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Rome: A New era of Post-Harvest Loss Prevention

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ABSTRACT

As the world's population continues to grow, existing methods of food production are becoming increasingly stressed and incapable of meeting food requirements. Most research to solve this problem focuses on increasing the yields of existing crops. However, an increasingly large proportion of research is being done in the area of Post-Harvest Loss (PHL) prevention. Post-harvest loss is defined as any food that fails to be consumed or used after being harvested because of spoilage or lack of a market for the product. In October 2015, an international conference was held in Rome, Italy with the intention of addressing the substantial problem of PHL, and what can be done to mitigate it. The conference's organizers sought to develop a working "roadmap" that can be used to direct funding and research. This would enable collaboration between governments, the private sector, Non-Governmental Organizations, and academia. Ideally, this collaboration would allow for the implementation of appropriate, scalable technologies, as well as education that would dramatically decrease the world's food waste.

INTRODUCTION:

The First International Congress on Postharvest Loss Prevention was positioned to be the genesis of what would hopefully be a new era, one without hunger. Two hundred and fifty delegates, each an expert in his or her field traveled to Rome, Italy. They came from sixty-two countries, with backgrounds in food production and processing industries, Non-Governmental Organizations, and academia. Their objective: create a global plan to reduce PHL and eventually end world hunger. In his opening presentation, Daniel Gustafson, Deputy Director General of the Food and Agriculture Organization of the United Nations, stated some 800,000,000 people go hungry each day because they are unable to get enough food. However, if the world were to fully eliminate PHL, there would be enough food produced for about 1,600,000,000 more people (Gustafson, 2015). Essentially, there is more than enough food produced for everyone, but because of PHL, hunger remains a global issue.

At the conference there were presentations demonstrating an enormous variety of potential methods for PHL reduction including the development of new technologies, implementing existing technologies on a larger scale, and various types of education and data distribution systems to help farmers optimize their harvest. As Dr. Ertharin Cousin, the Executive Director of the World Food Program said, "there is no silver bullet." In other words, no single approach would easily solve the problem of PHL. Rather, a combination of each of the available solutions must be implemented in a manner specialized for each individual farmer, taking into account the size of their production, existing infrastructure, and the area of the world in which they are growing.

Technology and Implementation:

As the second day of the conference began, Dr. Toby Peters, a professor at the University of Birmingham, gave a keynote address regarding the vital importance of cold storage and adequate cold chains to protect produce. Mr. Peters founded a company to use the evaporation of liquid nitrogen to power refrigeration trucks and increase the availability of cold storage around the world. He added that beyond merely providing cold storage, an even more vital consideration is the environmental and societal impacts of implementing any technology. Normally, a refrigerated truck can pollute 5-40 times more than a standard truck because of the incredible energy requirement of cooling (Peters, 2015). Lack of substantial regulation for emissions on diesel engines that power air conditioning systems has further worsened the problem. Since the evaporation of liquid nitrogen produces only nitrogen gas, no harmful emissions are created by Dr. Peter's new refrigeration systems.

The key idea that Dr. Peters presented was that rather than viewing a product (like cold) as merely a resource, it should be viewed as a component of a system (like the energy chain). This viewpoint can be used beyond the specific case of refrigeration and applied to any process relating to PHL. When a systems-based approach to a problem is adopted, the sources, implementation and impacts of the system must all be evaluated. This added level of interconnectivity means that systems can be adapted to meet a goal in any situation. Systems are flexible, whereas a resource is more ridged. It is easier to change how a resource is used and produced within a system than trying to change the resource itself. Thus, refrigeration should be viewed as a vital system that must exist along every part of a food products journey from field to fork.

Mr. Peters also made the point that these systems must be scaled so that they can be economically feasible and available for everyone. He stated that around one-third of food is wasted, and that it amounts to more than $1 trillion of lost profit. Refrigeration, or any technology, can be made profitable if it can reduce waste effectively, but it must also be widely available and easy to implement. Currently, refrigeration is cheap and easily affordable for large farmers in developed countries. However, it simply is not available or cost effective for many farmers in the developing world (Peters, 2015). In order to be able to reduce PHL in these regions, these existing technologies must be tailored to the exact needs of the farmers in the area. The most important takeaway from Mr. Peter's presentation was that this concept must be applied to all areas of technology. In many areas, technologies exist to reduce PHL, but they are simply not affordable or applicable to the situations that many farmers live in.

APeel Sciences is another example of a company that is setting an example for how technologies must be made easy to use. They know that many farmers struggle to see the immediate usefulness of some technologies, and also struggle to implement them. They have created an "enzyme reactor" system that selects specific water-soluble organic molecules that can be applied to the exterior of a fruit. When a fruit is dipped in a solution of these molecules, an impermeable membrane is formed, which keeps water in the fruit and oxygen out, greatly reducing the rate at which produce spoils (Aronson, 2015). They have taken time lapse photos to be able to easily demonstrate to farmers the value and direct results of investing in their product. They took special care to make this product simple, and easy to apply so that any farmer anywhere in the world can dissolve the organic molecules in water and treat his produce with the solution.

Technologies are an incredible way to reduce PHL, but more often than not, scaling an existing technology and making it affordable will work just as well as developing a new technology. Whether a technology is new or old, it is vital that it is specifically optimized to be effective in

the situation it is implemented. Too often inappropriate technologies are implemented that do little to improve a farmer's situation.

Education:

While the implementation and development of technologies can prevent spoilage, equally powerful is the education that can change current farming practices. Many farmers are not aware of some of the best ways to grow certain crops. For example, Lola Gaparova, who works for USAID Farmer Advisory Services in Tajikistan, spoke about effective agricultural extension programs. According to her, more than half of agricultural products are produced on small family owned farms. Furthermore, the farmers (who are mostly women) have no way to get information about agricultural production. This lack of knowledge contributes to the 15% PHL for all cereals in the region. In a country where about a quarter of all children have stunted growth because of insufficient nutrition, this is a serious problem. Fortunately, an agricultural extension program called FAST was implemented to train these farmers and give them better access to technologies. In places where these programs were used, the amount of food sold increased by 15-20%. Currently, FAST training has been provided for nearly 4000 people (Gaparova 2015). Furthermore, Joyous Tata, a horticulturalist working for the Modernizing Extension and Advisory Systems (MEAS) Project in the College of Agriculture, Consumer and Environmental Sciences at the University of Illinois Urbana-Champaign, explained extension programs that are being implemented and how farmers are usually quite willing to be educated, but trainings must have easily visible benefits and must have some element of follow-up (Tata and McNamara, 2015).

Another important aspect of education is getting critical information about crops into the hands of farmers. Jurge Boye, an agricultural engineer specializing in food hygiene, gave a presentation about what his previous 30 years of experience in PHL reduction had taught him. He made it clear he believed the most important developments would come in the form of data acquisition and implementation. As he explained, farmers often decide when to harvest, when and how to implement pest control manners, and how long to dry produce completely by feel. The result is that crops are harvested too early, dried insufficiently, or not adequately protected from pests. He felt farmers needed to be educated and given the tools to properly manage their crops (Boye, 2015). If farmers know the exact status of their crops, they can implement appropriate measures to protect them and minimize waste.

Furthermore, as cell phone use increases, web-based information collection can be used to optimize the farming and food processing industries and reduce loss. Jan Priebe, a researcher specializing in demography and health economics, demonstrated a free system that individuals in developing countries can use to optimize their warehouses. This system tracks each item in the warehouse and helps make sure produce does not stay "on the shelf " for too long and spoil. He also said similar systems could easily be developed for mobile platforms and could be used by farmers to manage the water content, pest count, and concentration of aflatoxin in their produce. It could also be used to determine optimal times for harvest (Priebe, 2015).

Overall, education is not a tool that can be used indiscriminately. Education must be tailored to each individual situation. However, relevant and accurate information can dramatically improve the efficiency of agricultural practices. Once farmers are educated and understand the importance of PHL reduction, it is far easier for them to see the value of investment in technological developments that can further increase their effective yields.

Conclusions:

PHL can be reduced, but the same methods that have been applied to combat many of the world's other large problems are insufficient. While a single technological revolution or

program was enough to eradicate smallpox or provide enough fertilizer to the world, this is simply not the case with PHL. Agricultural systems already exist in nearly every community around the world. The technologies and education that are provided to the residents of these communities must focus on the existing systems, and work within the framework they provide. Solutions must address the agricultural system as a whole, not just one aspect. They must be easily scalable, easily understood and easily implemented. The solutions to reduce PHL do not need to be complicated. The most important characteristic of these solutions is that they adequately address the problems a community faces, and that they are actually implemented on a large scale.

Personal Reflection:

Overall, I found the entire conference was an incredible experience. In addition to the huge diversity of the delegates, it was also amazing to be able to interact with the delegates who were all so knowledgeable and passionate about PHL. From the presentations, especially Mr. Peter's, I learned it is often important to consider a change of perspective. Rather than viewing a resource as a part of a system, it is important to view the resource as a system of its own. In addition, I learned a ton about the vital implementation of integrated cold chains. However, it is likely that my most important takeaway was that in order to enact change in the world, I don't have to develop a revolutionary new technology. All I need to do is take an existing technology and make it scalable so that it can be implemented on a wide scale.

While Dr. Peters' presentation was quite good, I did not really understand the origins of many of the numbers used in the study. The presentation was also very one-sided. I walked away quite convinced that the implementation of cold chairs was vital, yet I was unsure of why they had not been already implemented. I feel the presentation would have had much more credibility if Dr. Peters had addressed concerns about cold chains and then mitigated them. I think future presentations about an entire system, for example cold storage, should include more background such as what the prevalence of the system is right now, what the need for cold storage is, and the total impact improving the system would have. In the presentation, I heard increasing the implementation of cold storage on a large scale could improve the shelf life of products by a huge margin and reduce PHL. If cold storage is available for rural farmers around the world, and refrigerated trucks can transport that food around the country and globe, then the prolonged shelf life will prevent the glut of markets and the rapid rotting of much produce and grain.

From my experiences interviewing presenters and speaking with them about their posters, I learned there is an incredible diversity of information. Under the umbrella of PHL, studies have been conducted for dramatically different aspects of the issue. From technology to education to modeling to data acquisition and usage, people have explored every aspect of the issue. In order to be able to speak with the presenters, I first had to read and understand their research, and be able to interpret it within the broader context of PHL, and the world as a whole. Once I did that it was easy to be able to discuss the implications and results of their research. However, in the future, I would make sure to have a more coherent plan of whom I wanted to interview and during the poster presentations. I would also have been more assertive and confident with my interviewing and asked more questions when I was confused.

On the whole, this trip taught me how an academic conference worked. I learned a ton about PHL, and how it is perpetuating world hunger. However, the most important lessons I learned were hope and persistence. I saw that the seemingly insurmountable challenge of world hunger could be solved. Every day there are hundreds, if not thousands, of people who are working towards a better tomorrow, one where no one goes hungry. Additionally, I saw those people were just like me. I realized they are not super humans. They are regular people

who have devoted substantial energy and time to a specific field. That means that someday I too can become an expert in my field and change the world.

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