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Stop the brain drain – Why we need stored-product protection research for food safety

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Abstract

In the history of human development, stored-product protection (SPP) is probably older than the invention of agriculture because even what was hunted and gathered needed to be stored to provide food for the bad days. One may think that the human race had enough time to find out everything that could be found out on SPP. But this is not the case. SPP problems often require a solution custom-made for the given product or storage situation, climate, socio-economic background, etc. Modern SPP research in the Americas, Asia, Europe, or Oceania was often started as a result of World War I or II, when hunger was an issue. But, with the absence of hunger, we witness another scary development: SPP research is dying out, institutions are closed down, e.g., CSL UK 2009, SGRL Australia 2009, DPIL Denmark 2010, INRA France 2015. Yes, research costs money. But, do we take into account that climate change may already have led to increased numbers of conflicts and increased mobility? That a lack of food safety can tear apart all advances of civilization and culture in the brink of a moment? Why are there no calls for SPP research under Horizon 2020? What happened to the Millenium Goal to cut down hunger by 50%? The FAO states that one third of our grains are lost between harvest and consumption. It is high time to improve food storages and SPP methods using all knowledge and technology available in order to reduce losses, it is high time to support international SPP research!

Keywords: Storage, research, food-safety, policy, starvation, risk-prevention, innovation, needs

Introduction

If we imagine human development before the onset of agriculture, hunters and gatherers needed to store and protect their food in order to survive bad weather conditions or seasons of scarcity. Thus, stored-product protection was needed even before the development of agriculture. One could expect that all of this time that man had to deal with difficulties such as moulds or two-, four-, six-, and eight-legged competitors should have been enough to solve the problems, but this is not the case. According to the Food and Agriculture Organization of the United Nations (FAO 2011), one third of the harvest is not consumed but lost or wasted. While tropical and subtropical warm climates keep insect development and post-harvest losses high at all seasons, in temperate climates and industrialized countries a large portion of the harvest is wasted at the retail and consumer level (FAO 2011). If we try to grasp this gigantic loss, we need to think of one third of arable land, of plowing labour, of seeds, seeding, plant protection activities and products, irrigation, plus harvesting and storing in vain. If we take the grain harvest as an example, estimated by world-grain.com for 2016 at roughly 2.569 billion tons, one third, which roughly equals 850 million tons, will be lost. How is it possible that the human species allowing such a waste is called *Homo sapiens*? In less provocative terms, we could possibly agree upon the fact that there is a hidden treasure. Reducing such losses may help feed an ever growing population in the coming years, increase the productivity of agriculture, allow for more environmentally sustainable agricultural practices, and still leave some protected landscapes to maintain species diversity.

Climate, food security, and mobility

According to Diamond (1997), the availability of plant-based nutrition in early agriculture-driven societies allowed the development of different professions (farmers, hunters, warriors, doctors, chiefs). A society that cannot any longer supply sufficient food may easily fall apart. We should take into consideration that climate change and extreme climates with or without the influence of "El Niño" already cause drastic changes: It has been reported that in 2007 extreme climates caused unusually low harvests in Russia and the Ukraine which together with other factors (fires in Oceania, speculation) led to high grain-prices in the world market. This in turn caused hunger riots in

northern Africa and the so-called Arabic spring. The mass demonstrations of frustrated youths led to the demise of governments. Religious fundamentalism, war lords, and terrorist groups are more successful among young people that do not find a job nor see a future. We are facing times of increasing unrest and aggression in regions where adverse conditions drive desperate people to leave their homes and search for survival elsewhere. In Germany, we thought for a long time to be far away from such struggles, but in the past few years, we had to learn that considerable numbers of refugees made it all the way to our front door.

Thus, what does this have to do with stored-product protection research? Stored-product protection research could help reduce losses in both developing and industrial countries. Improved harvests and improved income from agriculture could help farming communities to be more productive and resilient. Europe claims the will to help improve living conditions in Sub-Saharan Africa and elsewhere. Reducing post-harvest losses would be among the most promising policies. Joint research could help to reduce not only losses but also improve quality of the harvested goods, e.g., by reducing infestation and mycotoxin levels. An example of this is hermetic storage in Purdue Improved Crop Storage (PICS) bags (Anon. 2008, Baoua et al. 2012). Stakeholders and researchers in many tropical countries also have innovative ideas, e.g., on how to improve solar drying, the use of plant parts or extracts, wood ash, zeolites, or other dusts. From Argentina came the innovation of hermetic grain storage in silobags (Bartosik 2012).

Less SPP research in industrialized countries

True stored-product protection research in the Americas, Asia, Europe, or Oceania was often started as a result of World War I or II, when hunger was an issue. But, with the absence of hunger, we witness another scary development: Over the past decades reducing numbers of researchers attended our SPP conferences. Especially in industrialized countries, less and less resources seem available for this kind of research. Research could help to improve storage, but from the Netherlands not one public stored-product protection scientist ever came to a meeting. There is no stored-product protection research done in Belgium, Sweden, or Norway. Denmark made its small Danish Pest Infestation Laboratory part of Aarhus University in 2007, where it was closed around 2010. The stored product protection group of the French Institute National du Recherche Agronomique (INRA), that hosted the IWCSPP in 1990, ceased to exist by the end of 2015, when the last colleague, Dr. Francis Feurat-Lessard, retired. The Stored Grain Research Laboratory in Canberra, Australia, that hosted the IWCSPP in 1994, was closed down in 2009, even though Australia is the 5th biggest grain exporter after Russia, the EU, the US, and Canada. The UK hosted the IWCSPP in 2002 and closed down its Central Science Laboratory after severe cuts in 2009. The few remaining scientists under the new roof of the Food and Environment Research Agency (FERA) cannot any more attend international conferences like this one. Obviously, many countries do not regard stored-product protection research as a priority and rely on other countries to develop the necessary innovation.



Fig. 1: Estimated numbers of public stored product scientists world-wide

We need stored-product protection research in industrialized countries because new ways of transportation, like bulk storage of cocoa in shipping containers and large horizontal storages, may be more cost effective on one hand but cause challenges like condensation, heating, and even damage by fire. We need research to develop and build better storage structures and to develop structures for the food processing industry that takes into consideration the latest information on insect behaviour. We need improved processing machines that give less opportunity for stored-product insect infestation. We need more research because with new and improved knowledge on pests, preventive methods, monitoring, and control can change. We need more research to learn which new species may find its way into our products or which known species is changing relative importance. Because biology never remains stagnant, we should be aware of changes. New materials can help us to improve packaging technology. Hermetic seals and vacuum could avoid or control pest infestation. Solar drying and aeration cooling could render storages unsuitable for arthropod survival at moderate costs. New camera equipment and computer chips can improve automatic pest detection, and new physical means like laser-technology can allow new methods of pest control (see IWCSPP 2018 publication Adler et al. "Starwars in food stores"). Improved lures with highly attractive volatiles could turn traps from monitoring tools into pest control equipment. A combination of acoustic detection with biological control could render the latter more effective and economically feasible (see IWCSPP 2018 publication Mueller-Blenkle et al. "A new approach to detect insects acoustically in grain storage").

How come we use computers, mobile phones, and other high-tech equipment in our every-day life. But our staple food is stored in storages that are often worse than those of our great-grandparents because the farmer is paid too little money per ton of grain. For decades, farmers were told to invest little into storage structures. Now it could make sense to implement IPM strategies, to propagate

preventive methods such as grain cleaning, drying, cooling, and pest-proof storage structures. Now we have fewer and fewer pest control options. But can we offer sufficient data to convince farmers? What happened to the United Nations (UN) Millennium Development Goal to cut down hunger by 50%? How can stored-product protection research be helpful to reach this goal? And is there sufficient research done?

The European Union (EU) did not make stored-product protection a topic in its calls for Horizon 2020 even though early on a number of colleagues wrote to their respective national contact points. So far, just mycotoxin-research is funded, but that insects locally increase moisture and thus facilitate mycotoxin formation is not taken into consideration. Who decides research funding policy, and who has sufficient oversight? Is there a way to make research funding a more flexible tool?

At least within Germany, there were national funds available for research projects within the last six years. But international cooperation mainly depended on personal scholarships by sources such as DAAD or Humboldt Foundation.

What needs to change?

As stored-product protection researchers, we are usually analyzing a specific problem and searching for specific improvements or solutions. But if I would lift my head to look at the greater picture, I would like to utter the following wishes:

1. EU: Please make stored-product protection research part of the funding for FP9!
2. EU and member states: Please provide funding and facilitate research cooperation between European and non-European stored-product protection scientists (travel grants, smaller and larger projects), while keeping administrative hurdles at a minimum.
3. FAO and UN World Food Programme (WFP): Please help initiating and coordinating stored-product protection research according to your needs, in organizing exchange of ideas and concepts. Participate more regularly in scientific conferences.
4. UN: Please develop an improved method on how to reach consensus and a clearer perspective on how to tackle pressing challenges (e.g., overpopulation, malnutrition and starvation, scarcity of fresh water, pollution).

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Counting losses to cut losses: quantifying legume postharvest losses to help achieve food and nutrition security

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