SARI) in Ghana
- Ethiopian Institute for Agricultural Research (EIAR) in Ethiopia

TREATMENT YIELDS AND GROSS MARGINS



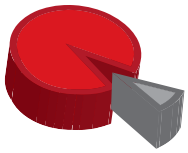
SMART Farms generate unique bundle recommendations for growers to maximize profits. Operators receive a gross margin analysis to understand which bundle is best suited for their growing conditions and budgets.

KEY IMPACTS

SIL's SMART Farm trials across Africa generate local, unique bundle recommendations for growers that consider their local input costs and grain prices.

For example, an operator in Malawi found that adding inoculum in addition to certified seed and good management practices (Yellow Bundle) yielded the most profit. Their Yellow Bundle raised yields from 800 kg/hectare to 3,300 kg/hectare and increased gross margins from $182/hectare to $1,090/hectare, resulting in an 18x return on their inoculum input costs.

Red Bundle



Best Management Practices
Certified Seed
9x return on input costs compared to farmer practice
Marginal Ratio: 3.2*

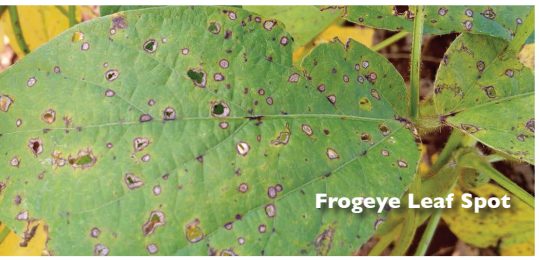
Yellow Bundle

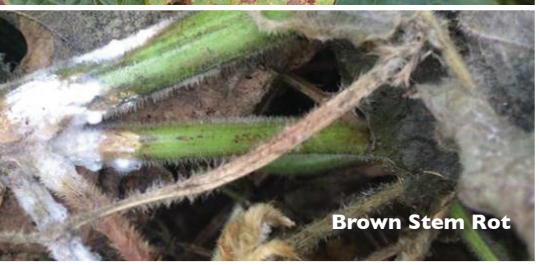
Best Management Practices
Certified Seed
Inoculum
18x return on additional input costs compared to Red Bundle
Marginal Ratio: 1.4**

Blue Bundle

Best Management Practices
Certified Seed
Potassium
Inoculum
5x return on additional input costs compared to Red Bundle
Marginal Ratio: 1.5**

Disease Scouting Network to Address Soybean Yield Threats





CHALLENGE:

As soybean production increases across Africa, disease pressure becomes more threatening to growers. The soybean industry requires knowledge on how to identify and manage soybean diseases, prepare for outbreaks, and understand varietal resistance to prevent potentially devastating yield losses due to soybean diseases like rust and red leaf blotch..

SOLUTION:

SIL provides a series of **knowledge assets** to address this problem, including disease hotspot maps, management guides, tools, and tactics, and guidance on resistant varieties.

SIL solutions are developed by leveraging the lab's unique and expansive Pan-African Soybean Variety Trial (PAT) network of operators involving 59 companies and organizations spanning 113 locations across 24 African countries.

This network serves as a critical early warning team, as their disease data collection and scouting efforts alert the network members to emerging diseases and threats in their region. SIL knowledge assets provide the sustainable foundation for the soybean industry to successfully manage diseases and pests that, without management, can cause up to 80% in yield reductions.

SIL supports a scouting network for emerging diseases and threats involving 113 locations, 24 countries, and 59 organizations and companies and hosts in-field and online training and capacity building for this network.

KEY IMPACTS

A suite of **knowledge assets**, including:

- Scouting network for emerging diseases and threats involving 113 locations, 24 countries, and 59 organizations and companies
- Africa's first **Field Guide to African Soybean Diseases and Pests**
- Africa's first **Guide to African Soybean Seedborne Diseases and Pests**
- **Hotspot Maps for soybean rust**, red leaf blotch, and other yield impacting diseases
- Disease and Seed Management Guides on **soybean rust** and the use of **certified seed** to address mold and pest issues and poor germination caused by farmer saved seed
- In-field trainings and **technical webinars** on soybean disease and pest identification and disease evaluation

  500+ trainees, 30+ countries, and 85+ different organizations trained to-date
- Open access, free, online education through SIL University's ("SIL-U") suite of **online courses** featuring a certificate-based **Integrated Pest Management course** with 9 in-depth modules

  1,200+ learners across 77 countries trained to-date
- **Pest and Disease Identification Board** that gives users real-time feedback on photos and questions they post about soybean diseases and pests they encounter in their fields
- **Genotype resistance data** to address strategic threats like Red Leaf Blotch and Soybean Rust
- **Disease by genotype by environment database** (DxGxE) available to researchers covering 168 varieties across 113 locations

SUCCESS STORY

RESEARCH IN AFRICA

Developing red leaf blotch resistant soybeans

SIL plant pathologist Dr. Harun Murithi leads the lab's efforts to identify soybean genotypes resistant to Red Leaf Blotch (RLB). He conducts both lab and greenhouse work in Kenya and evaluates RLB incidence, severity, and genotype resistance across SIL PAT sites in Uganda, Kenya, Ethiopia, Ghana, Malawi, and Zambia.

Developing soybean lines with resistance to RLB will not only lead to improved soybean production across Sub-Saharan Africa, but will also head off potentially disastrous effects faced by soybean producers in the Americas.

Following the anthrax attacks that occurred in 2001, the U.S. government established the Federal Select Agent Program (FSAP) to regulate the possession, use, and transfer of select biological agents and toxins that could potentially pose a severe threat to public, animal, or plant health. While bioterrorism is typically associated with toxins such as ricin or diseases such as smallpox or the bubonic plague, it can also take the form of plant pathogens such as bacteria and fungi.

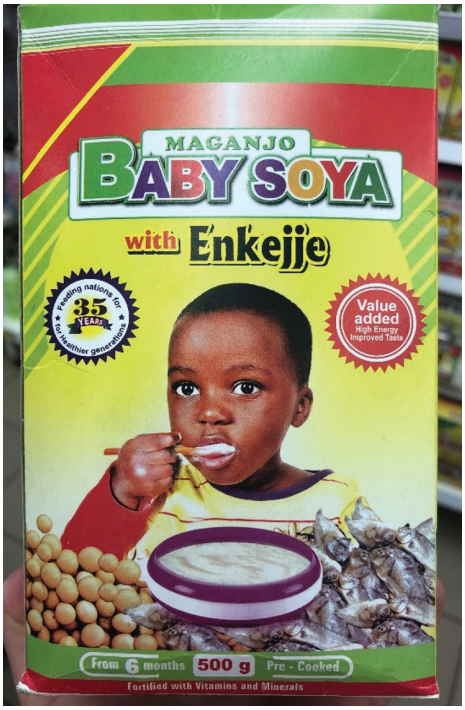
What does this have to do with soybean? Number 61 on the Select Agent and Toxin list is the fungus Coniothyrium glycines, the cause of a soybean disease referred to as red leaf blotch (RLB). The disease is native to Africa and currently affects soybean in central and southern Africa. Sub-Saharan African countries have reported soybean production losses of up to 70% due to RLB. The first cases of RLB were reported in Ethiopia in 1957, yet very little is known about the fungus today. The U.S. and Brazil now recognize RLB as a major potential threat to soybean production, but research on how to combat the fungus is limited, and there has been little progress made to-date on discovering sources of resistance to the fungus that causes RLB. And, because RLB is on the Select Agents and Toxins list, it is nearly impossible to conduct research on the disease in the United States.

With support from USDA Agricultural Research Service (ARS), SIL researchers now evaluate soybean genotypes for resistance to RLB directly in Africa through the Soybean Innovation Lab's network of over 113 field sites across 24 countries in West, East and Southern Africa.

As genotype resistance is confirmed, results will be disseminated through SIL's global network of soybean breeders and seed companies. Both the U.S. and African soybean industries can then use these sources of resistance to make crosses and develop soybean populations with resistance to RLB, leading to improved soybean production across Sub-Saharan Africa, and preventing potentially disastrous effects on the U.S. soybean crop.

Soy for Human Nutrition

Soy 360: A Network Response to Processor Needs



Many agro-processors like Maganjo Grain Millers in Uganda produce soy-fortified weaning foods. SIL supports these critical value chain players by linking them to a network of industry experts to support their goals of quality, efficiency, and market competition.

CHALLENGE:

Competitively viable agro-processors serve as critical nodes within the soybean value chain. However, processors often operate in isolation and lack access to the necessary technical expertise, support, mentorship, and guidance to improve their product offerings and expand their use and procurement of soybean. Agro-processors need and ask for technical guidance, information, and networking opportunities to improve their production of nutritious foods and feeds at scale.

SOLUTION:

SIL not only provides the technical support needed by soybean processors and food manufacturers, but complements this knowledge with a matched industry network and connections program. Agro-processors producing cereals, snacks, pet foods, edible oil, and meal, as well as food scientists, engineers, and nutrition experts are now linked through a virtual platform called Soy 360. The platform was launched in collaboration with the American Oil Chemists' Society (AOCS), the Institute of Food Technologists (IFT), the International Institute of Tropical Agriculture (IITA), Makerere University, and the National Agricultural Research Organization (NARO), and brings together members from 23 countries to share the latest innovative technologies and strategies for optimal agro-processing.

KEY IMPACTS

SIL, in partnership with CNFA's Farmer-to-Farmer program and AOCS, has created a unique program to provide mid-to-large scale agro-processors with technical assistance. CNFA is a leader in coordinating the delivery of short-term technical assistance. AOCS is a leader in soybean processing and food manufacturing technology. Together, with SIL's network of soybean processors and food manufacturers, expertise is deployed in the areas of:

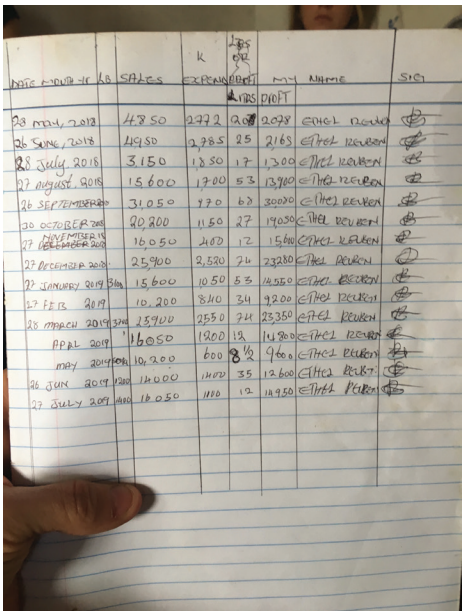
- New product development
- Processing innovations
- Equipment selection and procurement
- Quality control and benchmarking to improve efficiency
- Plant upgrades
- Value-added processes

Explicitly, the consortium works together to recruit seasoned professionals in oilseed processing and matches them with agro-processors in Africa. This newly formed network is critical to ensuring African processors have the necessary skills, training, equipment, infrastructure, and benchmarking knowledge to continually expand the demand for their country's soybean crop.

SOYBEAN 360

The Soy 360 platform links African agro-processors like Sunseed Oil Ltd. based in Malawi (pictured at right) with technical experts in soy processing to achieve efficient and profitable production of nutritious foods.

Women's Entrepreneurship Improves Community Nutrition



Ethel Reuben is Soy Kit operator based in the Michinji District of Malawi. She keeps a monthly log of the production, sales, expenses, and resulting profit for her Soy Kit production system. SIL's analysis of operator data shows the Soy Kit to be a profitable and appropriate-scale technology for household entrepreneurs.

CHALLENGE:

There has been strong interest in value-added technologies that are appropriate for household level entrepreneurs. Moreover, women who operate food enterprises can leverage at-home production technologies to support family nutrition, generate income, and provide consumers with nutritious foods. However, many technologies are inappropriate for household entrepreneurs due to high capital investment demands, large production scale, or excessive technical know-how.

SOLUTION:

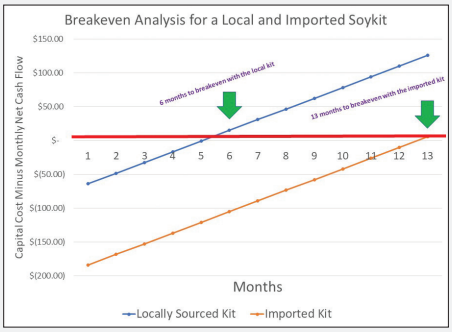
The Soy Kit is a new technology launched in Sub-Saharan Africa that focuses on improving household nutrition and supporting female entrepreneurship. The soy kit business model uses an appropriate technology to produce soy milk that leverages components often found in the household that are locally available and familiar to women. The kit was developed by the non-governmental organization (NGO) Malnutrition Matters and requires an investment of between $80-$200, depending on if the kit components are sourced locally or imported.

SIL collaborated with the Malawi Feed the Future Agriculture Diversification Activity to provide evidence on the kit's profitability, return on investment, and operational performance as well as the Soy Kit's overall appropriateness as a technology for the developing world.

SIL research found that Soy Kits are an appropriate technology for household entrepreneurs, enabling female operators flexibility and leveraging their tacit knowledge of local demand.

KEY IMPACTS

- Payback period for the Soy Kits from cash flow is < 6 months.
- Annual return on capital is 163% when using the domestically sourced Soy Kit valued at $80 USD.
- Soy Kit batches yield 3.5L of soymilk and 1kg of okara (a high-protein, high-fiber by-product) per 600g of soybean.
- Each Soy Kit batch takes 30 minutes, thus is manageable for women with many demands on their time and allows entrepreneurs to produce milk when they have time and see demand opportunity.
- Entrepreneurs can produce soy milk, yogurt, cheese, and tofu with the Soy Kit, and can use the okara in baking, or in raw form as a porridge ingredient or in animal feed.
- Soy Kits are not mechanical and utilize equipment common to kitchens, making maintenance and repairs easy.
- All raw materials for the Soy Kit are storable and shelf-stable, so entrepreneurs lose little in storage and allowing for flexible production schedules.
- Entrepreneurs can use the Soy Kit to grind and cook other raw foods.
- Soy milk is low-cost and healthy product, effectively competing against traditionally consumed beverages and capable of benefitting vulnerable populations.
- Capital and other fixed costs for the Soy Kit match the small-scale and episodic flow of a household enterprise where key inputs such as labor, fuel, soybean, and sugar can be intermittently available.
- Results show that the Soy Kit is an appropriate technology for female entrepreneurs based on the Soy Kit's small scale, low cost, flexibility, and profit potential.



Results from data collected among 224 household-led women entrepreneurs in Malawi over an 18-month period from 2018-2019 and published in the Food and Nutrition Bulletin.

SIL-University (SIL-U)
A Sustainable Online Learning Platform

CHALLENGE:

Free, open-access, quality education is necessary to ensure students, extension agents, and other agricultural professionals in Sub-Saharan Africa are equipped with the critical skills and knowledge to be successful in their agricultural careers. Adequate connectivity can be a challenge in many universities and research stations, so downloadable training materials that offer assessments are critical.

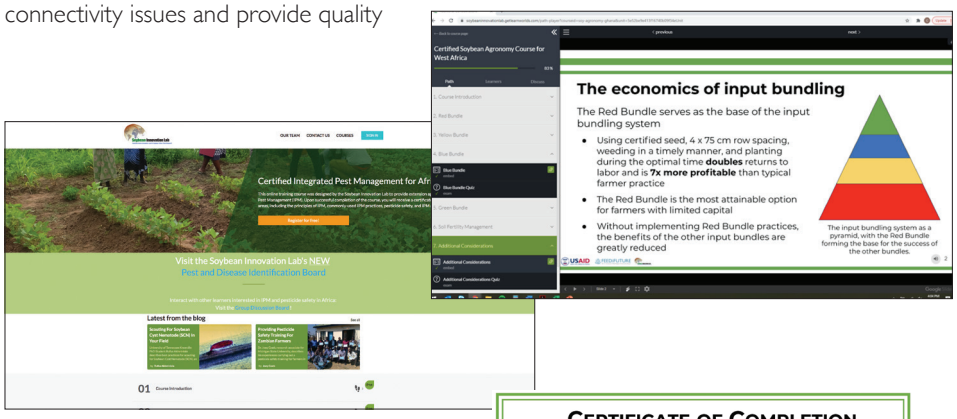
Dr. Amaral Chibeba, post-doctoral researcher at IITA in Mozambique translated SIL's online Integrated Pest Management (IPM) and pesticide safety course into Portuguese and provided audio. As a senior agronomist with extensive field experience, he was able to incorporate key terminology and examples unique to Mozambique. Dr. Chibeba uses SIL's online course materials for trainings with IITA and NARS technicians, staff and researchers.

SOLUTION:

Launched in 2019, SIL-University's (SIL-U) suite of online course offerings are free and self-paced, allowing learners to complete the courses in their own time through an open-access curriculum model. SIL engages and connects with agricultural researchers and practitioners across 81 countries around the world, who use SIL-U courses to improve their day-to-day activities in farm management, research, and extension.

In the past year, hundreds of students have engaged in courses related to integrated pest management, pesticide safety, soybean agronomy, early child nutrition, and gender responsiveness. Learners earn a certificate of completion once they receive a passing grade on quizzes and assessments.

By offering free, downloadable education and training materials, SIL works to overcome connectivity issues and provide quality curriculum to thousands of learners across the globe. Courses are currently available in English, Portuguese, and French. Local collaborators use SIL courses for their own agriculture education needs, including through university platforms and public extension agencies. Organizations and companies can complement the online course materials with practical examples and advice regarding local contexts. As partners utilize SIL online course materials, they provide critical feedback that enables SIL-U course designers to develop more context-specific training materials. Partners such as the International Institute of Tropical Agriculture (IITA) and the Agricultural Research Institute of Mozambique (IIAM) support SIL in the development of SIL-U courses and ensure materials are grounded in local contexts.



Through ICT-based extension education, SIL engages and connects with agricultural researchers and practitioners across 81 countries around the world. Courses are offered online, for free, and learners receive a certificate of completion (above) once they achieve a passing grade.

Dr. Amaral Chibeba trains IITA technicians on integrated pest management using SIL-University course materials in Portuguese.

Professor Amina Abudo Amade, Director of the Faculty of Agricultural Sciences at UMBB in Nampula, Mozambique, offers an undergraduate program in agricultural sciences that prepares students for a career in agricultural research and extension. Professor Amade uses SIL's online IPM course in Portuguese as supplementary learning material to complement the university's crop protection courses. "The current situation with Covid-19 demonstrates that online courses like SIL-U are an alternative, efficient platform for transmitting knowledge. This situation has caused us to reflect on future strategies for teaching that include a model of a mixture of online and in-person classes, provided that educational institutions are willing to evolve and adapt to new technologies."

SIL-U COURSE OFFERINGS

Integrated Pest Management (offered in English, French, Portuguese)
This course features **9 modules** focused on IPM principles and practices, the application of IPM for specific pests and diseases, and postharvest management.

Pan-African Soybean Variety Trial (PAT) Continuing Education Series
This course features **4 modules** focused on plot purity, inoculum use, disease screening, and data collection with frequent module updates.

Soybean Agronomy for West Africa
This course features **5 modules** focused on evidence-based guidance on the use of certified seed, inoculum, phosphorous, and lime to maximize returns on investment, and soil fertility management.

Complementary Feeding
This course features **3 modules** focused on early child growth and development, complementary feeding, and soybean nutrition.

Increasing Your Gender Responsive Agricultural Development Capacity
This course features **4 modules** focused on the importance of gender responsiveness, key gender terms, a gender mainstreaming framework, and deep dive case studies.

KEY IMPACTS

"I frequently work with small scale growers in Africa with the Farmer to Farmer program. During those trips I teach often about soybean. That is why I took the training to better share with extension staff in developing nations."

Dr. Hans Kandel
North Dakota State University

"I utilize the lab's extension materials, which are rooted in evidence and science, to support my partners across the globe. Most recently, my work took me to northeastern Nigeria to support efforts implemented by the Church of the Brethern's (COB) Global Food Initiative (GFI), which brings developmental assistance to the local COB affiliate in Nigeria, Ekklesiyar Yan'uwa a Nigeria (EYN). Last year, EYN formed an inaugural cohort of 15 young men and women to serve as Volunteer Extension Agents (VEAs), responsible for establishing and operating demonstration farms throughout Northeast Nigeria. To support the VEAs with capacity building and continuing education, I utilized SIL's Integrated Pest Management and Pesticide Safety Training Course. As connectivity in northeastern Nigeria is a challenge, SIL provides its online training course materials for free download, complete with recorded audio and audio transcripts."

Dr. Dennis Thompson
University of Illinois

"The course has really changed my life. It has made me a recognized person in my community. My former colleagues come to me for advice on integrated pest management on cashew and shea. I know it will boost my C.V. too. I say a big thank you to the course instructors."

Samuel Kwaku Antwi
Cocoa Research Institute, Ghana

The SIL Multi-Crop Thresher

Jeffrey Appiagyei is the co-founder of SAYeTECH, SIL's thresher commercialization partner in West Africa, and a lead designer and trainer for the lab's thresher fabrication workshops held across Africa.

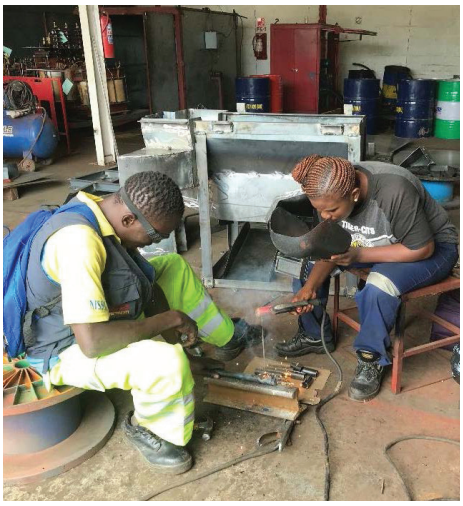
CHALLENGE:

In most SSA countries, hand threshing using sticks is the most common way to thresh crops, whether on farm or in the seed sector. The high labor demands and length of time needed to manually harvest and thresh a crop leads to delayed harvest and loss from shattering, lodging, and reduced grain quality from spillage and breakage. Manual threshing is especially burdensome to women who make up much of the labor force when it comes to threshing. Threshing loss is second only to storage loss as a contributor to post-harvest losses in most crops.

Mechanical threshing technology is important in reducing human drudgery and work exertion, in addition to improving productivity and yields. Yet in Sub-Saharan Africa, access to crop threshers and shellers for post-harvest operations is limited, particularly for locally produced and low-cost commercial equipment. Imported threshers are often too costly and too large for small farmers, are not designed for rough field conditions, or end up in the scrap pile if repair parts cannot be located or fabricated.

SOLUTION:

SIL recognized the need for mechanized crop threshers to relieve the burden of stick threshing and increase productivity. Designed by a Ghanaian fabricator, the SIL multi-crop thresher (MCT) has been extensively field-tested by both SIL and farmers. Interchangeable concave sieves make it usable for multiple crops including maize, soybean, rice, sorghum, millet, sunflower, barley, cowpea and common beans. The SIL MCT is fabricated locally from domestically-sourced parts and sells for $3,500-$5,000. Thresher designs are open source, providing free access to CAD plans and operator manuals. The MCT is sized and priced for purchase and use by mid-sized farmers or service providers. It can be powered with a diesel engine or through a tractor power take-off.



Proud thresher trainees in Ethiopia (below), a completed SIL multi-crop thresher (top right), and fabricator Florence Kabuka learning to operate a plasma cutter from SIL trainer Hakeem Karim in Zambia (bottom right). Starting with just 12 fabricators from Ghana in 2016, SIL has now trained over 200 fabricators across 10 countries to build, service and maintain threshers that can handle common bean, cowpea, maize, millet, rice, sorghum, and soybean.

The SIL MCT is 40x faster than traditional stick beating and reduces threshing time by 80%. Speeding up the time needed to thresh grains protects crops from bush fires, gets crops to market faster, and provides income for farmers in a timelier fashion. Mechanical threshing also reduces contamination from stones and dirt introduced during hand threshing, thus producing grain with higher market value.

SIL, partnering with local firms, promotes in-country production of the thresher, local economic development, and youth employment. To-date, SIL has trained over 200 fabricators on how to manufacture the multi-crop thresher across 10 African countries including Burundi, Ghana, Ethiopia, Kenya, Malawi, Rwanda, Tanzania, Uganda, Zimbabwe, and Zambia.

SIL trainees have gone to market with over 280 threshers across Africa, and 70 entrepreneurs are now commercially operating the SIL MCT.

SIL trained FirstWave Group in Zambia, a vertically-integrated aquaculture company, to produce a suite of threshers in 2020. The company needed a mechanized thresher solution to improve the timeliness and quality of grain procured form Zambian farmers for FirstWave's aquaculture feed production.

KEY IMPACTS

MCT 1.0
- The prototype and the first SIL multi-crop thresher design.

MCT 2.0
- Chassis improved for easier towing
- Engine and body size increased for greater threshing capacity
- Feeding chute redesigned for greater safety
- Suction increased for better cleaning

MCT 2.1
- Secondary suction fan added for improved cleaning
- Improved safety shields

MCT 2.2 (not pictured)
- Straw puller added to feeding chute to pull in soybean plants faster

MCT 2.3
- Chassis improved for higher speed road towing
- Improved air control on secondary suction fan
- Improved operator stand
- Chaff flow direction changed to reduce dust

MCT 1.0 2016-2017

MCT 2.0 2017-2018

MCT 2.1 March 2019

MCT 2.3

Science of the SIL Multi-Crop Thresher: Profitability, Performance, and Promoting Gender Equity

PROFITABILITY:
The SIL thresher is profitable and sustainable – operators can pay back the capital cost of the thresher and still earn a high rate of return (gross margins range from 64-80% based on data from Ghanaian and Zambian commercial operators).

Service providers can achieve a $57/day profit when threshing 50% maize and 50% soy.

PERFORMANCE:
The rated thresher capacity is approximately 2,000 kg of shelled maize per hour and 200 kg of soybean per hour with less than 2% postharvest loss.

PROMOTING GENDER EQUITY:
61% of women-led thresher groups reported better prices for their crops when using the SIL MCT and 55% reported an increase in cash on-hand and access to credit.

Women-led thresher owners reported feeling more 'important' and that their views were respected because men recognized they controlled a valuable asset – a mechanized thresher.

Rudy Ofori is a Product Manager with SAYeTECH, the Soybean Innovation Lab's commercialization partner for the multi-crop thresher in West Africa. Rudy leads thresher demonstrations for customers, showcasing the capacity and performance of the thresher across a range of crops including soybean, maize, cowpea, millet, sorghum, and rice.

Reactions from women-led thresher groups in Ghana

"The thresher has brought relief to women. For the first time in my life, I finished my farm before my husband's, and we will no longer manually thresh again. See my palm this year!" [Participant showed that the skin of her palm was not torn or damaged from manual threshing]

"Our thresher does not collect cash. We only request grain, which is easy for every farmer to pay."

"My soybean crop was burned last year in the field [during a bush fire while waiting to be manually threshed]. But not again this year because of the [mechanized] thresher."

"The men in our community have seen our importance, and they can't believe we have a thresher to ourselves. When they want to use our thresher, they come, and we negotiate in a meeting."

Throughput capacity of the SIL Multi-Crop Thresher

Averages
Throughput Capacity
Chaff/Weight %

Soybean
142 kg/hour
1.8%

Throughput capacity based on field data collected by SIL among thresher operators in Ghana and Zambia.

Maize
2,839 kg/hour
0.1%

Rice
105 kg/hour
0.3%

KEY IMPACTS

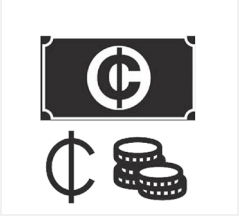
Thresher economic impacts cut across the value chain by:

- Increasing market value of farmers' produce
- Reducing the cost of threshing
- Improving grain quality
- Reducing postharvest losses
- Reducing manual labor
- Reducing the time needed for threshing
- Spurring rural industrial production
- Expanding opportunities for youth

BENEFITS REALIZED BY WOMEN-LED THRESHER GROUPS IN GHANA

58% reported no longer needing cash to pay for threshing services

61% reported better prices for their crops



55% reported an increase in cash on-hand and access to credit

SUCCESS STORY

A MODERN AFRICAN ENTREPRENEUR

Making a business as a thresher service provider

Ghanaian service provider Afua Helen Ohemeng uses her multi-crop thresher to quickly move crops from the field to storage, where she then dries grain for the poultry and food industries. She is joined by her husband (middle) as well as Jeffrey Appiagyei (left) and Theodore Ohene-Botchway (right) of SAYeTECH, SIL's thresher commercialization partner in West Africa.

Afua Helen Ohemeng is the embodiment of a modern African entrepreneur. The 40-year-old mother of three is the originator and director of three agricultural sector businesses that purchase, dry, and store grain for poultry and food companies in Ghana. Afua's most recent business venture is as a thresher service provider. In 2019, she purchased a multi-crop thresher from SAYeTECH, the Soybean Innovation Lab's commercialization partner in West Africa. Providing mechanized thresher services for farmers helps Afua move grain quickly from the field to the factory after harvest, enabling her to get product to her customers reliably throughout the year.

Afua, whose mother is a trader, grew up seeing successful female entrepreneurs in Ghana. A graduate of the University of Cape Coast and Kwame Nkrumah University of Science and Technology, she now resides with her family in Sunyani, Ghana.

The SIL/SAYeTECH multi-crop thresher is designed for entrepreneurs who want to provide high capacity threshing services. SIL findings from Ghana show that service providers can achieve high profits using the multi-crop thresher, averaging about $19/hour for maize, $34/hour for millet, and $15/hour for rice. The capacity for soybean is lower than other crops as the whole plant must be fed into the thresher. To address this, service providers can charge a premium for soybean to ensure profitability.

The multi-crop thresher sells for between $3,500 to $5,000 across Africa, depending on local prices for raw materials. This is compared to an average price of $8,000-$15,000 for similar-sized imported threshers where local knowledge on maintenance and repair can be lacking.

SAYeTECH outfits their threshers with electric start engines so women can more easily start the 22 Hp diesel engine and offer a GPS tracking app that allows owners like Afua to monitor the location and use of their machine.

With a profitable 2020 harvest season, Afua can pay back the cost of her thresher. She enjoys the satisfaction of helping Ghanaian smallholder farmers successfully market their grain while reducing the drudgery of hand harvesting.

Locally produced mechanical threshers drive employment, youth engagement, farmer productivity and profitability.

Economics of Soy

"Our work with SIL is a critical part of our strategy to support sustainable development of legume markets in Malawi. Our partnership with SIL enables us to conduct research that is rigorous and responsive to the agriculture and nutrition needs here. The things we are learning from studies like the Malawi Input-Output analysis are already being used to improve our project activities, and to guide investments by our private sector partners."

Elizabeth Venable
Economics and Evaluation Consultant, Malawi Agricultural Diversification Activity

CHALLENGE:

Policymakers are often challenged by development investment choices as resources are limited, thus the need to make tradeoffs. While many sectors and agricultural value chains hold promise, policymakers need an objective tool to compare sectors across key metrics of impact such as their contribution to job creation or overall addition to economic activity.

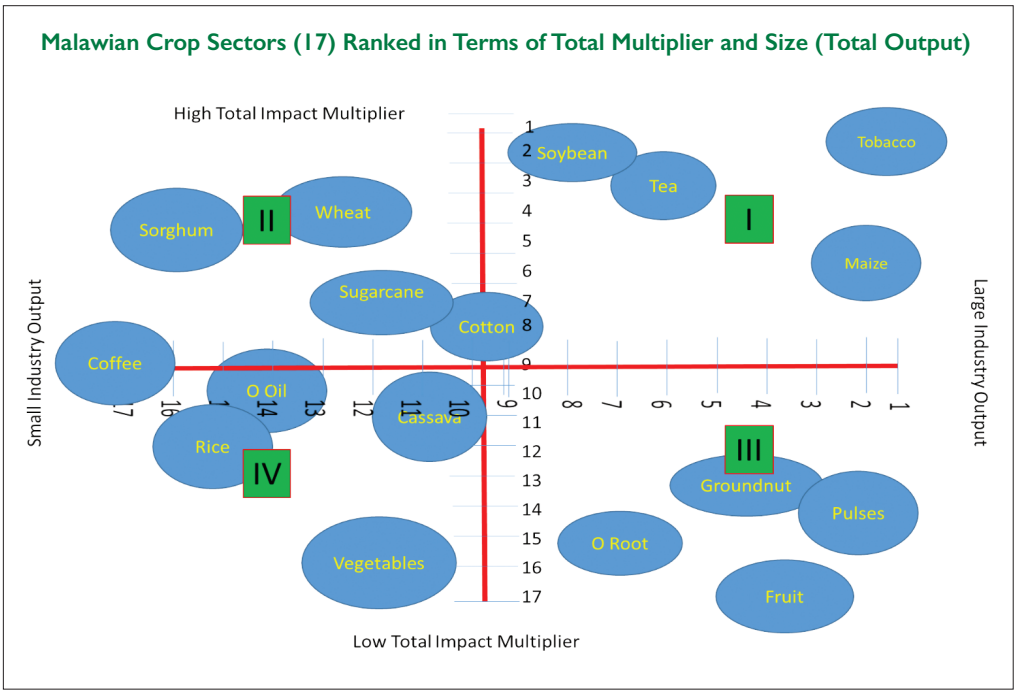
Depending on the sector, a dollar of investment can have a very different result for the wider economy. For example, investing in sectors that are reliant on many goods or services as inputs are likely to have large "upstream" effects, as those sectors also expand to meet the increased demand for inputs. On the other hand, investing in sectors that are used as inputs for further value-added activities are likely to have large "downstream" effects.

Policymakers may also be interested in how those economic benefits are distributed. Do they flow to workers in the form of wages? Or, do they impact overall productivity in the form of capital investment? Are wage earnings spread among many workers, or a small number of better-paid workers?

SOLUTION:

SIL employs Input-Output analysis as a powerful methodology to help policymakers, donors, and researchers better understand and compare the economic impacts of various investments. Industrial crops like soybean are thought to have relatively large multipliers with respect to upstream industries as successful soybean production requires inputs such as fertilizer, crop protection products, inoculum, lime, certified seed, and tillage services and equipment. There should also be large downstream effects within the food, feed, and livestock industries due to soybean's high levels of oil and high-quality protein.

The impact of sector expansion on the overall economy is a function of that sector's total multiplier effect and its size. Large sectors that also have large upstream and downstream multipliers (upper-right quadrant) will have the greatest positive economic impact when they grow—and the largest negative impact when they shrink. The four sectors in Malawi that have these features are tobacco, soybean, tea, and maize. These sectors annually produce over $900M USD of additional economic impact for the Malawian economy, more than 3.6x the impact of the remaining 13 sectors combined.



To confirm this hypothesis, SIL partnered with Cornell University, the University of Illinois' Regional Economics Applications Laboratory (REAL), and the USAID Feed the Future Malawi Agriculture Diversification Activity to employ Input-Output analyses in Malawi and Kenya. The team sought to identify the upstream and downstream effects of investments in the soybean value chain. The Input-Output method is similar to looking at the effects of dropping a rock in a pond, capturing both the size of the rock (i.e. the size of a sector within the national economy); the size of the splash (i.e. the overall value added to the national economy from the initial investment); the direction of the ripples (i.e. identifying the sectors included in the backward and forward linkages); and the length of the ripples (i.e. the magnitude of the backward and forward linkages). SIL continues to expand this methodology to other countries and regions of Africa.

KEY IMPACTS

In Malawi

- Every $1 USD invested in soybean results in $3.64 USD of economic impact, on par with investment in tobacco.
- Investment in the soybean sector has the 2nd largest economic impact multiplier among the country's 17 crop sectors.
- Expanding soybean production by 25% results in a $39M USD expansion of the Malawian economy.

In Kenya

- A coordinated investment strategy across the soybean value chain to increase annual soybean production, from its low base, by 4x can contribute $85 million to the Kenyan economy and create 4,800 new jobs.

Overall

- Expanding soybean production would have large knock-on benefits for overall economies, due in part to large downstream impacts in the food manufacturing and animal feed sectors.
- Strategic investment in increased soybean production can pave the way for the replacement of imported staple oils, in turn driving value to local farmers and supporting the expansion of the country's agro-industrial complex.

Strategic investment in increased soybean production in Malawi can pave the way to replace current imported staple oils with soybean oil. Companies like Sunseed Oil Ltd. (left), a leading soybean oil producer in Malawi, would be able to lower their raw material costs, improve the quality of their products, and reduce supply disruptions.

The ICT Health Checkup: A Key to Partner Self-Reliance

CHALLENGE:

Information and communication technology (ICT) is a mission-critical element for success in modern agricultural research around the globe. In that sense, ICT has become like the oxygen for today's agricultural researcher, who needs robust ICT connectivity and toolsets to carry out highly effective programs. Unfortunately, ICT connectivity and utilization at agricultural research institutions and universities throughout Sub-Saharan Africa lags far behind their counterparts on other continents. While fiber-based connectivity is pouring into Africa from every direction, not enough attention is currently being directed to improving ICT connectivity and bandwidth at Africa's National Agricultural Research System (NARS) and higher education institutions.

Limited connectivity weakens local partners' ability to lead projects, collaborate across organizations and geographies, attend webinars and apply for grants. Robust ICT connectivity is essential to ensuring African partners are operating on the same playing field as collaborators in Europe, Asia, and the Americas.

SOLUTION:

The first step in addressing and remedying connectivity issues at the institutional level is to use a reliable IT assessment tool that clearly identifies and quantifies constraints and gaps across the institution's use of IT resources. SIL developed the ICT Health Checkup app to serve as a quantitative assessment tool that provides instant guidance on connectivity gaps and provides specific and measurable benchmarks in four key areas:

- Connectivity
- Physical infrastructure
- Intranet services
- ICT staff

This year, SIL is launching the ICT Health Checkup as an independent online assessment tool in collaboration with a network of 14 NARS, higher education, and National and Regional Research and Education Networks (NRENs, RENs) in Ghana, Zambia, and Malawi.

KEY IMPACTS

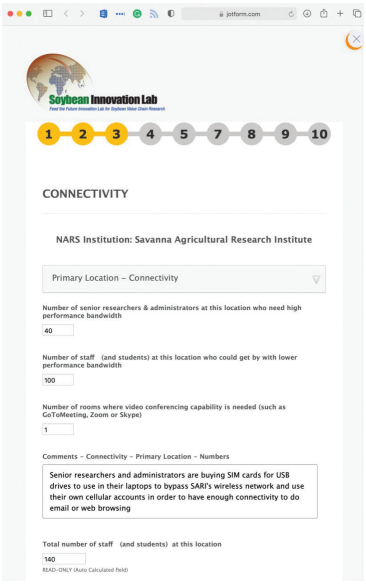
- SIL scales the ICT Health Checkup tool through a partnership with National and Regional Research and Education Networks (NRENs and RENs), which are mandated to bring connectivity to Africa's research and higher education institutions. RENs and NRENs are the best bet for providing higher speed connectivity at the lowest costs and offer additional value-added services to members beyond bandwidth.

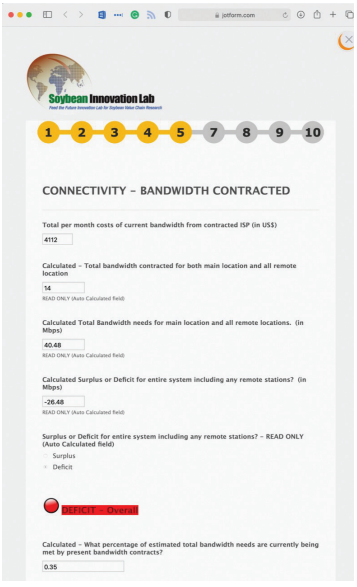
SIL's REN and NREN partners include:

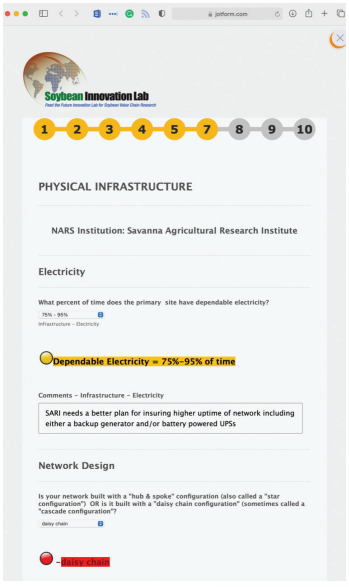
- Ubuntu Alliance
  Eastern and Southern Africa
- WACREN
  West and Central Africa
- GARNET
  Ghana Academic Research Network
- MAREN
  Malawi Research and Education Network
- ZAMREN
  Zambia Research and Education Network

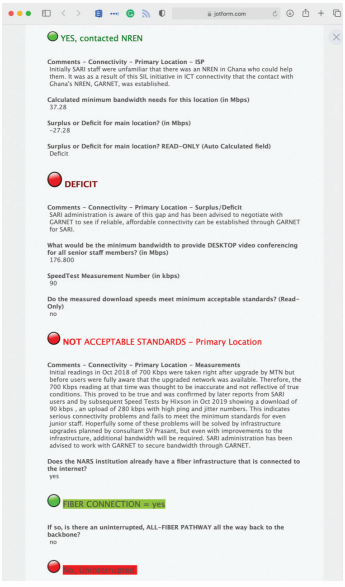
- SIL addressed two knowledge gaps: first, enabling partners to quantify their IT gaps and assets through the ICT Health Checkup tool (including a planning feature to support resource allocation in support of agricultural research and outreach); and second, connecting NARS and agricultural universities with their NREN system.
- Now, research and academic partners are matched with their appropriate NREN where together they address an alternative to the oligopoly of commercial telecoms. The collaboration opens up the opportunity to gain high speed access while simultaneously lowering the costs per Mbps.
- The ICT Health Checkup application will soon be available online for organizations to use on demand via SIL's **Tropical Soybean Information Portal.**

SIL's ICT Health Checkup app gives institutional users a quantitative assessment of their connectivity gaps in four key areas. Shown below are snapshots of the app focused on the connectivity and physical infrastructure areas.









A BIG WIN

Reliable, High-Speed ICT Connectivity Delivered to Agricultural Researchers in Ghana

Written by Dr. Nicholas Denwar, Soybean Breeder, SARI, Ghana

"The connection at SARI was so poor during the day, that I often had to come into the office in the evenings to work. Poor ICT connectivity had become something my colleagues and I had all learned to live with. Since the upgrade and switch to our new ISP, GARNET, my fellow researchers and I now have fast reliable internet using a wired ethernet infrastructure."

Dr. Edward Martey
SIL Partner and SARI Economist, Ghana

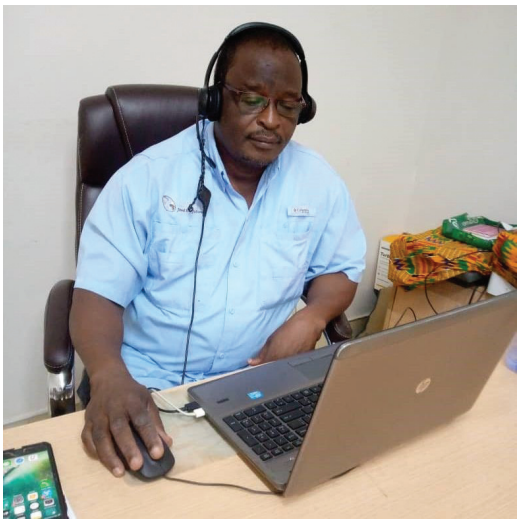
SIL's ICT Health Checkup showed that GARNET, Ghana's local NREN, was the lowest-cost internet service provider, reducing cost per Mbps by 93% and leading to a 78x increase in overall connectivity within the institution.

The first time I heard the expression "ICT is like the oxygen that agricultural researchers need to be successful" was at a Soybean Innovation Lab seminar as a member of the SARI Core of Excellence team. That seminar made me realize how much my work as a soybean breeder with SARI in Nyankpala, Ghana, had been held back by poor connectivity and slow internet speeds. As it turned out, that was not the last time the phrase would ring true for me.

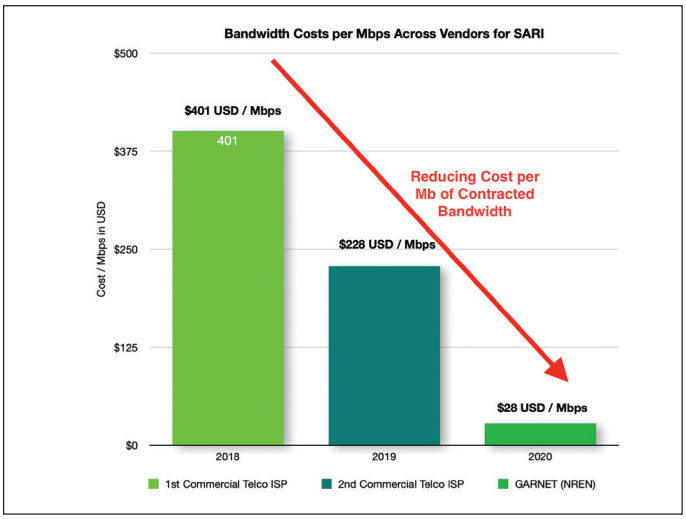
SIL's ICT Health Checkup tool showed the minimum institutional bandwidth for SARI's main campus at Nyankpala, with 40 senior personnel and 100 support staff, was 37Mbps. At the time, our total contracted bandwidth was only 2Mbps — about 5% of what we needed. Speed tests showed download speeds as low as 0.05Mbps, a mere 10% of the minimum needed for researchers. That led to the natural question, why was our bandwidth so low?

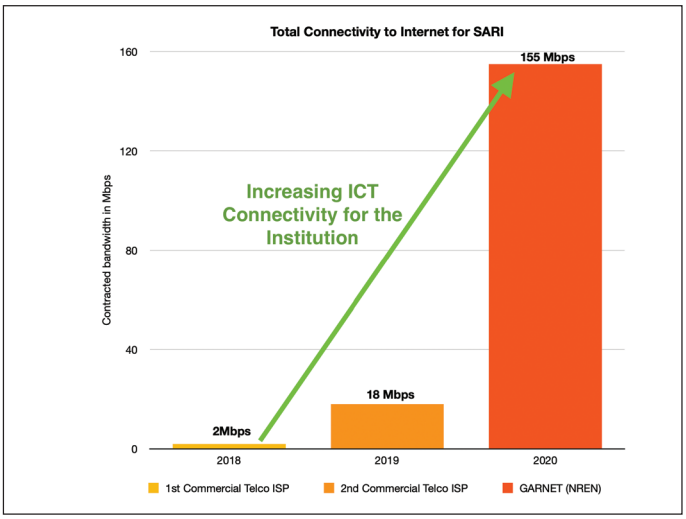
Two answers emerged. First, no one had ever explained to us how much bandwidth was required to do our jobs properly. Second, cost was a factor — we were paying $802 per month for that 2Mbps connection. With funds in short supply and without a solid justification that additional expenditures would produce significant results, SARI had continued to under-invest in this area. Our connectivity was so poor that Senior Researchers like me were purchasing prepaid SIM cards and using our personal cellphones to gain connectivity rather than relying on SARI's network.

SIL worked with our IT staff and local telecom providers to explore all available options to increase bandwidth and lower costs. This year, we achieved a breakthrough by switching to GARNET as our internet service provider. We now enjoy a 155 Mbps connection across the entire SARI station at Nyankpala, a 75x increase over our initial connection speed, and a 20x increase over the connectivity offered by cell providers in the region, at roughly the same cost. Our journey highlights the value of working with your local NREN and using the ICT Health CheckUp to quantify the strengths and weaknesses of your organization or company's connectivity.



Dr. Nicholas Denwar is a soybean breeder with the Savanna Agricultural Research Institute (SARI) in northern Ghana. Dr. Denwar collaborates closely with SIL to develop new, high-yielding soybean varieties for Ghanaian farmers. The improvement in SARI's connectivity enables colleagues like Dr. Denwar to effectively collaborate, leading proposal development, attending meetings, presenting at webinars, and applying for grant opportunities.





The Tropical Soybean Information Portal: tropicalsoybean.com

Transparent information systems are critical to successful network formation as members derive significant benefits from information platforms including data and resource sharing, connections to new partners and funders, and a curated repository of extension materials and research findings. A functioning information network did not exist for African soybean breeders, agronomists, processors, and economists – the practitioners that will continue to advance soybean production and utilization across Sub-Saharan Africa for decades to come.

In response, SIL developed a management information system for the growing African soybean network of managers, researchers, extensionists, and policymakers: the Tropical Soybean Information Portal (TSIP). The TSIP houses tropical soybean data, extension resources, publications, videos, online courses, and recipes in an open-access and searchable platform.

HOW CAN THE PORTAL HELP ME?

- Visit the interactive map on the Portal homepage to quickly view agronomic performance and oil and protein concentration data from SIL's Pan-African Soybean Variety Trial (PAT) program underway in 24 countries and 113 locations.
- Switch to the agronomic map to view the economic returns based on varying soybean production input bundles by country and location trialed on SIL's SMART Farms underway in 6 countries and 20+ locations.
- SIL's network of multi-crop thresher fabricators and vendors across Sub-Saharan Africa is also easily searchable using the mechanization layer of the interactive home page map.
- Are you looking for webinars, research briefs, training manuals, or Industry Extension Reports? Check out the extension corner of the Portal and search by format, type, and topic.
- Users can access webinars, presentations, tutorial videos in multiple languages, fact sheets, agronomic reports, and country-specific input bundle recommendations.
- The Portal hosts an online forum for tropical soybean researchers, extension workers, farmers, outgrowers, processors and seed producers to post pictures of pests and diseased plants to aid in identification and management. Forum visitors can pose questions, comment, engage with others, and follow posts that are of interest to them.

SIL's Tropical Soybean Information Portal is a curated repository of information related to tropical soybean, including extension reports, databases, webinars, training materials, and more. The portal hosts an interactive homepage map, webinar recordings, a SMART Farm calculator, and more.

The Tropical Soybean Information Portal supports various networks of soybean stakeholders in Sub-Saharan Africa including breeders, agronomists, trial operators, plant pathologists, mechanization experts, nutritionists, and social scientists. These networks will ultimately be the leaders in maintaining, updating, and continually developing the Portal to ensure its usefulness for members.

THE PORTAL: A TWO-WAY STREET

Not only can portal users access publications, extension materials, data, tools, and other soybean-related content, but members can also post through the portal's curated infrastructure additional materials and resources from their own organization, company or program.

The Portal currently offers:

- 200+ tropical soy-focused research articles
- 200+ soy-based recipes
- 50+ varietal and agronomic Industry Extension Reports
- 20+ soy-focused webinars
- 20+ soy-related training resources
- Soybean Pest & Disease Online Forum
- Interactive map with agronomic, seed, and mechanization data
- Input Bundling SMART Farm Calculator

Communications

SIL's research-for-development (R4D) model focuses on scaling technologies through active and self-reliant partner networks. To achieve this, SIL implements an active communications platform to foster and create networks, support their interaction, and help them strengthen and grow.

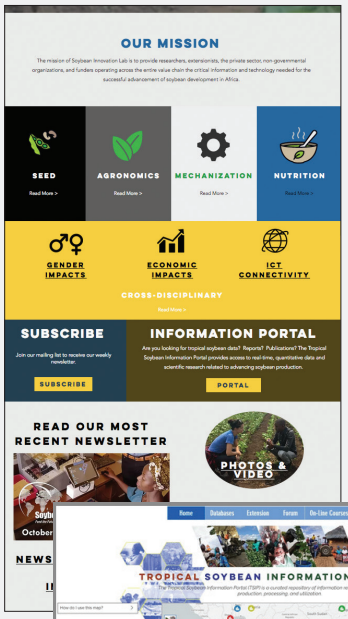
SIL has been a leading Innovation Lab in the use of a variety of ICT platforms and approaches to disseminate information, engage networks, and ultimately ensure uptake, scale, and sustainability of technologies.

This approach enables SIL to significantly economize on critical research dollars by building and supporting networks across broad geographies without the time and financial expense of travel.

SIL's communications platform allows for critical bidirectional information flows and feedback loops between partners who actively learn from each other, share resources and technologies, which in turn sustains relationships.

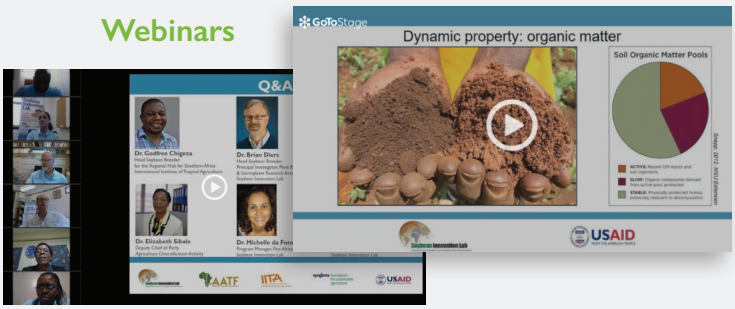
Strategic Communication Partners

AGRILINKS · ajfand · Tropical Conservation Science · AFSTA · The Chicago Council on Global Affairs · farmdoc · AOCS · FEED THE FUTURE The U.S. Government's Global Hunger & Food Security Initiative · SeedWorld



SIL Website and Tropical Soybean Information Portal

Webinars



Newsletters

Social Media Platforms

Soybean Innovation Lab

Tropical Soy Lab

Soybean Innovation Lab

YouTube
Soybean Innovation Lab

Soybean Innovation Lab

2020 COMMUNICATION IMPACTS

Weekly newsletter reaching 8,000+ subscribers

- 250+ newsletters released to-date

Bi-monthly Technical Webinar Series reaching 1,695 registrants this year across 74 countries

- 20+ technical webinars to-date
- 20+ countries and 50+ organizations represented on average per webinar
- 2020 topics covered:
  - Soybean Disease in the Tropics – A Management Toolkit
  - ICT Connectivity: The Oxygen of Today's Agricultural Researcher
  - Performance of the SIL Multi-Crop Thresher
  - Profitability of the SIL Multi-Crop Thresher
  - Promoting Gender Equity and Ownership of the SIL Multi-Crop Thresher
  - Pan-African Soybean Variety Trial Virtual Seed Marketplace
  - Universities and Development Impact
- Watch all webinars at www.tropicalsoybean.com/extension

Active, effective, and routine video content and social media activity on Facebook, Twitter, LinkedIn, and YouTube

- 2,700+ Facebook followers
- 100+ YouTube videos

Special journal and online issues and publications

- 10-part series in *African Journal of Food, Agriculture, Nutrition and Development*
- 12-part series in *Tropical Conservation Science*
- 10-part series in *farmdoc*

Soybean Innovation Lab information website

- 35,000+ visitors to-date

The Tropical Soybean Information Portal

- > 200 tropical soy research articles
- > 200 soy recipes
- > 35 Industry Extension Reports
- > 20 technical webinars
- > 20 modules across 5 SIL-U courses

Private Partnerships in Action

THE SECRET SAUCE:
HOW SIL SCALES INNOVATIONS THROUGH THE PRIVATE SECTOR TO ACHIEVE IMPACT

- We are demand driven by our clients – we listen to client needs first
- We design our technologies through co-creation
- We engage the private sector as scaling partners
- Our timelines are short because client needs are immediate and real
- Our ultimate metric of success is autonomous uptake and deployment of our technologies
- The private sector is essential to successful scaling as they have systems in place to bring new technologies to market through large and organized networks of farmers and input providers

A FEW OF OUR SCALING PARTNERS

SAYeTECH – scaling partner for the SIL Multi-Crop Thresher in West Africa – **5,000 Ghanaian end-users**

Pyxus – scaling partner for the Pan-African Soybean Variety Trials – **300,000 African growers, 10,000 Malawian growers**

Cottfield East Africa Ltd. – scaling partner for the SMART Farm bundle rollout – **30,000 Ugandan growers**

Good Nature Agro – scaling partner for the Pan-African Soybean Variety Trials and SMART Farm bundle rollout – **15,000 Zambian growers**

First Wave Group – scaling partner for SIL Multi-Crop Thresher – **2,000 Zambian growers**

Japan Tobacco International – scaling partner for the Pan-African Soybean Variety Trials and SMART Farm bundle rollout – **110,000 Malawian growers**

Horizon Farming Ltd. – scaling partner for the SMART Farm bundle rollout – **20,000 Malawian growers**

For more information, contact:

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