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

FEED THE FUTURE ETHIOPIA GROWTH THROUGH NUTRITION ACTIVITY

Piloting, adopting, and diffusing nutrition-sensitive postharvest technologies

BACKGROUND

Through its Feed the Future initiative, the U.S. Agency for International Development (USAID) partners with the Government of Ethiopia (GOE) to invest in food security, build resilience, and accelerate economic growth. The Growth through Nutrition activity is USAID's flagship nutrition and water, sanitation, and hygiene (WASH) investment, a six-year (2016-2022) project that aims to improve the nutritional status of women, young children, and adolescents in six regional states of Ethiopia (Southern Nations, Nationalities, and Peoples', Oromia, Amhara, Sidama, Southwest Ethiopia People's and Tigray regions). The project works across multiple sectors in close coordination with the Ministries of Agriculture; Health; Education; and Water, Irrigation and Energy.

Growth through Nutrition focuses on improving early childhood nutrition during the first 1,000 days, from pregnancy through a child's second birthday, a critical window of opportunity for a child's growth and development. It does this through joint implementation of multi-level, evidence-based interventions in livelihood and agriculture, social and behavior change, quality improvement of nutrition services, improved WASH practices at household and community levels, and sectoral capacity strengthening via pre-service education support. Save the Children leads a consortium of local and international partners to implement the Growth through Nutrition activity.

CONTEXT IN ETHIOPIA

While much has been done to address food insecurity in Ethiopia, very little has been aimed at improving postharvest yields. Millions of Ethiopian smallholder farmers produce fruit and vegetable crops for food and income; however, government figures indicate that an estimated 30 percent of fruits and vegetables are lost through postharvest activities such as transportation, storage, and consumption.[1] Estimates suggest that postharvest, two percent of raw milk and four

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percent of pasteurized milk is lost across the whole value chain.[2] Furthermore, food production in Ethiopia is facing additional challenges due to land shortages and increased weather variability caused by climate change.[3] Together, poor postharvest handling (PHH) and low food production are leading contributors to nutrition insecurity and a lack of diverse foods, key issues that Growth through Nutrition is working to solve.

Food and nutrition security requires the year-round availability of healthy foods and crops with no significant postharvest losses. Growth through Nutrition aimed to ensure nutrition security in its target communities by improving and diversifying agricultural production as well as reducing postharvest losses of fresh vegetable produce and animal source foods (ASF). To do this, Growth through Nutrition reviewed and identified available, contextually feasible postharvest handling technologies for ASF, fresh vegetables, and fruits. Postharvest loss occurs at all stages, from harvest to consumption, therefore the project focused on integrated and sustained efforts to minimize postharvest losses. In a rapid baseline assessment spanning the last 30 years, Growth through Nutrition found that a mere five percent of research investments went towards reducing postharvest loss, while 95 percent focused on increasing productivity.[4] Knowledge and technologies related to postharvest handling are limited in Ethiopia, particularly for highly perishable food products such as ASF (milk, meat, fish, and eggs) and fruits and vegetables.

Postharvest loss *can be defined as the degradation in both quantity and quality of a food product from harvest to consumption. Both qualitative and quantitative losses happen due to inefficient harvesting practices, inadequate processing and preparation, and inadequate storage practices.*

- ***Quality losses*** *include those which affect the nutrient or caloric composition, acceptability, and edibility of a given product*
- ***Quantity losses*** *refer to the loss of the amount of a product*

THE APPROACH

As part of its livelihoods and agriculture support, Growth through Nutrition implemented activities to increase smallholder farmers' and vulnerable households' access to diverse, safe, and quality foods through the promotion of nutrient-dense crops and small livestock and the use of improved inputs (e.g., seeds), cultivation practices, and PHH practices. By introducing and/or spreading improved PHH practices and technologies, the project aimed to help rural households keep their produce for a prolonged period of time and ensure year-round access to nutritious food.

To foster improved PHH practices, Growth through Nutrition identified feasible postharvest technologies, in close collaboration with relevant stakeholders, supported the production, piloting, and modification of selected PHH practices and technologies, facilitated field-tested, informed capacity strengthening sessions, and supported awareness creation activities around these new technologies for the wider community.

Collaborative identification and testing of feasible and locally applicable postharvest technologies

Growth through Nutrition organized stakeholder consultation workshops with experts from key institutions to identify potential PHH technologies that farmers could adopt, including solar dryers, evaporative cooling chambers, and potato harvesters. In addition, the preparation of *Metata Ayib*, a fermented cottage cheese (*ayib*) from West and East Gojam in Amhara which is preserved in spices and can last for more than eight years at room temperature, was selected as a traditional cottage cheese preservation practice that can be adopted in other milk productive areas.

Growth through Nutrition collaborated with the USAID Innovation Lab consortium, including Melkasa Research Institute, Hawassa University, Bahirdar University, and Mekele University, to develop prototypes for potato harvesters, evaporative cooling chambers, and solar dryers and conduct trials of the improved designs. Once trials were completed and the models deemed effective, Growth through Nutrition promoted the local manufacture of prototype technologies for the affordable use and adoption by small scale farmers and households.

Using the prototypes, Growth through Nutrition piloted five cabinet solar dryers and five evaporative cooling chambers

at five farmer training centers (FTCs) and tested over 100 potato harvesters with farmers in 50 potato producing woredas across five regions. The project tested solar dryers with locally available products. In Sidama they dried fish, vegetables, moringa, and berbere, in Amhara they dried vegetables, banana, mango, fish, and berbere, and in Wolega, coffee, vegetables, and fruit. Growth through Nutrition tested the potato harvester in the Enchini, Gaynt, and Awi zones of Amhara and Hawassa University in Sidama tested the cooling chamber.

Local capacity strengthening activities on PHH technologies and practices

Informed by field tests, Growth through Nutrition developed manuals and facilitated trainings among Development Agents (DAs), farmers, and manufacturers on major PHH topics, including an overview of postharvest losses of ASF in Ethiopia and how to prevent postharvest losses of vegetables, fruit, and staple crops. To facilitate farmers' access to and utilization of the tools, Growth through Nutrition also trained 12 workshop owners on potato harvesters and cabinet solar dryers and provided them with prototypes to reproduce and sell to users. To improve the preservation of dairy products, the project provided practical and theoretical training on traditional *Metata Ayib* production.

Awareness creation within the wider community to facilitate adoption and spread

Following trainings, mainly at FTCs, Growth through Nutrition supported woreda Agriculture Extension Workers and DAs in organizing field days to demonstrate new PHH practices and technologies to the surrounding community.

Linking local farming communities (e.g., FTCs) with government institutions to sustain PPH technology

Growth through Nutrition linked FTCs with the community service departments of the higher learning institutions which developed and tested the PHH technologies. This will facilitate the continuous modification of PHH technologies and nurture need-based identification and adoption of new PHH technologies.

RESULTS AND LESSONS LEARNED

Metata Ayib

The indigenous *ayib* preservation practice is technically simple, utilizes locally available resources (a clay pot or gourd, *ayib*, salt, and locally produced spices), and, in addition to its long shelf-life, is in high demand for its medicinal value. *Metata Ayib* is prepared at room temperature or ambient conditions, and its market price is four times higher than the price of *ayib* alone. Growth through Nutrition's rapid assessment indicated that, if prepared by smallholder dairy farmers and made available for household consumption throughout the year, *Metata Ayib* can help to reduce postharvest loss and provide additional income.

Spices	g spice per kg cheese	Oromifa
Mustard (Gomen zer)	123	Gomanzaara
Shallot (Key Shinkurt)	100	Qulubii Diima
Garlic (Nech Shinkurt)	87	Qulubii Adii
Ginger (Zingibil)	72	Zingibilaa
Mixed spices	34	Mie'esiftuu Walmakaa
Salt	19	Sogiddaa
Mustard (Sinafich)	15	Sanafichaa
Coriander (Dimbilal)	13	Jimbilalaa
Thyme (Tosign)	9	Xosanyii
Basil (Besobila)	8	Basoo Bilaa
Black Cumin (Tikuer Azmud)	8	Sunqqoo Gurrachaa
Rue (Tena Adam)	7	Tenaa Adamii

Table 1: Type and recommended quantity of spice for 'Metata Ayib' preparation

Based on field test outcomes, Growth through Nutrition facilitated training for dairy-producing women, small scale dairy producers, and extension workers and promoted *Metata Ayib* by detailing the amount of spices required for its preparation, as shown in Table 1. The standardization of this practice and inputs for preparation require further work. Similarly, as the level of adoption and spread of the practice following training sessions and demonstration events are not systematically tracked, subsequent actions should be taken to scale this PHH practice.

Photo 1: Training farmers how to use the improved potato harvester

Potato Harvester

Potatoes in Ethiopia are harvested using hand tools such as hoes or pickaxes or with a traditional plowing tool called a *Maresha*. Both methods result in huge postharvest losses and farmers must make multiple passes with these tools before the tuber is fully harvested.[5] Furthermore, harvesting a field of potatoes using these tools requires many laborers and results in mechanical damage to the crop. These tools therefore have a high cost of production. To address these challenges, Melkassa Agricultural Research Center developed a simple potato harvesting tool which reduces plowing time by 50 percent and results in a tuber with little soil or mud attached and no mechanical damage. The project equipped several model farmers and farmers' cooperatives with the new tool and provided demonstrations and training on its use. Farmers reported that the new harvester is ergonomic, safer, and requires less effort than traditional tools. Farmers also mentioned that the tool could be used to harvest other crops and dig furrows for irrigation.

Growth through Nutrition's rapid assessment of the utilization of potato harvesters by farmers revealed that those who participated in the demonstration accepted the tool and appreciated that it is more efficient than the *Maresha*, saves time, and reduces the quantity of damaged potatoes, increasing their quality and marketability. They also mentioned that its cost might not be significant considering its time savings and quality improvement effects. On the other hand, they reported that the harvester can be heavy for plowing oxen. The project is working with local manufacturers to address these concerns.

Evaporative Zero Energy Cooling Chamber

While the natural decomposition of harvested products cannot be stopped, it can be slowed with the right postharvest processing techniques, like cooling and drying. Growth through Nutrition promoted evaporative-cooled storage as a simple, low-cost option for households to extend the shelf life of nutritious fruit and vegetables.

Evaporative zero energy cooling chamber technology cools fresh produce by evaporating water through a porous surface to cool the air passing through by a few degrees, effectively preserving freshly harvested produce. This technology is mainly used at temporary holding points for fresh produce like leafy vegetables, green beans, and other vegetables before they are packed and marketed. Farmers can keep fresh vegetables for about a week in cooling chambers until they sell or use them. Tested at two FTCs, this technology preserved green vegetables for a week and tomatoes and carrots for over twenty days. Feedback from farmers indicated that keeping harvested leafy vegetables for three to five days in the cooling chambers kept them fresh and acceptable for the market, fetching a better price. Pilots also revealed that rural farming households can build their own cooling chamber using locally available materials with nearly zero operating costs. Field monitoring visits, however, showed that smallholder farmers were not adopting this practice mainly due to its initial cost. The design might need modifications using locally available inputs if it is to be promoted for household use. It can also be promoted among vegetable sellers and small scale agro-processing businesses.

Solar Dryer

Growth through Nutrition introduced two types of solar dryers, cabinet and chimney, in selected FTCs across five regions. Based on prototype testing conducted by Hawassa University, dried fruit and vegetable products processed using the solar dryers were of superior quality when compared to samples dried in the sun by the community. The drying process also took less time than the traditional open air drying process, as the temperature of solar dryers are six to nine degrees Celsius higher than ambient temperatures. Solar dryers were used to dry fish, vegetables, moringa, berbere, banana, mango, and coffee at different piloting institutions, depending on local availability. The dryers removed 85 to 91 percent of the moisture from carrots and onion and microbial test results were in line with food standards as long as the produce was properly cleaned before drying.

Results from an assessment conducted by Hawassa University demonstrated that drying technologies using solar radiation could be constructed and used during clear and dry seasons to preserve food and cash crops. This would help to reduce the postharvest loss of valuable crops and retain nutrients, greatly contributing to food and nutritional security as well as enhancing rural livelihoods. At Wayu Tuka FTC in Oromia region, development agents demonstrated the use of the solar dryer to dry coffee, fish, and vegetables. In Bekele Girissa, seventeen FTC farmers (six female) dried moringa leaves, fish, and green pepper. In Tigray, a complementary food producing women's group from 18 most vulnerable households dried cabbage as an ingredient in complementary foods. These local adaptations show that local experts and community members can drive further experimentation of accepted technologies based on community demand.

Project monitoring visits showed continued use of the solar cabinet in a few FTCs, but due to the high production cost, the practice is not being adapted at the household level. It can, however, be used for commercial purposes to provide drying services for valuable cash crops and the communal preparation of complementary foods. Field visits have shown the need for simultaneous promotion of proper food handling and storage in supporting FTCs alongside the introduction of these technologies. Growth through Nutrition is currently working with Hawassa University to make this technology more affordable at the household level.

RECOMMENDATIONS

- Investments to introduce PHH technologies benefit from **initial collaborative engagement with research institutes, higher learning institutions, and relevant stakeholders** by building on current PHH best practices rather than starting anew. On the other hand, community engagement, beginning with the identification of demand-driven technology, increases their acceptability and can address potential concerns at the design stage.

Photos 2, 3, and 4: Left and right, potato harvesting demonstrations using the improved potato harvester. Center, a demonstration solar dryer

- Feasibility and pilot studies of innovative PHH technologies **should consider the cost implications for targeted users of the technologies**, as cost has been shown to be a major limiting factor for the use of these technologies at the household level.
- Promotion of postharvest handling technologies should go hand in hand with the **promotion of safe food handling, storage, and preparation**.
- Implementing PHH technologies in **collaboration with small scale agro-processing businesses** facilitates the dissemination and uptake of these technologies.
- Future investments in PHH should **institute a monitoring system, such as a periodic survey, to track the adoption of PHH technologies, food safety, and community diffusion of practices**. Monitoring allows projects to identify what works and which areas need modification and to respond to emerging needs.
- There is a need to **increase investment in studies that will adapt available or develop new PHH technologies**. One strategy would be strengthening partnerships created with higher learning institutions and local farming communities to foster locally applicable assessments, monitoring, and continued improvement.

Recommendations specific to project-supported PHH technologies include:

- The dimensions and materials used for the solar dryer could be refined to minimize cost without compromising efficiency through the **continued engagement with research institutes and higher learning institutions to modify designs**.
- The **dimensions of the cooling chamber may be adjusted**, i.e., increasing the length and decreasing the width, to lower temperatures in the chamber more quickly. Ongoing assessments conducted with higher learning institutions can further inform the specific recommendations for modifying drying and cooling technologies.
- Demonstrations of drying and cooling **should include the right products and necessary cleaning and other pre-treatments** to improve the efficiency of the processes and the quality of the final products.
- The quantity and types of spices used for *Metata Ayib* preparation is not yet standardized. Spices determine its taste, nutritional content, microbiological quality, and shelf-life. Further investigation is required to **standardize *Metata Ayib's* spice content and microbiologic safety**.

CONCLUSION

Improved postharvest technologies have the potential to reduce food insecurity and make diverse, nutritious foods available all year long. The PHH technologies demonstrated by Growth through Nutrition, such as *Metata Ayib*, potato harvester, cooling chamber, and solar dryer, are acceptable to farmers and can extend the shelf-life of crops and cheese and reduce postharvest loss of crops and potatoes. These technologies can be constructed out of locally available and inexpensive materials, which is key to their affordability and sustainability. Small scale producers and traders who may not have access to refrigeration facilities could profit from PHH technologies like the zero energy cooling chamber. The Extension Directorate of the Ministry of Agriculture (MOA) should introduce and scale up these technologies through FTCs to more regions and districts as part of its PHH activities and plan. The MOA, in collaboration with agricultural research institutes, universities, and partners, should refine these technologies to improve their efficiency and acceptability by farmers, reduce costs, address food safety concerns, and involve local vendors, workshops, and youth in their production and sale to farmers.

References

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This product was prepared by Save the Children. It was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of and do not necessarily reflect the views of USAID or the United States Government.