

# SUMMARY OF RESULTS AND INSIGHTS FROM POST-HARVEST LOSS TECHNOLOGY TESTING IN GHANA

FEED THE FUTURE INNOVATION LAB  
FOR THE REDUCTION OF POST-HARVEST LOSS



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## GHANA'S PATHWAY TO PROGRESS.

Ghana continues to demonstrate the political will and perseverance to fight poverty, transform health and nutrition outcomes, and strengthen opportunities for all citizens. The country's vision for development has guided high-impact investments and interventions to support agricultural productivity, improved livelihoods, improved nutrition and health, gender equality, environmental health, technology development and adoption, and climate change adaptation and mitigation. These efforts have built an impressive track record.

The Government of Ghana's prioritization of agricultural production as a means of rural transformation and poverty reduction has led to incredible progress, with a reduction in poverty from 52 percent to 28 percent in the last decade. Major child health challenges have been improved with the prevalence of underweight children under the age of five decreasing from 25 percent in 1998 to 11 percent in 2014, and dramatic increases of exclusive breastfeeding. Ghana has one of the lowest levels of gender inequality in West Africa, and continues to close the gap. While there is still ample room for growth as nearly 28 percent of Ghanaians still live below the poverty line, and the prevalence of food insecurity, chronic undernutrition, and micronutrient deficiencies remain a persistent reality, Ghana has been showcased as an African success story in reducing poverty.

**“If we are to make any meaningful change in the lives of people, our efforts must be directed at agriculture. The majority of people can only feel a change in their lives when we develop agriculture.”**

*- President Akufo-Addo, President of the Republic of Ghana*

Ghana has embraced and adopted a multi-sectoral approach to development, with the objective of harmonizing partner actions for maximum impact. This, in addition to its vibrant research community, civil society and private sector is part of what makes Ghana's experience an example of sustainable transformation. The country has embraced innovations and approaches, and the Government has made its own investments to conduct research,

build capacity, and ensure that proven innovations can reach users along the value chain at scale.

## TACKLING AGRICULTURAL, ECONOMIC AND NUTRITION CHALLENGES

Agriculture is a major contributor to Ghana's economy, employing approximately 65 percent of the population. Despite national success in reducing poverty, there is still work to be done to ensure no one is left behind. As such, improving agricultural production has been prioritized as a means of rural transformation and poverty reduction.



Maize is the most important cereal crop in Ghana, accounting for more than 50 percent of the country's total cereal production. Women make up nearly half the agricultural labor but experience challenges such as access to and ownership of land, access to credit, and other inputs. Maize is culturally recognized as a 'male crop', which impacts cropping patterns and other behaviors. White maize, the culturally preferred food, is produced in both the Middle Belt region, which has two cropping seasons, and the Northern region, which has one cropping season.

Both exacerbating and stemming from productivity issues are high levels of post-harvest losses (PHLs). Maize storage losses at the farmer level due to pests, atmospheric moisture, heat and microbial growth reduce surpluses and quality of maize that could be sold at market, or consumed safely later, and nutritional profiles of harvested maize, which further diminishes nutrition and food security and farmer profits.

Due to critical time constraints to ensure a second season harvest in the Middle Belt region, farmers often delay proper drying of maize, which leads to high levels of aflatoxin contamination. This

contamination can result in high PHLs or human health risks if contaminated grain is consumed. In the Northern region, insect pests accumulate during the prolonged field drying stage and may go into storage along with the grain. Losses due to ineffective post-harvest practices can be as high as 40 percent in some cases.

Women are active with maize processing and marketing yet they lack access to agricultural extension, inputs, credit, and more. Additionally, women are responsible for meal preparation and ensuring her family is consuming an adequate diet. PHLs leave less income for a woman to purchase food with, forcing her to seek income-generating activities elsewhere in order to earn money for food. Sociocultural factors that disempower women, impact overall agricultural productivity, incomes, and most importantly, their own and future generation's health, nutrition status and livelihoods.

**“Current short-term challenges such as bad road infrastructure, inadequate machinery, extension services and adoption of simple post-harvest technologies need to be urgently addressed,”**

*- Victoria Adong, Program Director, Peasant Farmers Association of Ghana*

## THE POST-HARVEST LOSS INNOVATION LAB TACKLES THREE POST-HARVEST LOSS CHALLENGES FOR MAIZE

Through the USAID-funded Feed the Future Innovation Lab for the Reduction of Post-Harvest (PHLIL), Kansas State University (KSU), Oklahoma State University (OSU), Kwame Nkrumah University of Science and Technology (KNUST) and others<sup>1</sup> are working together on three key areas with significant post-harvest challenges: drying, storage and mycotoxin contamination of maize, through the testing and evaluation of traditional drying and storage technologies against improved technologies.

<sup>1</sup> Additional PHLIL program partners include: the USDA ARS Center for Grain and Animal Health Research, University of Kentucky, Fort Valley State University,

Through a phased approach, KNUST and Kansas State University are building capacity, conducting research to develop and identify post-harvest innovations to benefit maize farmers, and identifying pathways that can create access to these technologies and impact at scale in Ghana.

## PHLIL ACTIVITY FINDINGS AND FARMER PREFERENCES GUIDE DECISIONS ON POST-HARVEST TECHNOLOGIES

**Drying:** The team tested the Solar Bubble Dryer (SBD), which runs on energy from the sun, along with the Solar Biomass Hybrid Dryer (SBHD), which can be powered on biomass when solar power is limited, against open sun drying. The SBHD has proven effective at drying and disinfesting (killing insect pests) large amounts of maize, regardless of weather conditions and sunlight. Additionally, the dryer can be used to dry grains and other produce such as vegetables, roots and tubers, and fruits. As such, the SBHD is much more promising for reducing and preventing PHLs than the SBD alone.

**Storage:** PHLIL evaluated storage containers for a range of actors, from on-farm use to adoption at aggregation points. Hermetic bags, which prevent air and water from coming into contact with stored grain, including GrainPro, PICS and ZeroFly hermetic bags were assessed against technologies including polypropylene (PP) bags, jute bags, insecticide-treated PP bags and insecticide-treated jute bags.

ZeroFly hermetic bags are more effective than PP bags in terms of reducing insect populations, insect damaged kernels, and percent weight loss. The bags can be highly effective for long-term storage, if insect-free grains are stored in them. Collaboration between the PHLIL Ghana team and Vestergaard Frandsen has helped produce a new generation of more effective, hermetic ZeroFly bags. The hermetic ZeroFly bag is more effective and set to be prices lower than other hermetic bags. Additionally, the hermetic ZeroFly bag has a slow release insecticide-incorporated outer bag unlike other hermetic bags that repel pests.

**Mycotoxin and Grain Moisture:** The team compared the John Deere moisture meter and low-

Vestergaard, Agri Commercial Services Ltd. and PENS Food Bank.



cost PHL moisture meter and discovered that the PHL meters performed better and are more versatile compared to the John Deere meters. An assembly lab to produce the PHL Moisture Meter was established at KNUST, and the formal launch of the Ghana-based production of the meter took place in November of 2017.

KNUST continues to collect mycotoxin baseline data in stored maize. The heaping of maize, heaping harvested cobs on the ground or another material, is commonly practiced by farmers for a few days before shelling. The analysis of early collected data showed that heaping maize prior to primary processing increases aflatoxin beyond the acceptable limit set by the Ghana Standard Authority and should not be practiced.

### PHLIL'S WORK SUPPORTS NATIONAL PRIORITIES OF GHANA

PHLIL's efforts in Ghana support the country's agriculture development strategy, focusing on improved agricultural performance in the post-harvest stage of the value chain. The increased availability of food and provision of safe food associated with PHLIL's work provides pathways to increased nutritional status, greater recognition of health, a transition out of poverty, and the tools necessary for children to adequately learn, develop and prosper.

**Agriculture development is the key to economic growth and poverty reduction in Ghana.** The agricultural sector is recognized as having a greater impact on poverty reduction than any other single sector. In order to leverage the impact it is necessary to remove agricultural constraints such as limited human capacity and management skills, poor technology development and dissemination, inadequate infrastructure and market access, food insecurity, and gender inequality. A lack of women-friendly and time-saving technologies, in addition to inequitable extension, limits women's productivity and profitability. All farmers are lacking post-harvest management skills, relevant technologies and post-harvest infrastructure, which limits income growth.

Policies such as the Food and Agriculture Sector Development Policy, the Medium Term Agriculture Sector Investment Plan, Gender and Agricultural Development Strategy, and the National Climate – Smart Agriculture and Food Security Action Plan of Ghana include objectives to enhance human capacity in technology and improved practices, ensure women

access to gender-friendly technologies and agricultural inputs, improve accessibility to markets, and improve the dissemination of relevant technologies.

**Agricultural productivity and food security depends on improving quality seed production and supply to farmers.** Currently, certified maize seeds are less than 10 percent of the needed level, and only five percent of smallholder farmers have access to certified seed. Inadequate seed production, processing, storage and quality assurance capacity have challenged the seed industry, which is primarily comprised of informal seed producers. The private sector has been identified as responsible for the commercial components of the seed industry, with interventions laid out to support this role. A number of policies have focused on the issues constraining seed production and dissemination, providing policy directives to increase quality production and support the development of the private sector as certified producers.



**Climate resiliency must be mainstreamed into policies and sectoral activities to achieve sustainable growth.** There is already evidence of the impacts of climate change on food and nutrition security in Ghana. As such, national agricultural goals and objectives have been enhanced to become climate-smart. The National Climate-Smart Agriculture and Food Security Action Plan is focused on developing climate-resilient agricultural and food systems in addition to human resource capacity for climate-resilient agriculture. Reducing PHL is a major priority area in the Action Plan with improvement noted in management and capacity-building activities, and relevant technologies such as community drying sources, solar drying, and proper storage structures.

**Reducing and preventing PHL supports improved health and nutrition outcomes through women's empowerment.** Gender equality is cited as the single most important determinant of food and

nutrition security and consequently, plays a major role in PHL and the related impacts.<sup>2</sup> Women are involved in all aspects of agriculture, even with male-dominated crops such as maize, with a heavy role in processing, storage and marketing. Despite having similar needs as it relates to storage, women involved in agriculture have less access to agricultural inputs than men.

Women are responsible for meal preparation and ensuring her family is consuming an adequate diet. Losses at the drying and storage stages result in less grain for consumption and/or for sale to purchase other nutritionally-diverse foods. If women have less income to purchase food, they are forced to take on income-generating activities in order to earn money for adequate food supplies. At mealtimes, while men, women and children eat from the same pot, in male-headed households, the man may get the biggest and best portions of food. Any shortage of food or income for food due to PHL will further ravage a woman's nutritional status.



Access to and adoption of PHL-reducing technologies leads to reduced PHLs and impacts women's empowerment. When agricultural and household activities are combined, women work longer hours than men, making time-saving agricultural technologies critically important.<sup>3</sup> Adoption and use of time-saving technologies for women reduces the amount of time she spends on drying and storage activities. This time can now be spent on homestead gardening, income-generating activities, pursuit of healthcare, or education. Reducing women's time further allows them to improve resiliency to climate change through participation in community decision-making, learning

about adaptation strategies or investing in new livelihoods.<sup>4</sup>

Women are not only tantamount to sustainable reductions in PHL but also beneficiaries of the improved productivity that may translate into personal health, nutrition, and education opportunities. Furthermore, women have frequently been shown to have greater impact on the health, education and nutrition of children when they benefit from the increased opportunities and incomes that increased productivity allows.<sup>5</sup>

## THE PATH FORWARD REQUIRES MULTI-SECTORAL COLLABORATION AND ACTION

PHLIL has and continues to support the Government of Ghana in its' agriculture and food-led strategy for economic transformation. Raising the capacity of farmers to reduce and prevent PHL in addition to increasing productivity paves the way for attainment of a sustainable and dependable food system.

To truly make progress, the path forward must support scale up and adoption of PHLIL innovations. A sustainable food system, free of maize losses, requires full participation, holistic approaches and partnerships from all sectors. The following specific calls to action to each stakeholder group will help reduce PHLs and create the food system envisioned for Ghana.

### UN/Multi-laterals:

- **Share and promote PHL-reducing technologies.** UN agencies, international and regional institutions provide unparalleled technical support, leadership, capacity development, shape the research agenda and facilitate partnerships that support sustainable food systems. Sharing and promoting the PHL-reducing technologies will create a more enabling environment for dissemination, adoption and scale of the innovations.
- **Help strengthen public-private collaboration to improve PHL outcomes.** Successful delivery and adoption of PHL technologies require a multi-sectoral approach with multi-level support and engagement in place. UN agencies and multi-

<sup>2</sup> De Schutter, O. (2013). Gender equality and food security: Women's empowerment as a tool against hunger.

<sup>3</sup> USAID. (2014). APSP.

<sup>4</sup> UNDP. UNDP Climate Change Adaptation: Impact Gender - Time Poverty.

<sup>5</sup> De Schutter. (2013).

lateral institutions can engage stakeholders and facilitate efforts across a range of sectors for the greatest impact.

#### Government:

- **Include PHL-reducing technologies within Planting for Food and Jobs program.** Knowledge of PHL and profitability are critical components of farmer practices and adoption of new techniques. The Planting for Food and Jobs program has an opportunity to include information and training on PHL-reducing technologies, in addition to subsidies for the technologies. A subsidy alongside training on the use and long-term financial benefits would make PHL-reducing technologies even more advantageous to farmers, improve accessibility and demonstrate the importance of post-harvest management.
- **Provide high-quality training on PHL reduction for extension agents.** Extension agents are a trusted source of agricultural knowledge and practices to farmers throughout Ghana, with a responsibility to disseminate agricultural technology. Ensuring this resource is adequately trained on PHL-reducing technologies is a critical link to on-the-farm PHL reductions, climate resiliency and improved production and profitability.

#### Donors:

- **Fund trials of dryers and hermetic bags by large audience of farmers.** Trial is an integral part of the adoption process but smallholders cannot afford to experiment with new technologies that may or may not impact an issue on the farm. In Ghana, farmers struggle to understand and appreciate the future benefits of a new technology so upfront investments challenge technology adoption. Allowing a large group of farmers with opinion leadership to try out the dryer and hermetic bags without the economic risk allows them to build an understanding of the long-term benefits, which supports increased adoption.
- **Frame PHL solutions within national priorities for increased action.** Reducing PHL links to economic growth, food systems strengthening, farmer resiliency, improved markets, gender equity, and nutrition security. Making the link between PHLIL practices and technologies to national priorities will allow for increased PHL efforts and impact.

#### Research Institutions:

- **Focus research into specific impact points along the value chain.** PHL can occur at different impact points along the value chain. While losses of any dimension challenge a farmer's productivity, health, and well-being it is important to take into account the cost of investment and consequent benefit with specific attention to the impact points of loss. Research into PHL reduction must focus on specific points of the PH pathway to support reduced PHLs and agricultural development.
- **Tailor research findings for specific audience groups.** Research drives investment, needed interventions, and helps build awareness. It is critical that research findings be tailored to resonate with specific stakeholder groups that may not be familiar with or close to the research.

#### Private Sector:

- **Assess the benefit of PHLIL technologies for seed production.** Seed industry challenges include inadequate seed processing, storage and quality assurance capacity. PHLIL technologies can also address many of these challenges. Additionally, the technologies are user-friendly, which supports national efforts to include farmers in seed production.
- **Educate producers on technology benefits.** The long-term cost benefit of investing in PHL-reducing technology upfront for increased financial generation later is not well understood. The private sector has the skills and assets to create a compelling case that will resonate with farmers and support technology adoption.

**“The issue of post-harvest losses is increasingly threatening to plunge Ghana into a food insecure country and therefore needs a multi-stakeholder commitment to address the problem.”**

*- Eric Banye, Country Program Coordinator, SNV*

The U.S. Government's Feed the Future initiative is

“Feed the Future harnesses the power of American development leadership and innovation to partner with host governments, and community leaders and the private sector to build resilient communities with the goal of helping people stand on their own two feet, no matter what challenge may come their way.”

- USAID Administrator Mark Green

#### **Civil Society:**

- **Promote PHLIL PHL-reducing technologies in programming.** Reducing PHLs impacts agricultural productivity, income, gender, nutrition and health of farmers. Alignment with other priority sectors allows for a wider audience to be exposed to and trained on PHL-reducing technologies from trusted entities, while addressing key impact areas of training activities.
- **Provide education and advocacy on PHL and PHLIL technologies.** Awareness and education on the issue of PHL and its' impact along the value-chain cannot be performed by government extension agents alone. NGOs and other institutions are needed to increase farmer awareness about post-harvest issues and identified solutions.

### THE U.S. GOVERNMENT'S COMMITMENT TOWARD A PROSPEROUS AND RESILIENT GHANA

Ghana's international relation policy objectives have long been guided by social and economic development priorities, with a priority to leverage economic and technological opportunities for sustainable development. As such, the country has been open to partnerships with institutions and countries, such as the United States, that support economic and social development. Through strategic cooperation, Ghana continues to create sustainable and inclusive economic growth, improve health and nutrition, drive agricultural growth and ensure food security.

tackling root causes of poverty, hunger and malnutrition. Through the Innovation Labs, it has propelled innovative research and academic institutions forward, and fostered mechanisms to develop, test and scale technologies and approaches that can have a transformative impact on the lives of the poor around the world. Due to its' commitment to food security investment, potential for agricultural growth, and to sustain the successful partnership and development gains made, Ghana was selected as one of the target Feed the Future countries.

Together, with a range of in-country institutions and leaders, the Feed the Future Post-Harvest Loss Innovation Lab can address PH technology adoption challenges, build upon strengths and achievements to date, foster awareness and engagement to improve post-harvest practices, and support the country's leadership in building a vibrant food system through tools and technologies that hold the promise of great impact at scale.

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