Meridian Institute
Connecting People to Solve Problems

Innovations for Agricultural Value Chains in Africa

Applying Science and Technology to Enhance Cassava, Dairy, and Maize Value Chains

We are extremely excited to share an update with everyone who contributed to the Innovations for Agricultural Value Chains project about a number of concepts that originated in the project, which are under development. The project exceeded all our expectations and we are grateful to the Bill & Melinda Gates Foundation for supporting this project. The project was charged with: 1) developing specific technology concepts for reducing post-harvest losses in the maize, dairy and cassava value chains; 2) developing recommendations for methods and mechanisms that could accelerate the commercialization of post-harvest technologies in SSA, including but not limited to cassava, dairy and maize. Most of the project activities under the foundation's grant took place in 2009-2010. More than 200 ideas were developed, which were distilled down to 25 unique technology concepts. Since the close of the grant period, Meridian and a number of our partners have continued to develop several concepts generated during the project, including:

1. Low-Cost Drying and Storage Technologies for Maize
2. Stackable Milk Container
3. Low Cost Diagnostics
4. Universal Power
5. Granaries from Interlocking Stabilized Soil Blocks (ISSB)

Luiz Colnago, one of the Science Team members, is also working on the development of a Portable Magnetic Resonance Equipment to Detect Fraud/Adulteration in Raw Milk, which was inspired by the Innovations for Agricultural Value Chains project.

We are excited to provide this brief update on these concepts. Please feel free to share this update with your networks, provide feedback, and share additional updates about relevant activities with us. We look forward to hearing from you!

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Concept Updates

Low-Cost Drying and Storage Technologies for Maize

Figure 1: Prototype for On-Farm Tank

The Maize Storage and Drying Tank is a low-cost maize storage tank for shelled grain and feed that can be used on farm by small producers, in local co-ops, or in local facilities, such as milk-chilling plants. This concept adapts a popular, locally manufactured plastic water tank for maize storage. Long-term storage is made possible by making the tank airtight and depleting the oxygen within it.

This concept consists of three tracks:

- Hermetic storage vessels for on-farm use
- Low-cost tank drying for on-farm use
- Local grain storage and handling system (e.g., through dairy chilling plants or local agri-dealers)

Figure 2: Water Tanks in Use

In March 2012, the Bill & Melinda Gates Foundation, USAID, and Meridian Institute established a Global Development Alliance (GDA) to jointly support AflaSTOP: Storage and Drying for Aflatoxin Prevention, totaling $4,000,000 over three years. In the AflaSTOP project, Meridian and its partners (including ACDI/VOCA and Agribusiness Systems International) will develop and commercialize existing smallholder-friendly technologies for post-harvest storage of staple and legume crops to prevent aflatoxin. AflaSTOP will support the piloting of a rotationally molded plastic storage tank, the development of which began in 2009 through Meridian's Innovations for Agricultural Value Chains in Africa project. Science Team member Bob Adams will support this project. AflaSTOP will advance the progress already made by finalizing, testing and evaluating the design against competing technologies and, if promising, by deploying the technology for the benefit of smallholder farmers.

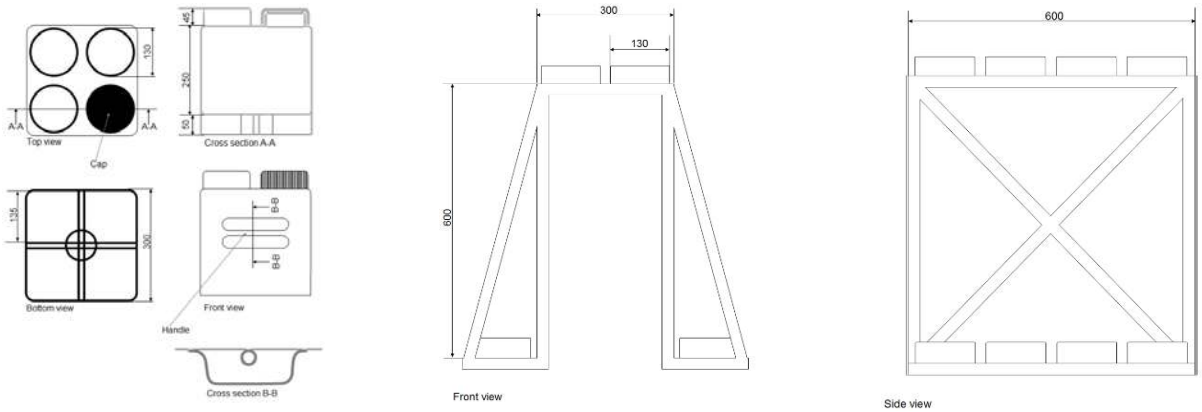
AflaSTOP will include development and commercialization of smallholder-friendly drying technologies for staple and legume crops. Additionally, this concept and the partnership with Kentainers are discussed in Roger Thurow's new book *The Last Hunger Season*.

Plastic Milk Container

Figure 3: Milk Container Model

The Plastic Milk Container is an anti-microbial, stackable ("lego-block" shaped) milk container. By making the containers easily stackable, they can be securely attached to a bike or any other mode of transportation. This will reduce the milk lost during transport as well as creating a stable, better balanced transport system. Additional properties could be added to minimize bacterial contamination of the milk, including: anti-microbial properties to prevent bacterial growth during transport as well as reduce the risk of bacterial contamination from batch to batch of milk; and super hydrophobic properties to make the container easy to clean and reduce milk residues and associated risks of bacterial growth.

Intellectual Ventures developed and field tested a milk container prototype in early 2012 in Kenya. Redesign work and development of a commercialization strategy are in process. Intellectual Ventures' work is part of a broader suite of innovations targeting the dairy value chain in East Africa. Current activities focus on the design of the milk container. Future activities may include the addition of anti-microbial functionality.



Milk Container Design | Bike Rack Design | Bike Rack Design

Figure 4: Milk Container Design Sketches

In early 2012, Frans Kampers – one of the Science Team members in the Innovations for Agricultural Value Chains in Africa project – Meridian Institute, Intellectual Ventures and the foundation participated in a teleconference to share information and facilitate connections. Following the teleconference, Meridian sent Intellectual Ventures the draft Research Plan developed in April 2010 by Frans Kampers, and a detailed concept

description – describing the technical concept (including sketches), identifying potential markets, and potential partners. Meridian Institute will connect periodically with Intellectual Ventures to share and seek updates about our relevant work.

Low Cost Diagnostics

In January 2011, BMGF announced a grant, totaling $1,988,318 over two years, to Diagnostics for All (DFA) to further develop and field test the following diagnostic tests.

Figure 5: Patrick and team reviewing prototypes for milk spoilage, aflatoxin detection, and bovine heat detection with workers at a Sidai franchise in Kapsabet on a recent trip to Kenya. The Sidai shops provide farm inputs and services such as artificial insemination to farmers in remote villages.

Figure 6: DFA scientist Matthew Stewart explaining the prototype designs to a farmers' meeting at the Tanykina Chilling Plant.

- **Milk Safety Diagnostics:** The concept describes a disposable, rapid test for rapid detection of lactic acid bacteria, protein levels, and pH. The assays are performed on a patterned-paper platform, similar to lateral flow tests for human health diagnosis and screening. In addition to its simplicity, one of the benefits of this test is that it does not require antibodies, enzymes, or other biological reagents that are not stable at higher temperatures. Because the reagents are relatively easy to work with in remote settings, it is envisioned that this test could be made not just in-country, but potential regional or even on-site.
- **Reproductive Health Diagnostics:** Reproductive Health Diagnostics are rapid tests (similar to lateral flow or dip stick tests) to detect pregnancy and heat in cows. The test would be based off of progesterone and pregnancy-specific protein B (PSP-B). There are currently point of care tests for progesterone detection (to detect heat and pregnancy). However, pregnancy cannot be detected unless last heat status was known. Therefore, a multiplexed device that measures both progesterone and PSP-B could be used to give a more accurate diagnosis.

- **Aflatoxin Diagnostics:** This concept was not generated by the Innovations for Agricultural Value Chains in Africa project, but it is mentioned here because it touches on several ongoing activities by BMGF and Meridian Institute, including the Partnership for Aflatoxin Control in Africa. A low-cost, field test for aflatoxin has the potential to create tremendous benefits for smallholder farmers who are suffering from chronic exposure to aflatoxin through contaminated staple crops. The test is slated for field testing in early 2013.

Universal Power

Universal Power is a universal interface between available power and simple machines or farm implements. It is similar in concept to the Power Take Off (PTO) found on tractors, which are standardized in dimensions and speed. This concept is modular and interchangeable – farmers are able to buy implements and power sources individually, which assists these farmers who have little capital to spend on complex and expensive implements. Additionally, this standardized interface fosters open innovation of power sources and implements.

Figure 7: The Cassava Dryer Prototype at the Class Presentation

Assistant Professor John Morrell of Yale University was a member of the Innovations for Agricultural Value Chains in Africa Science Team and organized a class that further explored the concept, developed prototypes and draft commercialization strategies. The results from the class were presented in July 2011 to an auditorium filled with students, faculty, administrators, and a small number of invited experts and guests, including Arlene Mitchell from the Gates Foundation, Bob Adams, and Todd Barker.

Figure 8: The Students of ME 491: Appropriate Technology for the Developing World

Dr. Morrell recently indicated that "The challenge remains for finding ways to field test ideas in a meaningful way." The class included business students working on potential commercialization models. More information is available at http://onewheeldrive.weebly.com/index.html

Granaries from Interlocking Stabilized Soil Blocks (ISSB)

Moses Musaazi is continuing to develop the granaries constructed with ISSB. He is piloting with a cross section of farmers and beneficiaries in Uganda and finding that, once the farmers are sensitized, they would be willing to invest US$ 130 for a granary of storage capacity 3,000 kg.

Figure 9: Traditional Granary in Uganda (not ISSB)

Figure 10: ISSB Granary at a Peasant Farm

Figure 11: ISSB Granary at a Medium Farm

Figure 12: ISSB Granary at a Primary School

Figure 13: ISSB Granaries at a Cooperative of Peasant Farmers

Moses and his colleagues intend to lobby the Government of Uganda (GoU) to provide granaries at primary schools to enable school children have a meal of maize (or a cup of maize porridge) per day for lunch. To date GoU provides free primary and secondary education but has insisted on not feeding the school children! This hugely contributes to poor academic performance, as poor parents are unable to provide lunch to their children.

Portable Magnetic Resonance Equipment to Detect Fraud/Adulteration in Raw Milk

Luiz Colnago has been collaborating with a Brazilian Professor of Chemistry at the Federal University of Sao Carlos, Brazil to develop low-cost methods to detect fraud/adulteration in raw milk. They are developing a low cost magnetic resonance equipment and method to check milk freshness. The device tests quality inside the container - without contact with the milk. This method may one day replace the alcohol test used in East Africa.

It is a portable magnetic resonance equipment (sensor plus electronic/computer weighs less than 30 Kg). The device currently costs about US$ 20,000.00. The technology is similar to Mouse NMR sensor that was developed at Aachen University, Germany.[1]

Post-Harvest Technology Commercialization Initiative

As a part of a grant from the Bill & Melinda Gates Foundation, Meridian Institute was asked to develop strategic and structural recommendations to the foundation and other potential donors for supporting and accelerating the commercialization of post-harvest technologies in Sub-Saharan Africa (including, but not necessarily limited to, innovations developed by participants in the Meridian project) to improve smallholder farmer food security and income in sub-Saharan Africa. The Concept Note for a Proposed Post-Harvest Technology Commercialization Initiative is available at: http://merid.org/value-chain-innovations.

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[1] http://www.act-aachen.com/profile_MOUSE.html

In March 2012, USAID's Bureau for Food Security requested applications for an Agricultural Commercialization and Innovation Activity. This activity will provide a platform from which the bureau can fulfill its role to promote new approaches to food security through new and innovative partnerships, tools, and methodologies that improve market access for food insecure households in Feed the Future countries. The AC&I Activity (now called Partners for Innovation) will have four components: Agricultural technology commercialization; Partnership development; Investment design and modeling; and Knowledge management. This activity may address a number of the gaps Meridian identified in our Concept Note and we will follow this process with great interest. More information is available at http://feedthefuture.gov/article/usaid-request-applications-agricultural-commercialization-and-innovation-activity.