FEED THE FUTURE INNOVATION LAB

Collaborative Research on Sorghum and Millet

ACTIVITIES & IMPACTS 2014

KANSAS STATE UNIVERSITY

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

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FEED THE FUTURE
INNOVATION LAB

Collaborative Research
on Sorghum and Millet

INNOVATING SCIENCE

to build the crops of the future

TRAINING & COLLABORATION
CUTTING-EDGE RESEARCH
POVERTY REDUCTION
CLIMATE RESILIENCY

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OUR LAB

Established in 2013, the Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet is a global hub of cutting-edge research along the sorghum and pearl millet value chains. With an emphasis on the countries of Ethiopia, Senegal and Niger, the Lab is focused on increasing the resiliency of small-scale producers in the face of climate change. It is located at Kansas State University and links U.S. and international universities and research organizations in a collaborative effort to make sorghum and pearl millet the crops of the future.

As the Lab's first full operational year, 2014 saw the establishment of a five-person staff, the selection of an $8.5 million research portfolio of ten projects with activities in the three focus countries and supported in five other countries, the development of strong national and international partnerships and the launch of training programs of the next generation of sorghum and millet scientists from around the world. It has been a truly successful year that brings much promise for the future!

OUR STAFF

Timothy Dalton
Director

A note from the Director...

We are excited to present you with our first Activity and Impact Report for the Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet! This report describes our exciting progress since the program's initiation in developing a diverse portfolio of research projects along the sorghum and millet value chains, initiating a variety of scientific activities and identifying the next generation of sorghum and millet scientists for long-term training opportunities. We hope that this report will provide you with a comprehensive overview of our early accomplishments and a vision of our future directions.

All the best,

Nat Bascom
Assistant Director

Kira Everhart-Valentin
Program Coordinator

Kristen Sanborn
Business Financial Specialist

Shelby Mettlen
Communications Intern

EXTERNAL ADVISORY BOARD

The External Advisory Board (EAB) is a competency-based board that was selected based on technical skills useful for evaluating the potential for scientific discovery in sorghum and pearl millet science in East and West Africa.

One of the EAB's most important roles in 2014 was to contribute to the development of the research portfolio by evaluating concept notes and proposals submitted for consideration as well as to review the scientific progress of funded research projects and provide overall guidance for future research priorities.

Brhane Gebrekidan
Ethiopian Academy of Sciences

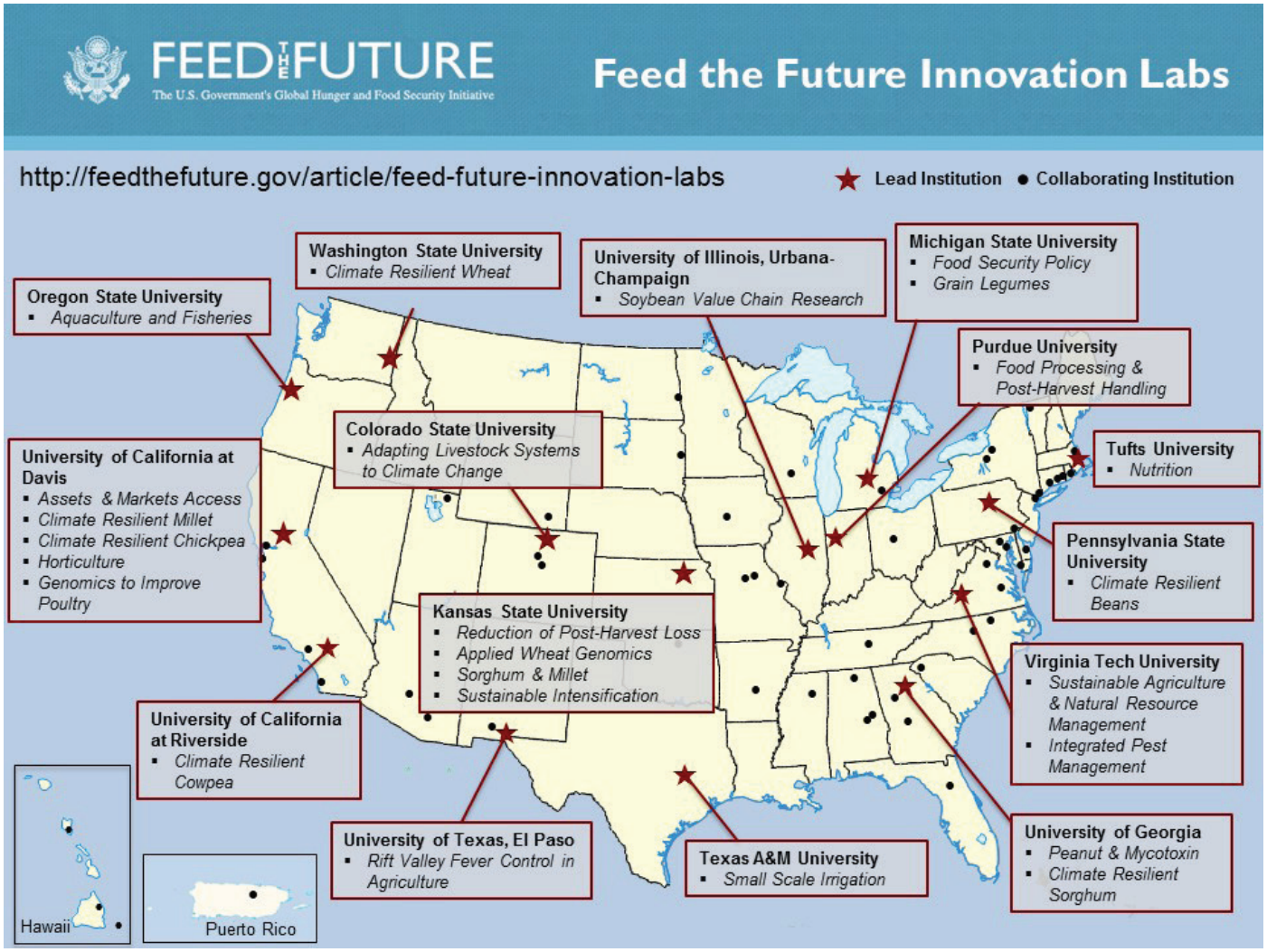
Bettina Haussmann
University of Hohenheim & McKnight Foundation

Tim Lust
National Sorghum Producers

Peter Matlon
Cornell University

Barbara Stoecker
Oklahoma State University

THE INNOVATION LABS



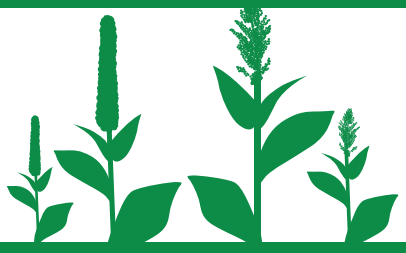
Feed the Future is the U.S. government's global hunger and food security initiative that targets 19 low-income countries in Latin America, sub-Saharan Africa and Asia to accelerate inclusive agricultural growth, improved nutrition, gender integration, private sector engagement, research and capacity building and climate-smart development (www.feedthefuture.gov). Feed the Future Innovation Labs are one vehicle to contribute to this agenda that are authorized under the Foreign Assistance Act of 1961. These labs link knowledge and science at U.S. universities, the USDA and other public and private organizations with counterparts in the target nations. The Sorghum and Millet Innovation Lab is one of four Innovation Labs located at Kansas State University, all of which were awarded in 2013 and 2014.

OUR RESEARCH

The research activities supported by the Sorghum and Millet Innovation Lab all aim at improving the adaptation and resilience of sorghum and pearl millet to the semi-arid climates of East and West Africa. The projects selected in 2014 for funding by the Lab contribute to food security, household resilience and private sector growth in the Ethiopia, Senegal and Niger through the enhancement of production and value-added product development.

The Lab's program focuses on three areas of inquiry - genetic enhancement, production systems management and value-added products and market development - while insuring that cross-cutting themes of gender, the environment and nutrition are fully integrated across these areas.

Additionally, the Lab links U.S. and international universities and research organizations in a collaborative effort to build human and institutional capacity across all focus countries. In its first year in operation, the Lab has built active partnerships with nine U.S. institutions and 27 international institutions from a variety of different countries, including Ethiopia, Senegal Niger, Burkina Faso, Mali, South Africa, Germany and France.



FOCUS COUNTRIES

The Sorghum and Millet Innovation Lab's work is centered in three focus countries: **Ethiopia**, **Senegal** and **Niger**. Multiple criteria were utilized in the selection of these focus countries, including current supply of sorghum and millet vs. projected future demand, the number of impoverished sorghum and millet farmers in each country, the role of sorghum and millet within the national agricultural economies, opportunities for broad-based farm impact, opportunities for local progress in added-value product development to stimulate demand for sorghum and millet and a determination of where there exists a critical mass of scientists.

Ethiopia

Ethiopia is one of the most important sorghum-producing nations in East Africa. It has the largest acreage of sorghum in East Africa after Sudan.

Ethiopia is estimated to have 12.3 million sorghum farmers who live on less than $2 a day. In addition, Ethiopia is considered a center of genetic origin for sorghum and offers great landrace diversity.

Senegal

Senegal grows a large area of pearl millet, which is the most widely grown subspecie of millet. Pearl millet has adapted to the harsh semiarid environment in West Africa, especially in areas where few other cereal crops can thrive.

Researchers are working to improve productivity and add value to pearl millet crops and sorghum. Doing so can help Senegal's 3.5 million millet producers who are economically classified as "ultra poor."

Niger

Niger is one of the largest sorghum- and pearl millet-producing countries in West Africa, with the roughly 8.4 million sorghum and 9.8 million millet farmers in Niger living on less than $2 a day.

Niger neighbors several other important sorghum-producing countries in the region, which are expected to economically benefit from the advancements made in Niger.

Mali and Burkina Faso

While the Lab identified three focus countries, its research has wide-reaching impacts. Mali and Burkina Faso are two additional Sahelian partner countries in which the Lab has research activities taking place.

PORTFOLIO OF RESEARCH

ETHIOPIA

Developing superior functionality in sorghum for food applications to promote sorghum value chain in Ethiopia

Principal investigator: Joseph Awika (Texas A&M University)
Award amount: $809,941
U.S. collaborating institutions: Texas A&M University
Focus country: Ethiopia
Intl. collaborating institutions: Ethiopia - Hawassa University; South Africa - University of Pretoria

Genetic enhancement of sorghum to promote commercial seed supply and grain market development in Ethiopia

Principal investigator: Gebisa Ejeta (Purdue University)
Award amount: $912,703
U.S. collaborating institutions: Purdue University, Kansas State University
Focus country: Ethiopia
Intl. collaborating institutions: Ethiopia - Ethiopian Institute of Agricultural Research (EIAR) (Melkassa Research Center, Sirinka Research Center), Holleta Biotechnology Center, Tigray Regional Program, Oromia Regional Program, Haramaya University

Genetic improvement of sorghum and millet for resistance to fungal pathogens

Principal investigator: Tesfaye Mengiste (Purdue University)
Award amount: $842,963
U.S. collaborating institutions: Purdue University, Kansas State University
Focus country: Ethiopia
Intl. collaborating institutions: Ethiopia - EIAR (Asosa Research Center, Pawe Research Center, Bako Research Center), Holleta Biotechnology Center

Improved crop genetics, production practices and processing methods for increased productivity and nutrition for smallholder sorghum producers in Ethiopia

Principal investigator: Tesfaye Tesso (Kansas State University)
Award amount: $821,421
U.S. collaborating institutions: Kansas State University, USDA-ARS, Purdue University, KSU - Hays Research Station
Focus countries: Ethiopia
Intl. collaborating institutions: Ethiopia - EIAR (Melkassa Research Center, Sirinka Research Center, Pawe Research Center), Tigray Agricultural Research Institute, Haramaya University




WEST AFRICA

Improving sorghum adaptiation in West Africa with genomics-enabled breeding

Principal investigator: Geoffrey Morris (Kansas State University)
Award amount: $1,090,093
U.S. collaborating institution: Kansas State University
Focus countries: Niger, Senegal
Intl. collaborating institutions: France - Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) ; Senegal - Institut Sénégalais de Recherches Agricoles (ISRA), Centre d'Etudes Régional pour l'Amélioration de l'Adaptation à la Sécheresse (CERAAS), Centre National de Recherche Agronomique (CNRA) ; Niger - International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Institut National de la Recherche Agronomique du Niger (INRAN)

Trait development pipeline for food and feed value in sorghum

Principal investigator: Bonnie Pendleton (West Texas A&M University)
Award amount: $876,284
U.S. collaborating institutions: West Texas A&M University, Texas A&M AgriLife Research
Focus countries: Niger, Senegal
Intl. collaborating institutions: Senegal - ISRA, CNRA, CERAAS; Niger – INRAN

Development of biotic stress-resistant sorghum cultivars for Niger and Senegal

Principal investigator: Mitchell Tuinstra (Purdue University)
Award amount: $1,044,323
U.S. collaborating institution: Purdue University
Focus countries: Niger, Senegal
Intl. collaborating institutions: Senegal - Institut de Technologie Alimentaire (ITA), CERAAS, ISRA, CNRA; Niger – INRAN

Biological control of the millet head miner in Niger and Senegal

Principal investigator: Malick Ba (ICRISAT - Niger)
Award amount: $638,788
U.S. collaborating institutions: Virginia Tech University, IPM Innovation Lab
Focus countries: Niger, Senegal
Intl. collaborating institutions: Senegal - ISRA, CERAAS, University Cheik Anta Diop de Dakar; Niger - University of Maradi, INRAN

Optimization of the seed ball technology for pearl millet, and agronomic and socio-economic evaluation in the context of smallholder farmers in Senegal and Niger

Principal investigator: Ludger Herrmann (University of Hohenheim – Germany)
Award amount: $172,600
Focus countries: Niger, Senegal
Intl. collaborating institutions: Senegal - ISRA, FAPAL (farmer organization); Niger - INRAN, Fuma Gaskiya (farmer organization)

Expanding markets for sorghum and millet farmers in West Africa through strengthening of entrepreneur processors and nutrition-based promotion of products

Principal investigator: Bruce Hamaker (Purdue University)
Award amount: $816,328
U.S. collaborating institutions: Purdue University
Focus countries: Niger, Senegal
Intl. collaborating institutions: Senegal - ISRA, CNRA, ITA; Niger - INRAN

TECHNOLOGY ROLLOUT TIMELINE

Time in years

0

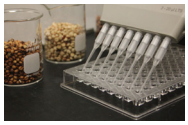
Short-term technologies
(In testing)

Parasitoids for millet head miner control (Ba)

Pearl millet seed balls (Herrmann)

Sorghum for value-added food products (Awika & Hamaker)

Medium-term technologies
(In development)



Improved food and feed value sorghum (Tuinstra)

Biotic stress-resistant cultivars (Pendleton)

Long-term technologies
(Under research)

Genetic information on desired sorghum traits (Morris & Tesso)

Striga, drought & disease-resistant sorghum lines (Ejeta & Mengiste)

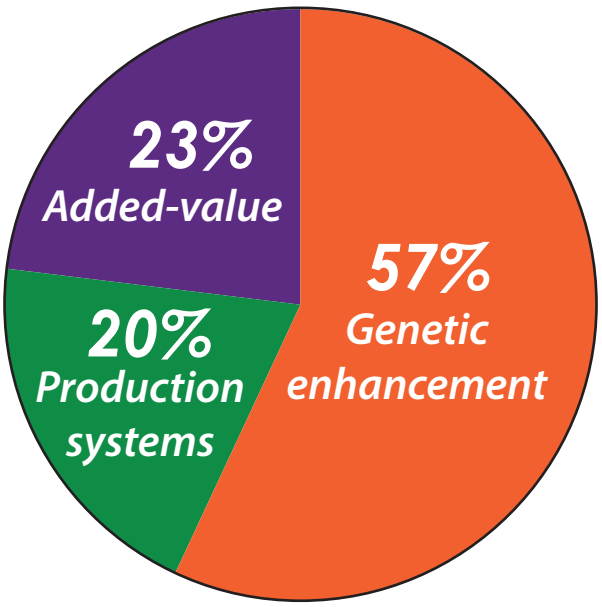
5+

FUNDING DISTRIBUTION

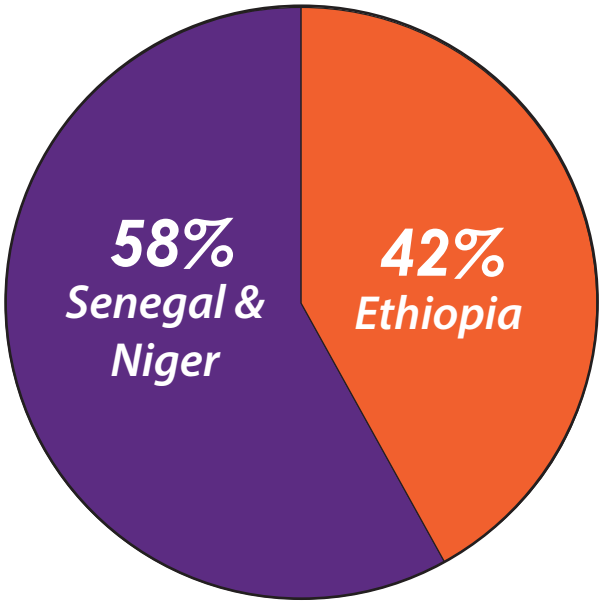
Across the ten funded projects, approximately ***57%*** of project funding will be invested in the genetic enhancement of sorghum and millet, ***20%*** in production systems management and ***23%*** in added-value product development and markets.

Within that, ***42%*** of the total research finds will be directed to projects targeting Ethiopia and ***58%*** in projects in Senegal and Niger.

Area of research	Funding
Genetic enhancement	**$4.8 mil.**
Ethiopia - *(Ejeta, Mengiste, Tesso)*	
West Africa - *(Morris, Tuinstra, Pendleton)*	
Production systems management	**$1.7 mil.**
Ethiopia - *(Tesso)*	
West Africa - *(Ba, Herrmann, Pendleton)*	
Added-value products	**$2.0 mil.**
Ethiopia - *(Awika)*	
West Africa - *(Hamaker)*	



Funding by area of research



Funding by country

OUR IMPACT

As a part of the Feed the Future initiative, the Sorghum and Millet Innovation Lab joins a network of 23 other Innovation Labs to use research, education and outreach to advance solutions to hunger, poverty and under nutrition in low-income countries. It builds on the 30-year legacy of the International Sorghum and Millet Collaborative Research Support Program (INTSORMIL CRSP) which prioritized international collaboration and capacity building in sorghum, millet and other grains.

Three interrelated objectives comprise the Sorghum and Millet Innovation Lab's priorities and overall vision, and drive its on-the-ground impact:

- Build a coalition of science and industry around sorghum and millet where structure and opportunity creates entrepreneurial advances to reduce poverty and hunger,
- Incubate and nurturing a new wave of feed and food products to stimulate demand for sorghum and millet,
- Create an economically rationalized business and research investment plan to leverage U.S. Agency for International Development core financing and attract broader donor support.

The projects selected for funding by the Lab all fall within these objectives and contribute to the overall Feed the Future goals of reducing global hunger and improving food security. While 2014 was primarily dedicated to program and project startup, the research activities that were undertaken quickly began to demonstrate the essential, lasting impacts that would be made in the coming years.

Through scientific advances in production and the enhancement of entrepreneurial opportunities along the value chains, the Sorghum and Millet Innovation Lab is innovating science to make sorghum and millet the crops of the future.

AT-HOME IMPACTS

The Sorghum and Millet Innovation Lab links knowledge and science at U.S. universities, the USDA and other public and private organizations with counterparts in target nations to develop innovative solutions to some of the most difficult problems facing global agriculture today. These solutions are designed to have a lasting impact on hunger and food security, as well as bring key genetic information and technological advances back to the hands of Kansas farmers by:

- Gaining access to sorghum germplasm for future breeding use
- Proactively working on a variety of sorghum pests and diseases before they hit the United States
- Stimulating demand and opening trade opportunities for U.S. producers
- Developing technologies, varieties and methodologies with direct application to domestic farm operations
- Exchanging the best and brightest scientists in the world
- Promoting strong international exposure for Kansas and Kansas State University

TRAINING TOMORROW'S SCIENTISTS

Human and institutional capacity development are cornerstones to the Sorghum and Millet Innovation Lab's research program. By providing training and research opportunities for graduate students, postdoctoral associates and young researchers, the Lab is investing in the future of sorghum and millet science. Young researchers play an integral role in helping conduct research and develop outreach and education methods for farmers and scientists in the Lab's focus countries and are given the opportunity to prepare for their own roles of leadership as the next generation of sorghum and millet scientists. Additionally, existing in-country institutions and programs are supported by the Lab in order to enhance each country's ability to drive its own research priorities.

Long-Term Training Outlook

M.S. students	**12**
Ethiopia	4
West Africa	7
U.S.	1
Ph.D students	**13**
Ethiopia	5
West Africa	8
TOTAL *(2014-2018)*	**25**

EMPOWERING WOMEN

In all three of the Sorghum and Millet Innovation Lab's focus countries, women play a key role in the production, harvesting, processing and preparation of sorghum and millet on a daily basis. Because many of these women do not have access to the same resources or opportunities as their male counterparts, it is imperative that all Lab activities make a concerted effort to equitably integrate gender-sensitive research methods to ensure that men and women will equally benefit. Some ways in which the Lab has proactively integrated gender-related issues into its programming include:

- Prioritizing those project proposals that presented a clear gender strategy during the selection process
- Inviting USAID gender specialists to project meetings to facilitate gender planning sessions and provide direct feedback to researchers on their projects
- Supporting female scientists in training to help them access equal research and career opportunities
- Providing project-specific guidance on key gender-related issues and the development of strategic activities to address those issues
- Identifying opportunities to facilitate opportunities for technologies targeted towards women working along the sorghum and millet value chains

DRIVING SUCCESS

The search for sorghum stress resistance and novel genes

Three researchers come together in a coordinated effort to find new sources of resistance in sorghum

For the hundreds of millions of people around the world that depend on sorghum as the foundation of their livelihood, the threat of losing a season's crop is alarming. In Ethiopia, sorghum serves as a source of food, livestock feed and building materials, making common environmental stressors such as drought, disease and pests potentially devastating to entire families and villages. In an effort to diminish these risks faced by so many Ethiopian farmers, three research teams have combined efforts in a coordinated hunt for new sources of stress resistance in sorghum.

The initiative, led by Drs. Gebisa Ejeta and Tesfaye Mengiste of Purdue University and Dr. Tesfaye Tesso of Kansas State University, is part of a broader strategy under the Sorghum and Millet Innovation Lab aimed at improving the adaptation and resilience of sorghum and pearl millet to the semi-arid climates of East and West Africa. The Lab's support of the three scientists is an important step towards achieving that.

One of the researchers' first accomplishments was to plant 2,500 different sorghum lines in numerous test nurseries across Ethiopia. Plantings were completed in the summer of 2014, and the nurseries represent the broad range of climatic and environmental stressors present in the country. Very likely the largest screening of its kind in Ethiopia, the planted lines include local landraces, improved open-pollinated varieties and hybrids. Ethiopia is generally considered as the genetic origin for sorghum, and the countless landraces bring promise of access to a great diversity of genetic material. Many of the lines being evaluated are not a part of the U.S. germplasm collection, making the initiative a unique opportunity to comprehensively explore the Ethiopian sorghum germplasm and identify areas of promise for the development of new stress-resistant varieties.

In order to gain access to the extensive breadth of land races and successfully plant test plots in so many regions, the research team relied on linkages with the Ethiopian Institute of Biological Diversity and the Ethiopian Institute for Agricultural Research, as well as regional programs and universities. From the broad collection of germplasm planted, the researchers have been able to begin screening the varieties for a diverse range of desirable characteristics, including grain quality, drought resistance, disease resistance and Striga* resistance. These screenings will soon be paired with genotyping that will compare each plant's expressed characteristics with its DNA to locate specific genes that are linked to resistance or grain quality. By doing this, the researchers will be able to identify the lines that carry the greatest potential for future breeding activities. This will give Ethiopian and international breeders alike the tools they need to create better, more resilient sorghum varieties, and in turn result in greater food security and income-generating opportunities for countless sorghum farmers around the world.

**Striga is a parasitic plant that attacks sorghum and other crops, often resulting in high losses.*

Setting the stage for entrepreneurial growth

Technology incubation centers increase competitiveness of local food processing industries; offer nutritious meal options

Demand for value-added products made from local grains is high in West Africa, but few entrepreneurs have access to the capital needed to create, test and produce new products in order to build their business. To respond to this need, Purdue University food scientist Bruce Hamaker - along with his research teams in the U.S., Senegal and Niger – is expanding opportunities for local entrepreneurs to grow the value-added product market while addressing important needs in the area of human nutrition.

Through the centers, small-scale entrepreneurs – most often women - pay a small fee to utilize mechanized food processing equipment in order to test and develop high-quality sorghum and millet products for commercial sale. The entrepreneurs use inexpensive, locally-appropriate food processing technologies and also have access to business and technical support and training. Additionally, they are educated on the importance of purchasing high-quality grain for their businesses and are encouraged to obtain it from local farmers.

As a part of this project, researchers and entrepreneurs will also be experimenting with the development of new, nutrient-fortified food products, including infant food products and thin porridge flours. The fortification will be sourced from nutrient-dense plant materials found locally, such as amaranth, baobab, pumpkin leaf, wild jute, cowpea leaves, spider flower, mango and carrots.

Hamaker's project is based on the technology incubation center model that was first created under the leadership of the Sorghum and Millet Innovation Lab's predecessor, the INTSORMIL CRSP. First launched in Niger, and later expanded to Mali, Senegal and even Kenya, this model has a strong track record of successes in growing local markets and business opportunities in both rural and urban settings. The centers have a history of helping to carve out local and regional markets for traditional food products like couscous and boullet, which are popular in West African countries but typically have to be imported from North Africa or Europe. Through sustained investment, the Sorghum and Millet Innovation Lab will build on this legacy with an increased focus on fortified sorghum and millet products that can position smallholders to earn more income supplying nutritious foods.

For more information, contact:

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