

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

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



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ETHIOPIA'S PATHWAY TO PROGRESS

The Federal Democratic Republic of Ethiopia has consistently demonstrated the political will and a long-standing commitment to fighting poverty, improving health and nutrition outcomes, and improving livelihoods. The country has invested heavily in building country-level capacity to ensure sustainable growth and development, while ensuring the benefits are inclusive. Ethiopia has demonstrated tremendous leadership in supporting and implementing high-impact interventions to support environmental health, gender equality, improved nutrition and health, climate change adaptation and mitigation, and improved livelihoods. The track record is clear.

The UNDP notes the role of high economic growth and pro-poor investments in reducing poverty in Ethiopia. Over 2 million people have been lifted out of poverty, and the portion of the population living in poverty has been declining since 2004. In addition to increased primary school coverage and enrollment rates, more girls are able to attend school with an increase from 21 to 49 percent enrollment in the past two decades. While food insecurity and malnutrition remain too high, there has been progress in reducing malnutrition over the last decade. The adoption of improved technologies and practices on the farm more than doubled from 2009 to 2014, contributing to the country's agricultural development and productivity goals. While there is more to be done, the United Nations recognized Ethiopia's monumental efforts in achieving the Millennium Development Goals and selected the country as one of the top 50 countries tasked with providing data in preparation of the 2030 Sustainable Development Agenda.

The UNDP notes that the Ethiopian Government's track record of monitoring, evaluating and fine-tuning policies, strategies and policies to ensure inclusive impact is the foundation to Ethiopia's progress in transforming poverty, livelihoods and hunger and food security. It is this capacity that will allow Ethiopia to achieve the national vision of becoming a middle-income country by 2025 while ensuring no one is left behind. This foundation of success is one that Ethiopia is determined to build upon, with a focus on mainstreaming gender equity, improving access to post-harvest innovations, supporting the commercialization of smallholder agriculture,

ensuring climate-resilient approaches, and removing obstacles to the mechanization of agriculture.

TACKLING AGRICULTURAL, ECONOMIC AND NUTRITION CHALLENGES

Ethiopia's economy is heavily dependent on agriculture, accounting for 41 percent of the gross domestic product, 84 percent of exports and nearly 80 percent of employment. As such, this active sector has been identified as the primary vehicle for transformation into a middle income country by 2025. Chickpea and sesame are major crops for both domestic consumption and export, with sesame the second biggest export crop in terms of value. Maize, wheat and teff account for 77 percent of all cereal production, and Ethiopia is the fourth largest maize-producing country in Africa.



A critical factor of Ethiopia's planned economic transformation is the transition of smallholder farmers, which comprise nearly all agricultural production, and pastoralists from subsistence-based farming toward broader agricultural commercialization for increased national agricultural productivity. Agricultural productivity is severely limited by lack of access to agricultural inputs such as credit, machinery and labor-reducing technologies, and utilization of agricultural technologies. In 2006, the State Minister of the Ministry of Agriculture identified the use of traditional farm tools and low level use of improved agricultural inputs as primary culprits in low national agricultural productivity.¹

Both exacerbating and stemming from productivity issues are high levels of post-harvest losses (PHLs). Traditional post-harvest practices for drying, moisture management, insect, mold and pest management, proper storage, and use of pesticides challenge

¹ Abraham Tadesse (ed.). 2008. Increasing Crop Production through Improved Plant Protection – Volume I. Plant Protection Society of

Ethiopia (PPSE), 19-22 December 2006. Addis Ababa, Ethiopia. PPSE and EIAR, Addis Ababa, Ethiopia. 598 pp.

consistent and uniform availability of grain, and overall agricultural productivity. Losses of chickpea, sesame, maize and wheat at various stages from production to storage can be as high as 13 percent. Reduced PHL has been prioritized by the Government as a critical component for increasing agricultural productivity, and as an essential component of an enabling environment for smallholder farmers to increase their productivity.

These post-harvest activities are predominately the responsibility of women, who lack access to agricultural extension, inputs, credit, and control over critical resources and assets. Women are also victims of workload, which manifests in PHLs, as the agricultural and domestic workload can negatively impact post-harvest practices, and leave little time for women to learn and train on time-saving agricultural technologies. Sociocultural factors that disempower women, impact overall agricultural productivity, incomes, and most importantly, their own and future generation's health, nutrition status and livelihoods.

Adoption and use of innovative inputs and machinery can enhance labor productivity, improve the efficiency and effectiveness of inputs, and reduce PHLs, leaving more production surplus for sale and consumption. Limited supply of and access to agricultural processing technologies that reduce women's workload is noted as a challenge in the Growth and Transformation Plan. As such, dissemination and adoption of productivity-enhancing technologies is a national priority.

Increasing agricultural productivity is essential to improved socio-economic, nutritional, and agricultural outcomes, and supports the Government's realization of becoming a middle-income country by 2025.

“We have more tools to transform agriculture than Asia had before the green revolution. What is needed is the will, the ability, and the commitment to take technology to scale and by so doing reach tens of millions of farmers.”

- Dr. Akinwumi A. Adesina, President, African Development Bank

Through the USAID-funded Feed the Future Innovation Lab for the Reduction of Post-Harvest (PHLIL), Kansas State University (KSU), Mekelle University (MU), Bahir Dar University (BDU) and South Carolina State University are working together on four key areas with significant post-harvest challenges: drying, storage, mycotoxin contamination and insect control of chickpea, maize, sesame and wheat. The collaboration involves the testing and evaluation of traditional drying and storage technologies against improved technologies, with considerations for socioeconomic, gender and nutrition contexts. The Ethiopia work also encompasses insect pest research, a severe challenge to reducing PHLs.

Through a phased approach BDU, MU and KSU are building capacity, conducting research to develop and identify post-harvest innovations to benefit farmers, and identifying pathways that can create access to these technologies and impact at scale in Ethiopia.

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

Drying: The team has selected the Solar Bubble Dryer and the Solar Cabinet Dryer to test and evaluate against the traditionally practiced open-sun drying. The dryers were tested in three different drying modes to measure variation in solar radiation, wind speed, temperature, relative humidity, and initial moisture content, which impacts the efficiency of the dryer. Sunny, clear weather and low humidity rates lead to more effective drying, though validation and adaptation of drying technologies is ongoing.

Storage: Hermetic bags, which prevent air and water from coming into contact with stored seed, including GrainPro and PICS bags were assessed against traditional technologies including polypropylene and jute bags, metal silos and plastic drums. PICS bags were found to be highly effective as compared to traditional storage technologies and work towards disseminating and validating storage interventions for beneficiaries continues.

THE POST-HARVEST LOSS INNOVATION LAB TACKLES POST-HARVEST CHALLENGES FOR PRIORITY CROPS.

Mycotoxin: The team evaluated storage options to prevent mycotoxin-producing mold growth for sesame, chickpea, wheat and maize. GrainPro and PICS bags were found highly effective as compared to traditional storage technologies in preventing mold growth and mycotoxins production. Trainings on mycotoxin management using hermetic storage bags were provided to farmers, regional quality control agents, technical specialists, university researchers and extension agents. These training sessions included an explanation of the risk of mycotoxins to human and animal health, testing methods for mycotoxins and demonstrations on storage management options.



Pesticides: During research characterizing post-harvest losses, and engagement of end-users while piloting drying and storage technologies, one critical area of concern that was identified is the unsafe use of pesticides. They are highly toxic and often misused by smallholder farmers and other value chain actors, including use without personal protective equipment and storage in the home. Training on safe handling and disposal of pesticides, standard applications, calibration techniques and pesticide formulations were provided to individuals involved in pesticide use. The team also evaluated methods to control insect pests during storage. Research into inert filter cake revealed that it is effective at controlling two primary insect pests on grain. Coupled with participatory research with hermetic bags on farm, the team has identified non-toxic, safe and ecologically friendly solutions to obviate the need for use of toxic pesticides.

PHLIL's efforts in Ethiopia support the country's agriculture development strategy, with a focus 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 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 productivity as a means of poverty alleviation and socio-economic development is a national priority. The agriculture sector comprises the largest portion of the economy and has been identified as the vehicle for leading Ethiopia's transformation, yet the smallholder farmers who comprise the sector primarily practice subsistence-based farming with low levels of productivity and profitability. Farmers are constrained by weak market linkages, ongoing drought conditions, low-input use, and lack of access to credit and other inputs. Female farmers are disproportionately impacted due to lack of access to and control over assets, resources, agricultural inputs, services, information, and property, which prevents profitability of agricultural activities.

The Agricultural Sector Policy and Investment Framework notes that post-harvest storage is a critical component of an enabling environment for smallholder farmers to increase agricultural productivity and transition out of poverty. Policies such as the Plan for Accelerated and Sustained Development to End Poverty, the Second Growth and Transformation Plan (GTP II), Agricultural Transformation Agenda, and the Agricultural Sector Policy and Investment Framework all focus on increasing the productivity and profitability of smallholder farmers, ensuring equitable opportunity to agricultural inputs, while practicing sustainable use of natural resources.

PHLIL technologies support agricultural productivity and profitability. Additionally, the technologies are gender-sensitive and provide women with opportunities for poverty reduction, economic empowerment and empowerment in decision-making capabilities.

“Africa’s agriculture will be modern and productive, using science, technology, innovation and indigenous knowledge.”

- Africa Agenda 2063

PHLIL'S WORK SUPPORTS NATIONAL PRIORITIES OF ETHIOPIA.

National agricultural goals depend on improving quality seed production. The current national seed supply falls dramatically short, covering less than 10 percent of the total agricultural land, which limits national agricultural productivity. The Government has identified overcoming seed shortages through national-level production as a priority in the GTP II, with investments going to training and development of improved infrastructure. The dryer and hermetic bags are accessible, easy-to-use technologies that are critical to quality seed production. A number of seed producers provided with PICS bags by the PHLIL Ethiopia team were pleased with the performance of the bag and expressed desire and need for the innovation.

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.² Post-harvest activities such as drying and storage are primarily women's responsibility, but women have little to no economic empowerment or leadership within the home as it relates to post harvest, and lack access to agriculture extension training and information.

Women are responsible for any losses or damage that occurs during storage and adopt detrimental actions to hide losses from the men. In some cases women serve men the good quality grains for so they won't find out about grain damages, and consume the damaged grains for themselves and their children. Women even use chemical treatments on grains above recommended standards for fear of men's responses when they learn of the losses. It has even been reported that women may use the chemically-treated grain for household consumption.

Losses at the drying and storage stages result in less grain for consumption and/or for sale to purchase other nutritionally-diverse foods. Women are the last to eat, left with whatever remains after the man and children have eaten. Any shortage of food or income for food due to PHL will further ravage a woman's nutrition status. Mycotoxin contamination may not be

noticeable in stored grain, or the severity of the fungus may not be known. Consumption of mycotoxin-contaminated grain has a range of health implications including immunity suppression, impaired growth, nutritional interference, liver cancer and death³.



Adoption and use of time-saving technologies by women reduces the amount of time she spends on drying and storage, traditionally time-intensive activities, and allows for best practices to be carried out. This time can now be spent on homestead gardening, income-generating activities, pursuit of healthcare, or education. Reducing women's time poverty further allows them to improve resiliency to climate change through participation in community decision-making, learning about adaptation strategies or investing in new livelihoods.⁴

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 allows⁵.

Human capacity development is needed to drive and sustain inclusive economic growth.

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

³ Ochieng, P. J., Okun, D., Runo, S., Njagi, N. J., & Murage, J. (2013). Public Health Strategies for Preventing Aflatoxin Exposure. *BJC*, 45, 1-22.

⁴ UNDP. UNDP Climate Change Adaptation: Impact Gender - Time Poverty.

⁵ De Schutter. (2013).

Sustainable economic growth and transformation requires a labor force equipped with the knowledge and skills to be a driver of economic growth and a participant in economic activities. Human capacity development, especially as it relates to agriculture, is an area of national focus. The National Strategy for Ethiopia's Agricultural Extension System was adopted to increase farmer capacity for adoption and use of yield- and quality-enhancing agricultural technology. Capacity-building and training are important aspects of PHLIL's work in Ethiopia with over 200 farmers and agricultural extension experts having received training on proper use of hermetic storage containers, operation of moisture meters, the importance of proper grain drying, mycotoxin analysis, and best management practices to reduce PHL. The Ministry of Agriculture noted its support and desire to collaborate through capacity building and dissemination of PHLIL technologies.

THE PATH FORWARD REQUIRES
MULTI-SECTORAL COLLABORATION AND
ACTION.

PHLIL has and continues to support the Government of Ethiopia in its' agriculture-led strategy for economic growth. Raising the capacity of smallholder farmers to reduce and prevent PHL is a critical aspect to the commercialization of agriculture, through reduced losses, improved quality, lower costs of production and saved time.

To truly make progress, the path forward must support scale up and adoption of PHLIL innovations. A sustainable and productive agricultural sector, free of PHLs, 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 agricultural transformation envisioned for Ethiopia.

UN/Multi-laterals:

- **Share and promote PHLIL 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 PHLIL PHL-reducing technologies will create a more enabling environment for dissemination, adoption and scale of the innovations.
- **Help strengthen public-private collaboration to improve PH outcomes.** Successful delivery

and adoption of PH technology requires a multi-sectoral approach with multi-level support and engagement in place. UN agencies and multi-lateral institutions can engage stakeholders and facilitate efforts across a range of sectors for the greatest impact.

Government:

- **Create an enabling environment for private sector participation.** The country's goal of moving from subsistence based agriculture into market-oriented agriculture depends on a vibrant private sector. Packages that attract private enterprises and encourage private investors are needed to strengthen the capacity of the private sector, and its involvement in Ethiopia's economic growth.



- **Provide high-quality training on PHL reduction for extension agents.** Extension agents are a trusted source of agricultural knowledge and practices to farmers throughout Ethiopia. Ensuring this resource is adequately trained on PHL reduction is a critical link to on-the-farm PHL reductions. Additionally, PHL reduction training should be gender-sensitive and focus on creating extension opportunities for female farmers.

Donors:

- **Fund trial of dryer 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. Allowing a large group of farmers with opinion leadership to try out the dryer and hermetic bags without the economic risk not only increases their overall adoption, it also supports adoption at scale.

- **Frame PHL reduction 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 post-harvest 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:

- **Engage with the public sector to create an effective public-private partnership.** National objectives to engage the private sector in agriculture have fallen short. To enable an

effective partnership, the private sector should engage the public sector to discuss enabling legal, regulatory and investment frameworks.

- **Provide education and training support.** The private sector can support education and training in post-harvest technologies, especially to overlooked groups such as women.

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 entities.
- **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.
- **Integrate PHLIL technologies into seed-producing cooperatives.** There are nearly 300 seed-producing cooperatives throughout Ethiopia but most fail to meet regulatory requirements to become accredited institutions. PHLIL technologies are accessible and easy-to-use inputs that could help cooperatives enhance capacity.



“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

THE U.S. GOVERNMENT COMMITMENT TOWARD A PROSPEROUS AND RESILIENT ETHIOPIA.

Ethiopia's foreign and security policy was built around the elimination of poverty through development and economic initiatives. As such, the country has been open to partnerships with institutions and countries that support people-centered development and prosperity. Ethiopia has a long-standing relationship with the United States, which is engaged in capacity-building and development partnerships with countries around the world. This relationship is an example of one of the most effective development partnerships, especially in the areas of health, food security and nutrition.

The U.S. Government's Feed the Future initiative is 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, Ethiopia was selected as one of the target Feed the Future countries.

Moving forward, the Feed the Future Post-Harvest Loss Innovation Lab will continue working with Ethiopia to 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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