i-ACES Vol. 2 No. 1 (2016)
Inquiry in ACES: An Undergraduate Research Journal
College of Agricultural, Consumer and Environmental Sciences
University of Illinois at Urbana-Champaign

i-ACES
{inquiry-ACES: Highlights of Undergraduate Research in ACES}

Developing International Connections and Consensus to Reduce Postharvest Loss

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ARTICLE INFO

Article history:
Received 16 January 2016
Accepted 2 April 2016

Keywords:
Postharvest loss, Congress, gender, scaling-up, sustainable

ABSTRACT

The ADM Institute at the University of Illinois Urbana-Champaign held the First International Congress on Postharvest Loss Prevention in Rome, Italy to bring together various researchers and people from organizations around the world to network and provide insight into methods of reducing postharvest loss (PHL) globally. PHL presents a significant threat to food security now and in the future because of the tremendous amount of food lost along with the time and inputs lost with it. The other goal of the Congress was to reach a consensus on key areas along the food supply chain that organizations should focus on in order to significantly reduce PHL. The participants at the Congress agreed on emphasizing proven technologies by connecting smallholders to the private sector and implementing them on a large scale in a sustainable manner. Solutions are sustainable when they are implemented in a regional context that accommodates to the needs of all members of the community, especially women, when education and training allows members of the community to maintain them, and when they have a minimal environmental impact.

INTRODUCTION

Eight hundred and seventy million people around the world are currently undernourished (ADM Institute 2015). With a rising global population expected to reach 9.5 billion by the year 2050, the number can only increase if the current agricultural practices and processes continue, making the issue of food security for all people ever more critical. With the increased population looming in the future, an estimated 95 percent of agriculture research is dedicated to provide more food by increasing crop yields. Yet, there is already an abundant amount of food harvested that could contribute to feeding the currently malnourished and the future increased population. However, the food is not reaching the people who need it the most because of one the greatest challenges to agricultural production, postharvest loss (PHL). Postharvest loss is the cumulative crop yield lost at each step of the supply chain starting with harvest and ending with consumption. Approximately one-third of all food produced each year is lost or wasted (Gustavsson et al. 2011). PHL is most prevalent in developing countries among smallholder farmers and the predominant causes are poor handling, improper storage, inadequate transportation, deterioration, and absence of a consistent market to sell. The majority of the losses in each area occur because of a lack of modern technology, training, and incentive to produce quality goods. Many universities, government organizations, and non-profit organizations are focusing on research in different areas of the food supply chain to reduce PHL. Solutions must be regional, considering the culture and needs of the people, and require that many groups work together. Decreasing PHL aims to both bring food security and improved livelihoods to

smallholder farmers and their families and to reduce resource waste, ensuring food availability for all people now and in the future.

THE FIRST INTERNATIONAL CONGRESS ON POSTHARVEST LOSS PREVENTION

Because each region of smallholder farmers varies with different crops, cultures, and needs, solutions to PHL must be unique for every region and address more than one problem in order to be long lasting. Therefore, the formation and implementation of a dynamic solution requires that many groups specialized in different aspects of PHL communicate and work together. To facilitate communication between organizations working on different aspects of PHL and to ultimately address the issue of food security, the ADM Institute for the Prevention of Postharvest Loss at the University of Illinois at Urbana-Champaign organized the First International Congress on Postharvest Loss Prevention. The Congress brought together more than 250 people from 62 countries on six continents all working to address PHL and wanting to contribute their expertise and experience to coordinating solutions to global PHL reduction. At the congress many researchers and representatives discussed issues and solutions at different parts of the supply chain during poster, presentation, and panel sessions. A central goal of the congress was to develop a roadmap that represented a consensus on different key issues that need to be addressed within each area of PHL so that everyone knows not only where to focus their efforts but where other people are focusing. The roadmap would also help serve as a basis to guide future PHL prevention policy, which is crucial to regulating PHL practices along the supply chain.

EXISTING TECHNOLOGY

Many of the causes of PHL are a direct result of inadequate technology along the initial steps of the supply chain—drying, storage, and transportation (Gustavsson et al. 2011). Much of the discussion at the Congress involved bringing simple, proven technologies to smallholder farmers. The basic goals for drying and storage are to protect the harvest from the sun, moisture, bruising, deterioration, contaminants, and pests. A simple technology made of relatively accessible materials that does not require a lot of training and could prolong the life of crops is hermetic storage units that seal the crops from the surroundings. Different kinds of hermetic packaging include barrels, plastic bins, and plastic bags. Since pests are a significant source of yield loss, the research done at Iowa State University supporting that hermetically sealed steel barrels kill 100% of maize weevils suggests that hermetically sealed bags could decrease PHL (Brumm et al. 2014). Hermetic storage is additionally effective because it allows farmers to produce insecticide free and safe food to sell and provide to their families (Abdoulaye et al. 2015).

Simply storing the crop, however, may not address issues of moisture or heat causing deterioration. Many new innovative technologies that are being designed to be accessible to farmers for drying and cooling include solar dryers and brick coolers. Solar dryers in place of traditional direct sun drying are more hygienic and safe, and solar dryers are relatively inexpensive (Ngulu et al. 2015). Cooling is another essential part of storage that could help prevent losses, especially in vegetables and fruits. Brick coolers or zero energy cool chambers are relatively inexpensive and accessible because they are made of brick, sand, and pipes. The sand is held between two brick layers that form a storage unit for the produce, and the pipes drip water onto the sand. The water evaporating from the sand then causes the sand to cool, creating temperatures within the coolers 6-10°C below the surrounding temperature (Ambuko et al. 2015).

Although improving technology accessible for smallholder farmers can decrease PHL, getting the farmers the technology in the first place presents a challenge. Many farmers do not know how to get the technology, and many technologies are too expensive (Ambuko et al. 2015). Often private businesses do not have the

incentive to sell their products to smallholders either. The limits in accessibility greatly prevent new technology from being scaled up and widely used. Similarly, simply providing farmers with new technology does not create a long lasting solution because they need to know how to use and maintain it. Further, that technology may not be usable for everyone in the community. Even then, the technology may prevent product damage, but the farmers could lack a market to sell their product, so the harvest is lost anyway. To counter the learning curve necessary for more complex technologies, technologies that already exist and are known to work, such as plastic crates and hermetic bags, need to be prioritized. Decreasing PHL among smallholders will require more than technology; it will require training and education programs, access to information, establishing a reliable market, and developing relationships with the private sector.

SUSTAINABLE SOLUTIONS

UNDERSTANDING THE PEOPLE

Before a solution or technology can be brought to a community or area, the needs and wants of the people need to be considered. If solutions are designed that do not take the culture of the people into account, the people will not adopt the solution or become engaged in reducing PHL, then the solutions will not last. Different methods to understand the needs of the farmers include surveys and effective agricultural extension programs that work within the communities.

For example, the first step in the ADM Institute's recent research project launched in Bihar, India starting in January 2015 was to conduct a "baseline household survey to assess the cultural, technological, and economic aspects of PHL in the state of Bihar." They surveyed 3000 farmers across 60 villages in Bihar (Pullabhotla & Baylis 2015). The survey gave them information on the current practices and difficulties of the farmers in the crop value chain. Their aim was to compile data on resource availability, agricultural infrastructure, agricultural practices, agricultural costs, and farmer knowledge and use of PHL technology. They gathered additional data on farmer awareness of PHL and its costs as well as their incentives to reduce PHL. Knowing the status of farming in a community, especially knowing where along the value chain yield is being lost, allows a group to deduce exactly which technology or solution can best reduce PHL while still benefitting the people. Once the problem is identified and an appropriate technology or solution is formulated, methods and strategies of intervention, communication, education, and monitoring can be developed to effectively implement the technology and ensure its longevity.

The study in Bihar also helps in understanding the effectiveness of different extension programs and interventions in PHL technology adoption and its outcomes for farmers (Pullabhotla & Baylis 2015). Understanding the effectiveness of different approaches in substantively reducing PHL and benefitting farmers can then help design better PHL prevention programs.

WOMEN AND THE GENDER GAP

Throughout the Congress, an issue that repeatedly came up when discussing PHL at different steps of the supply chain and the implementation of new solutions was women's role and the gender gap that existed in many developing smallholder communities. Since women are predominantly responsible for postharvest activities in developing regions, the stakeholders have to consider their needs as both contributors to the supply chain and beneficiaries to the gains that come from producing and selling the products. Women need to be able to physically use the new technology and have access to information about new technology without leaving their home because of their roles in childcare. As main contributors to the crop value chain, women must be able to operate all of the equipment and machinery comfortably. Manufacturing suitable technology for women requires that businesses accommodate for women when designing their product, which would require businesses to

communicate with the communities that are receiving the technology.

The work of Compatible Technology International (CTI) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Malawi exemplifies how product quality can increase and gender equality can improve after communicating with men and women farmers through individual interviews, family surveys, and group discussions to understand their difficulties in groundnut harvesting then assigning specific technologies to help optimize production and reduce their labor (Spieldoch 2015). With the mechanization of much of the labor involved in harvesting, stripping, and shelling groundnuts, women had more time to do household chores and potentially be involved in community groups. The mechanization of groundnut processing labor encouraged men to participate in the production, helping close the gender gap in the industry. Like in Malawi, to empower women, the gender gap in communities must be reduced to enable women to make more production related decisions and to receive the benefits of their labor. Women generally have more access to resources but less power in controlling money (Abedeta et al. 2015). The ultimate goal of reducing PHL is to bring food security and prosperity to all people; therefore, achieving equality for women in the communities needs to be an equally important goal in PHL prevention.

EDUCATION AND TRAINING

Basic postharvest handling principles such as harvesting at the correct maturity, gentle but efficient handling, and good worker sanitation are simple methods of reducing PHL through education and training. Additional education is necessary when a new technology is given to a community to ensure that the technology is effective and being used properly. An effective way of building the capacity of contributors along the supply chain to use PHL prevention practices is extension programs hosting training sessions.

When the USAID partnered with regional training institutions in Malawi, Mozambique, and Zambia to teach grain management to employees from warehouses, government, private businesses, and feed & grain mills, the increase in education caused a reduction in PHL and a subsequent increase in the amount of product sold (Chikoye 2015). Their workshops consisted of lectures, practical work, and discussions addressing specific problems and ended with testing for certification and discussing plans for how the new skills and knowledge could be used. The partnership demonstrates how knowledge of actors in the supply chain is essential to improving PHL management. To spread knowledge, effective extension programs in regional agricultural administrations need to include PHL prevention in their training and education services.

The core principles of an effective teaching method for both employees of a contributor to the supply chain and smallholder farmers are accessibility and understandability. A greater challenge exists with teaching smallholders different techniques of PHL and how to use new technologies because they speak many different languages and have many different cultures (Bello-Bravo & Pittendrigh 2015). To bridge the gap between scientific knowledge and smallholder farmers in an efficient and cost-effective manner, in place of a traditional extension programs, Scientific Animation Without Borders creates informative animations that illustrate PHL techniques and technology use. The animations are available on a variety of portable devices such as cell phones, tablets, and computers. The videos are effective because they are visual, simple to understand, and available in 90 different languages and dialects (SAWBO 2015). Further education has to be given to not only use the technology but to maintain the technology over time.

SCALING UP

Bringing technologies and education to communities has proven to be effective in reducing PHL; however, the communities are isolated and PHL practices have yet to become widespread in rural farming communities

around the world. In order to markedly reduce PHL, technology and education among smallholders needs to be scaled up. Private sector companies manufacture many of the technologies, so a critical method of scaling up PHL technology will be engaging the private sector in rural communities and encouraging their investment. Sustained private business investment will emerge when there are willing buyers, capable farmers, and an enabling environment for business (The Rockefeller Foundation 2015).

Rural farmers' ability to get PHL technology from the private sector is additionally limited because of their lack of access to information. They do not have a single place to go to get the information that they need. Even motivating the farmers to want or try to attain PHL reduction technology presents a challenge because they do not have the market incentives to improve their product and reduce PHL. Lack of incentives originates from lack of consumer demand for higher quality, return on higher quality products, and access to a consistent market. Before farmers invest the extra time and effort into PHL reduction through acquiring a new technology or training, they need assurance that they will get return on their investment in the form of profit (Mitcham et al. 2015).

A contributing factor to the lack of market demand for an increase in food safety and quality results from consumer unawareness of the side effects of consuming contaminants, such as fungal growth and mycotoxins, and from consumers' inability to notice the contaminated product (Hoffman & Jones 2015). Therefore, creating producer and consumer awareness could establish the market demand for higher quality safe goods and create an incentive for producers to provide them. To create a producer/consumer relationship and to ensure return on investment, farmers and traders need to be linked to consistent profitable markets. Successful outcomes have resulted from connecting farmers to local hotels and supermarkets as well as encouraging market demand through consistent production of safer products (Mitcham et al. 2015).

Another limitation to the large-scale adoption of PHL technology exists because farmers who want to adopt PHL technology cannot because of their lack of access to credit. Establishing lines of credit to smallholders will greatly increase their ability to adopt PHL technology. Once the incentive from the market to produce higher quality goods exists, only when the private sector connects to rural farmers by both creating an enabling environment for investment, and only when farmers have access to information about where and how to get the technology as well as have the credit to purchase the technology, will widespread adoption of PHL technology occur and be followed by an overall PHL reduction.

ENVIRONMENTAL IMPACT

To substantially reduce PHL and make gains in food security, the use of PHL technology and practices has to be scaled up across many developing regions. However, greatly increasing the use of greenhouse gas emitting technology and resources will have a significant environmental impact, posing a new challenge of PHL prevention: how to implement PHL technology with a minimal environmental impact (Peters 2015). While bringing technology to developing regions will reduce PHL and increase food security in the short term, the threat of climate change, because of its adverse effects on agriculture, could threaten food security locally and globally in the future.

Climate change is predicted to increase temperatures and change the timing and amount of precipitation. Specifically, throughout Africa and southern Asia maize, wheat, sorghum, and millet yields are expected to decrease by 2050 (Stathers et al. 2015). Beyond crop yields decreasing, crop nutritional value will decrease. Many of these changes will happen too quickly for farmers to easily adapt. Even if climate change does not directly lead to crop loss, it could make the production of the goods more difficult, demanding more resources including land, labor, water, and other agricultural inputs. This emphasizes that the benefits of preventing

PHL lie in increasing food security both directly by increasing food supply and quality and indirectly by conserving the resources necessary to produce them and reducing the greenhouse gases emitted during their production. An estimated 2% of global emissions of carbon dioxide, which is approximately three gigatonnes of carbon dioxide, came from food waste and loss (FAO 2013). With rising global populations increasing demand for food, water, and energy and the oncoming threat of climate change, sustainable solutions to PHL must be implemented to ensure long-term resource availability and food security for all people.

CONCLUSIONS: CONNECTED GLOBALLY, ACTING LOCALLY

At the First International Congress on Postharvest Loss Prevention, the attendees came to an overwhelming consensus that we have the tools and knowledge to reduce PHL, but the challenge is to simultaneously bring together all of the factors to form a solution that fits a regional context. Coordinating all of the resources and knowledge while implementing PHL solutions requires enhanced communication between the different stakeholders. Extension programs have to listen to the farming communities to understand their needs. Then extension programs have to share their needs to others when coordinating other groups and resources to implement PHL solutions. Researchers need to share their findings on whether certain technologies, practices, or programs are successful or not. Manufacturers must reach out to the communities that they are providing with technology to accommodate to their needs. Scientists have to express to other groups the potential environmental harms of certain technologies or practices. All of the organizations need to communicate with governments to form policies that encourage PHL reduction. PHL occurs at every step of the supply chain, so preventing PHL will require communication between stakeholders and experts at each step.

The congress plays an important role in facilitating the necessary communication to share knowledge and build networks. Now the connections must be sustained for continued relaying of information and resources. The Food and Agriculture Organization of the United Nations aims to maintain those ties by creating a community of practice on food loss reduction at fao.org/food-loss-reduction/ that will serve as a global reference center on food loss where people can go to obtain relevant resources. The Congress further serves to align the priorities of the stakeholders so that everyone focuses on the keys issues along the supply chain within the steps of harvesting, drying & storage, transportation, processing, and retail. While reducing PHL requires a global initiative by global partners to create global solutions, reducing PHL requires that stakeholders act locally every day to implement dynamic regional solutions while utilizing their global connections and resources.

REFLECTIONS

The part of the First International Congress on Postharvest Loss Prevention that still impresses me the most is both the diversity of people who came from around the world and the variety of research topics and knowledge that they had. It reflects how not only PHL is a multifaceted issue, but it truly is a global problem that will require a global initiative to solve. It reminds me that though we have different point of view, cultures, and experiences, we still have in common the fundamental value of security in our lives. I admire the people working in PHL so much because they want to improve the lives of other people, both in their community and on the other side of the world. I am confident that the ongoing research and the collaboration can bring together all of the elements needed to reduce PHL and improve people's livelihoods.

At the Congress, a lot of insightful research was shared and meaningful connections were formed between groups. Further, the attendees repeatedly recognized that while the Congress was an essential step in establishing consensus

and ties, the most important step was continuing efforts after the Congress was over and continuing communication between the different groups. With the ultimate goal of the roadmap in mind, the next Congress on Postharvest Loss Prevention should allocate more time for creating the roadmap and express more clearly to the participants the expectations for what should be included in the roadmap.

ACKNOWLEDGMENTS

The Congress motivated me further to better the environment for people to have sustained resources and security. Now more than ever, I want to go to the parts of the world where agricultural and environmental problems exist so that I can understand them and the people they affect, which will help me find solutions that will improve their lives.

I am still incredibly thankful for the experience given to me by the ADM Institute. Learning about postharvest loss gave me insight into how to approach global problems, but the experience also allowed me to get to know other students, professors, and staff while experiencing Rome.

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