

Establishment of a World Food Preservation Center: Concept, Need and Opportunity

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The World Food Preservation Center can be an international hub for the generation and dissemination of technologies to reduce postharvest losses of food worldwide.

INTRODUCTION

The United Nations estimates that our global population will increase by one quarter and grow to 9.6 billion by 2050 (Anon, 2013). Most of this growth will occur in urban areas and emerging economies in Asia, Latin America, sub-Saharan Africa. How we feed this ballooning population will become one of the most challenging problems of our time. Awareness of this urgent issue is slow in developing in the industrialized world where food is generally abundant. Yet, the primary responsibility for solving this problem rests with developed countries.

The world met a similar challenge in the 1960's and 1970's and was able to avert mass starvation through the Green Revolution. Through crop breeding and more intense cultural practices, yields of major staple crops such as wheat and rice realized exponential growth during the Green Revolution allowing countries such as India to actually become grain exporters.

The success of the Green Revolution has unfortunately lulled us into a false sense of security in meeting another pending worldwide food shortage because of the current pending population.

PENDING WORLDWIDE FOOD SHORTAGE

Studies show that global agricultural production may need to increase 60-100 percent by 2050 to meet increasing demands and provide food security for a rapidly growing population (Tilman et al., 2011). A recent study by the University of Minnesota based on approximately 2.5 M data points from around the world found that yields of four key crops – maize, rice, wheat, and soybean are increasing 0.9-1.6 percent every year. At these rates, production of these crops will increase 38-67 percent by 2050 which falls far short of the 60-100 percent needed to provide food security for the world at that time. The top three countries that produce rice and wheat were found to have very low rates of increase in crop yields. In the words of one of the authors of this study, "Clearly, the world faces a looming agricultural crisis with yield increase insufficient to keep up with projected demands" (Ray et al., 2011).

A SECOND GREEN REVOLUTION WON'T BE ENOUGH

Why not another Green Revolution? In the 1960's and 1970's the world faced a similar food shortage crisis that was met by the Green Revolution. Crop yields in developing countries such as Mexico and

India were increased exponentially through crop breeding and more intense cultural practices.

The environment that supports our present agriculture has radically changed over the past 50 years and is no longer able to provide the exponential increases in yields realized during the *Green Revolution*. Nearly one-third of the world's cropland (115 billion hectares) has been abandoned due to soil erosion and loss of fertility (Pimentel, 1994). Climate change is resulting in erratic and severe weather patterns and subsequent crop yield losses (Lovwill and Gourdjii, 2012). Seventy percent of our ground water is used for agriculture and it is rapidly being depleted. Also, our environment is being degraded by the continuous use of fertilizers and pesticides (<http://www.spiegel.de/international/world/worldwide-crisis-the-geopolitics-of-food-scarcity-a-606937.html>). Ways to reduce these environmental impacts and provide more food are a major challenge.

Against this background agribusiness is moving rapidly to create the *Second Green Revolution* in the developing world. They are buying and establishing fertilizer and pesticides plants and buying and establishing seed companies throughout Africa and other developing parts of the world. They are preparing to supply the developing world with seeds, fertilizers, and pesticides. In all this effort there are no initiatives by agribusinesses for programs or technology to save food once it is created.

WHY DON'T WE SAVE MORE OF THE FOOD WE PRODUCE?

The United Nations has determined that one-third of the food that we produce worldwide is lost or wasted after harvest (Gastavsson et al., 2011). We could go a long way toward feeding a starving world if we could reduce these postharvest losses.

But, this does not interest the agricultural industry because it doesn't fit their business model for profitability. Although a number of programs exist worldwide to reduce postharvest losses of food, the magnitude of these programs does not approach the enormity of the problem and most of these programs are not sustainable.

Presently we invest 95% of our resources in the production of food and only 5% in the postharvest preservation of food (Rader and Rolle, 2012; Kader, 2013). Yet, the return on investment in technologies to preserve food postharvest can far exceed that for food production. It is estimated that 1.5-2% increases in crop yield are presently realized by improved genetics and intensified production practices (Tilman et al., 2011). Often 50% savings of food can be realized in one year by advanced food storage technologies. Since farmers and consumers realize this return on investment in postharvest technologies, not by agribusiness, there has been little progress in shifting this investment imbalance.

With an obvious greater return on investment in technologies to preserve food over technologies to produce food, "Why are we putting 95% of our resource into food production and only 5% into the postharvest preservation of food?" This minimal investment in postharvest technologies is reflected in the paucity of technologies that we have to reduce postharvest losses of our food.

Agribusiness is at the root of policies that favor investments in food production over postharvest food preservation. The business model for agribusiness is based on the sale of seeds, fertilizers, and pesticides -- all technologies to support food production. Cynically, the postharvest preservation of food actually reduces sales for agribusinesses by reducing the demand for food production.

The policies of governments and even humanitarian organizations are heavily influenced by agribusiness so it is not unexpected that they too emphasize investments in production technologies over those that preserve food postharvest. Realizing that returns on investment are greater in postharvest food preservation technologies over food production technologies we should be investing more in this area

The problem is that the return on investments in postharvest technologies are not to a company selling these technologies but to the farmer that has more product to sell and the consumer that has a better product to eat. Humanitarian organization can play a major role here in that their “bottom line” is not primarily profit but improving the human condition. Unfortunately, you see even humanitarian organizations putting an emphasis on food production over the postharvest preservation of food.

PRESENT PROGRAMS TO COMBAT POSTHARVEST LOSSES

Worldwide there are a number of programs that recognize the importance of postharvest losses of our food and are trying to reduce them. Because the problem of postharvest losses is so much greater than the effort to combat these losses a critical need exists to coordinate and accelerate activities in this area. The UN FAO Save Food Program (<http://www.fao.org/save-food/en>) attempts to do this but most of their effort so far has gone into drawing attention to the problem of postharvest losses and waste of our food and to support studies that document the impact of postharvest losses and waste. Since it is already clear that postharvest losses of food particularly in developing countries are enormous the time has come to place less emphasis on studying this

problem and more emphasis on initiatives that attack it.

Fortunately, there have been success stories in creating and deploying postharvest food preservation technologies in developing countries. Exemplary is the Purdue Cowpea Improvement Program (PICS) for developing countries (Murdock et al., 2012). Basic studies at Purdue determined that if cowpeas were hermetically sealed in plastic bags, insects that generally infested the seed were killed. This was translated into a simple double bag that is now used throughout Africa to protect cowpeas and other grains and extend their storage life. This technology besides feeding hungry people has also reduced the poisoning of numerous Africans who otherwise would have eaten cowpeas treated with insecticides to control the weevil infestations.

A few successful businesses are evolving that market technologies to preserve food postharvest. GrainPro, Inc. describes itself as a “Not-Just-For Profit” company (<http://www.grainpro.com>). It has been successfully selling grain storage bags and grain “cocoon” to the developing world and is a profitable business. Governments and philanthropic organizations need to serve as incubators to foster companies such as this. Since it is the farmer and consumer that profit from saving food postharvest they need to support such companies politically.

In January 2011, the Archer Daniel Midlands company (ADM) presented a \$10 million gift to the University of Illinois to found the ADM Institute for the Prevention of Postharvest Loss (<http://postharvestinstitute.illinois.edu>). The Institute was created as a response to the rising amounts of oilseeds and grains lost each year in food chains around the world and it is working toward the implementation of postharvest technologies

such as tin silos for grain preservation in developing countries.

In 1970, the Rockefeller Foundation proposed a worldwide network of agricultural research centers under a permanent secretariat. This was further supported and developed by the World Bank, FAO and UNDP, and the CGIAR was established on May 19, 1971, to coordinate international agricultural research efforts aimed at reducing poverty and achieving food security in developing countries.

The CGIAR originally supported four Centers: CIMMYT, IRRI, the International Center for Tropical Agriculture (CIAT) and the International Institute of Tropical Agriculture (IITA). The initial focus on the staple cereals, rice, wheat and maize, widened during the 1970s to include cassava, chickpea, sorghum, potato, millet and other food crops, and encompassed livestock, farming systems, the conservation of genetic resources, plant nutrition, water management, policy research, and services to national agricultural research centers in developing countries. By 1983 there were 13 research centers around the world under its umbrella.

CGIAR Laboratories contributed substantially toward increasing crop yields through the *Green Revolution* around the world and they are starting to recognize the importance of the postharvest preservation of food after it is produced. Even though the need has been recognized there have not been the resources available to initiate new programs directed toward the postharvest preservation of food. Since these laboratories are in place worldwide, an initiative is needed for an accelerated effort to greatly increase their research programs directed toward the postharvest preservation of food.

Goletti and Wolff (1999) have urged the CGIAR to redirect more of their effort from

the production of food to the postharvest preservation of food stating, "The very skewed allocation of funds to production versus postharvest topics cannot be justified. Since so far, relatively little has been invested in postharvest research, there is potential for large impacts as constraints and bottlenecks are removed. It would thus be desirable to re-examine current funding priorities and to allocate a larger proportion of resources to the postharvest area."

Present programs to combat postharvest losses in developing countries generally have two major shortcomings in that they require the continual input of experts from developed countries with uncertain budgets in order to be sustainable, and they have a very limited number of technologies to recommend to developing countries for the preservation of their food. A World Food Preservation Center is proposed here that would be able to overcome these shortcomings. It would be an institution that would implant sustainable programs into developing countries for the preservation of their food and develop new technologies appropriate for the preservation of food in developing countries.

A WORLD FOOD PRESERVATION CENTER

The World Food Preservation Center proposed here addresses two major deficiencies in our present attempts at reducing postharvest food losses in developing countries (<http://www.agricultureandfoodsecurity.com/content/2/1/1>). The proposed World Food Preservation Center will provide an excellent education to young scientists in developing countries in advanced technologies for the postharvest preservation of their food. Moreover, it will conduct research and develop new technologies appropriate for the postharvest preservation of food in developing countries. When young scientists return to their native countries after attending the

World Food Preservation Center they will be able to establish research, education, and extension programs tailored for the needs in their specific country. Also, they will be able to introduce innovative new technologies for the postharvest preservation of food developed at the World Food Preservation Center such as solar refrigeration, solar transportation, and solar storage, as well as, biological controls for postharvest diseases and insects and active and intelligent packaging. With its specific focus on postharvest losses, the World Food Preservation Center can act as an informational hub and coordinator of other programs and laboratories worldwide to reduce the postharvest losses of food.

Lack of a cold chain for the storage, transport, and marketing of food in developing countries is a major contributor to postharvest losses. The World Food Preservation Center will be able to tap into the great advances that are being made in solar and wind generated energy to develop solar and perhaps wind generated refrigeration. And, it can serve as a vehicle to put into place in developing countries self-sustaining research and extension programs that will have a substantial impact on food losses in developing countries thereby reducing world hunger and improving world health.

Developing countries have a rich resource that can be leveraged in the fight against the postharvest loss of food. This is a group of young postharvest scientists that are familiar with the postharvest losses of food in their countries and are highly motivated to reduce these losses. We need to put effective tools in the hands of these young scientists so they can solve their own postharvest problems. Some of these young scientists have already been identified though a LinkedIn discussion group that I started over a year ago asking "What about a World Food Preservation Center?" Young postharvest scientists from over 40 developing countries have participated in

this discussion and they have been highly supportive of the idea (<http://lnkd.in/kz2zx4>).

The extension arm of the World Food Preservation Center will develop educational and e-learning materials for farmers and extension workers in developing countries for the postharvest preservation of their food. It will also create and maintain a "Virtual World Food Preservation" website that can serve as a communication hub for technologies that are applicable for the control of postharvest losses of food in developing countries. The World Food Preservation hopes to coordinate its extension efforts with the Postharvest Education Foundation that is already doing an excellent job of providing educational materials and trainers for farmers and extension workers in developing countries on technologies to preserve their food after it is harvested (<http://lnkd.in/kz2zx4>).

Strong economic arguments can be made for a return on investment in postharvest technologies to preserve food and the establishment of a World Food Preservation Center. A study in India determined that at least 50% of the production of fruits and vegetables is lost due to wastage and value destruction (<http://www.postharvest.org/home0.aspx>).

The cost of wastage was estimated at US\$4.6 billion per year. Investment in a program that would reduce these losses by only 5% would result in a return on investment of US\$2.3 M dollars per year. This is one commodity in one country. Imagine the economic impact of developing and implementing technologies that could reduce postharvest losses worldwide by 5% not to mention the attendant impact on reducing world hunger.

Who needs to take responsibility for the establishment of a World Food Preservation Center? Agribusiness has pledged its efforts to meet the pending food storage caused by

a rapidly increasing population and adverse environmental conditions that are limiting food production. Yet, up until now their activity in the postharvest arena is notably absent. They are putting their efforts into the production of food where the outcome will be the sale of seed, fertilizers, and pesticides.

WHAT BARRIERS NEED TO BE OVERCOME

It has been shown clearly that returns on investments in technology for the postharvest preservation of food have a much higher yield than investments in crop production. This and the fact that we are not going to be able to produce ourselves out of our current food crisis presents a strong argument for a major shift in our investments in agricultural research and education. Unfortunately, there are industrial and governmental policies that are resisting this paradigm shift and taking us in another direction.

The agricultural industry and researchers have not been given the incentives to develop technologies for the preservation of food postharvest because of a perceived poor economic return from the sale of such technologies. Hence technologies to reduce the postharvest losses of food in developing countries are severely limited. Perhaps we have a lesson to learn from the approach used to encourage industry and research institutions to shift from research and technologies on carbon-based fuels to more sustainable fuels such as solar, wind, and biofuels. This change requires heavy infusions of money by governments through grant programs and economic incentives to businesses and research institutions. Justification for this paradigm shift in funding was prompted by public awareness of the "Inconvenient Truth" of global warming. The "Next Inconvenient Truth" of a pending worldwide food shortage is just as compelling and

meritorious of the world's attention and resources.

The proposed World Food Preservation Center can be an international hub for the generation and dissemination of technologies to reduce postharvest losses of food worldwide. Through its educational system it can put into place highly trained scientist around the world that will be capable of establishing independent research, teaching, and extension programs in their native countries that can be self sustaining for generations to come. Through its research arm it will develop much needed innovative technologies for the preservation of food tailored for developing countries. The World Food Preservation Center is an idea whose time has come. The time is now.

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- <http://www.spiegel.de/international/world/worldwide-crisis-the-geopolitics-of-food-scarcity-a-606937.html> Spiegel International: The Geophysics of Food Scarcity. Justification for this paradigm shift in funding was prompted by public awareness of the “inconvenient truth” of global warming (2009)(accessed July 15, 2013).