Income Intervention Quick Scan: Post-Harvest Loss Prevention

Farmer Income Lab Intervention Quick Scan

Renée Beune

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Wageningen Centre for Development Innovation
Wageningen, September 2018

Report WCDI-18-033

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Renée Beune, 2018. *Income Intervention Quick Scan: Post-Harvest Loss Prevention Measures; Farmer Income Lab Intervention Quick Scan.* Wageningen Centre for Development Innovation, Wageningen University & Research. Report WCDI-18-033. Wageningen.

Abstract UK This quick scan, commissioned by the Farmer Income Lab, is part of a wider research effort looking at, "What are the most effective actions that lead buyers can take to enable smallholder farmers in global supply chains to meaningfully increase their incomes?". The quick scan provides an overview of the publicly available evidence on the impact of post-harvest loss prevention measures have had on raising farmer income. Such subsidies have had little positive effect on farmer income, are not notably beneficial for women nor is this effect long-term. They have been applied at large scale. This quick scan is part of a series of 16, contributing to a synthesis report "What Works to Raise Farmer's Income: a Landscape Review".

Keywords: farmers' income, intervention, agriculture, smallholders, post-harvest loss, food quality, food safety, handling, storage, processing, packaging

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Report WCDI-18-033

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List of abbreviations and acronyms

ATT	Agriculture Technology Transfer project in ghana
BCR	Benefit-Cost-Ratio
CSR	Corporate Social Responsibility
FLW	Food Loss and Waste
IRR	Internal Rate of Return
NGO	Non-Governmental Organization
PHL	Post-harvest losses
PHILIL	Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss
TOC	Theory of Change
WCDI	Wageningen Centre for Development Innovation, Wageningen University & Research
WUR	Wageningen University & Research

1 Introduction

1.1 Definition

Post-harvest losses (PHL) are losses of agricultural produce that take place between harvest and consumption. In highly food-insecure regions such as Sub-Saharan Africa, approximately 20% of all grains, 44% of roots and tubers, and 52% of fruits and vegetables are lost between harvest and consumption. There is also substantial degradation in quality, affecting financial value and associated incomes, nutritive content and public health (Belaggio statement 2018). For this analysis the focus will be on measures that aim to tackle post-harvest losses which take place at farm level, to be able to analyse the effect of post-harvest loss prevention measures on the income of farmers. In the case of smallholder farmers the phases of production, handling, storage, processing and packaging all have the potential to take place at farm level (Lipinski et al 2013). Interventions in these phases are analysed.

1.2 Theory of change

The theory of change considering the effect of PHL interventions on farmer income and gender is as follows: Less post-harvest loss in quality and quantity leads to more marketable product, which in turn leads to more income for small scale farmers. Next to that, more agricultural product means more safe quality food for household consumption, contributing to family health and freeing up resources to spend on other needs. For women farmers specifically, their time spent farming can be diminished through time saving technologies. Next to that, household expenditures can be lowered through higher food availability for home consumption (Lipinski et al 2013). This frees financial resources. It also can create time for other income generating activities. This additional income can be spent on their own- and the family's wellbeing. This TOC is presented in Figure 1.

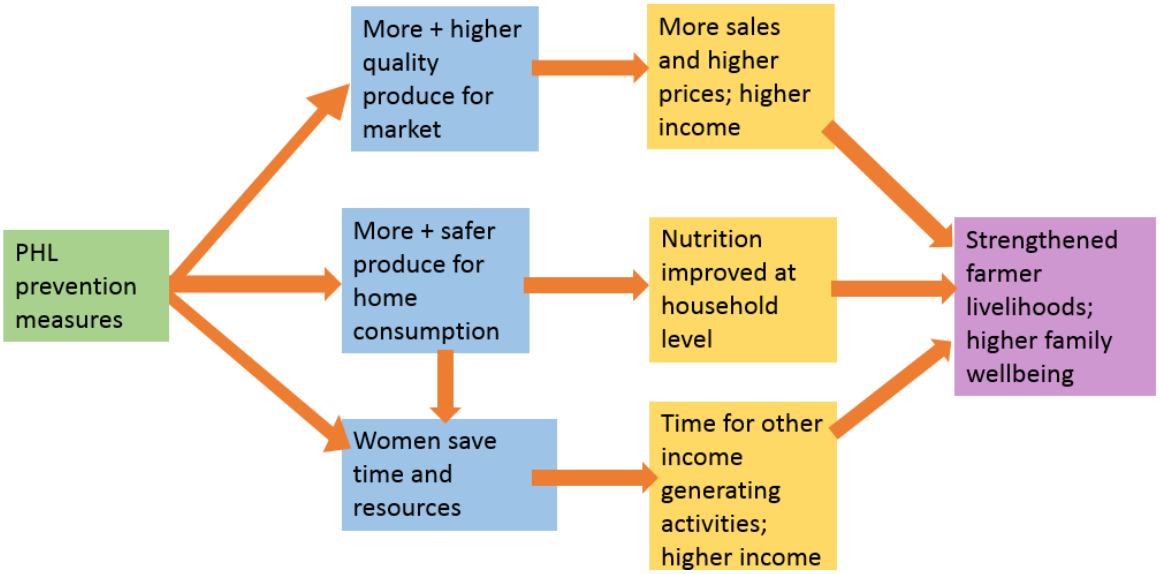

Figure 1 *Theory of Change PHL prevention measures & farmer livelihoods.*

1.3 Geography

The bulk of the literature that looks into the income effects of PHL interventions is focused on central Sub Saharan Africa. Areas and countries that were focused on in the selected meta studies are West & Central Africa (1), Sub Saharan Africa (1), India (2), Nigeria (2), Afghanistan (2), Ghana (1), Ethiopia (1), and Rwanda (1). Areas and countries considered in the selected case studies, in order of occurrence, are the West African Sahel (1), Central America (1), Ghana (2), Kenya (2), Tanzania, Nigeria, Uganda, Brazil and Ethiopia. The geography of interventions is reflected by the kind and amount of food loss that takes place in these regions, presented in Figure 2.

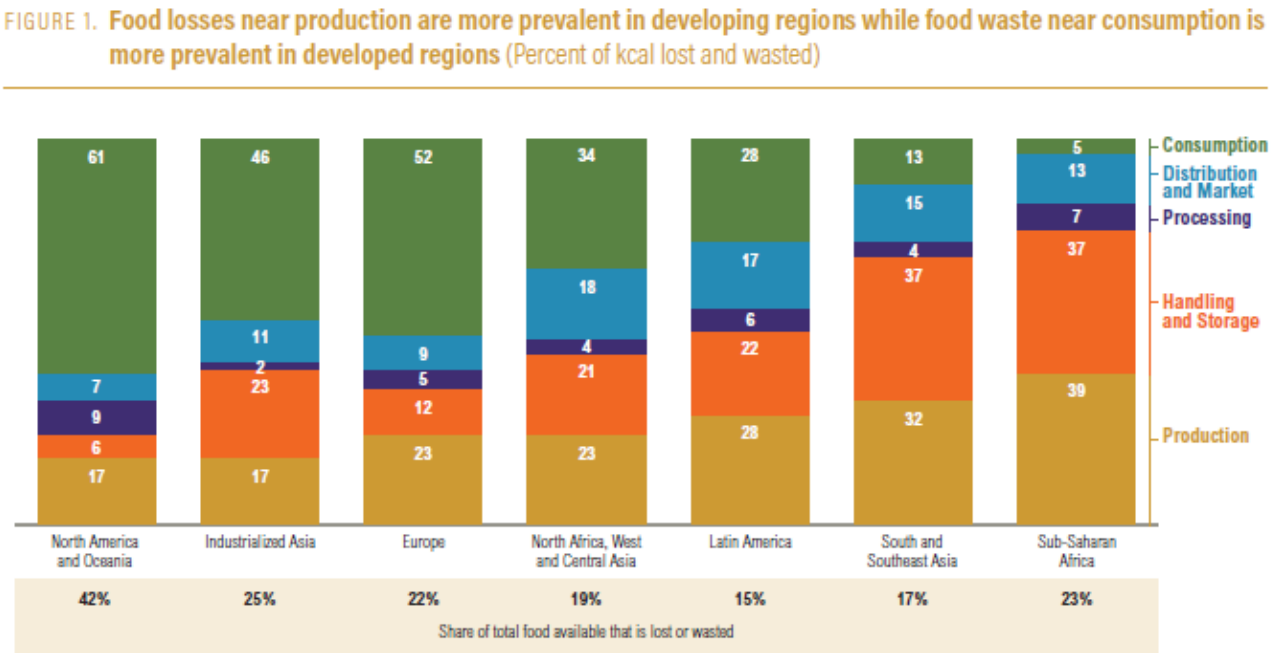

Figure 2 *Geography of post- harvest loss and food loss (Lipinski et al 2017).*

1.4 Role of actors

In the literature a division can be made between actors in PHL prevention with a philanthropic approach and those who are involved from a business perspective. This chapter presents clear examples from literature.

Philanthropy

Bhadra (2017) gives a clear overview of the roles that different actors have in the scaling of PHL technologies in projects of PHILIL, the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss, housed at Kansas State University. This overview seems to be representative for the makeup of many collaborations with a comparable goal. PHILIL works with local NGOS to spread information about technologies to farmers in targeted regions. Research is performed jointly with local universities. Private partners contribute to lab studies of technologies and contribute in the form of CSR donations, like John Deere through the Deere foundation. Scaling up of technologies happens through international agricultural organizations like ATT, Africa RISING and SPRING.

Business

Van Gogh et al (2017) see intervening in the post-harvest chain on value chain level as foremost a matter for the private sector. In an extensive study done by Wageningen Food & Biobased Research, Wageningen Economic Research and RIKILT they demonstrate that a value chain approach to the matter has to be taken, rather than actions from a single stakeholder or a single solution approach. The value chain approach implies that the costs that are incurred in specific parts of the chain to

create the added value, will be sufficiently compensated by the revenues from the entire value chain. Post-harvest management measures will be stimulated when the prospect of obtaining the revenues in exchange for the costs and risk of investment is there. To support this process they see a threefold role for national and regional governmental policy. This role consists of (1) facilitation: creation of right infrastructure and incentives for investment in PHL prevention, (2) measuring: monitoring of impacts and (3) enforcing: to set and maintain concrete Food Loss & Waste (FLW) targets for stakeholders to comply with. A last important factor that Van Gogh et al point towards is the necessity of international harmonisation of legislation on food safety and quality. This will level the playing field for businesses in the food sector and avoid disturbances in international trade of food products.

2 Summary and justification of assessment

Strength of outcome		
Assessment criterion	**WUR score**	**Rationale for score**

Scale: Size of the population intervention could impact and potential to scale to other contexts (i.e., geographies, value chains)	Low	• There are many PHL prevention technologies with proven functionality that have not yet been applied or introduced in many contexts.
		  ○ Bhadra 2017; Lipinski et al 2013; Rockefeller Foundation 2015
		• PHL prevention measures are regularly too expensive or time consuming for the smallest of the small scale farmers. There is no/limited access to finance to combat this problem.
		  ○ Ansah et al 2017; Chegere et al 2017; Gitonga et al 2013; Rockefeller Foundation 2015
		• Broader socioeconomic factors often stall/block scaling of technologies. Examples include: inefficient marketing systems, lack of infrastructure and necessary materials, lack of information, inhibiting regulations.
		  ○ Kitinoja et al 2011; Rockefeller Foundation 2015; Zorya et al 2011
		• PHL prevention is not new. Measures started in the 1970s, but not much scaling has happened despite active horticultural education and research programs in many countries.
		  ○ Kitinoja et al 2011; Chegere et al 2017; Zorya et al 2011

Impact: degree of increase in incomes	Medium	• Improved storage methods can lead to a rise in prices paid for products through improved quality and because farmers can wait for better prices instead of directly having to sell their product after harvesting. Price rises in the literature broadly range from 5% to 91%.
		  ○ Costa 2015; Fischler et al 2011; Lipinski et al 2013
		• Improvements in handling, transport and storage that lead to less spoilage and loss can lead to a higher amount/weight of intact agricultural product, ranging from 4% to 96% in the literature.
		  ○ Baoua et al 2016; Costa 2015; Gitonga et al 2013; Lipinski et al 2013
		• Farmers can benefit from PHL prevention methods in terms of increased income and welfare, measured in different ways in the literature (food security, welfare, IRR, literal raise in come) which do not sketch a clear picture in percentages.
		  ○ Fischler et al 2011; Lipinski et al 2013

Sustainability: financial ability of farmer income increase to endure independent of ongoing external support	Low	• Smallholders are often not (sustainably) linked to markets – this inhibits more product leading to more income.
		  ○ Lipinski et al 2013; Rockefeller Foundation 2015; Zorya et al 2011
		• Reducing PHL is not always economically efficient, sometimes the cost of losing agricultural product is lower than that of trying to avoid loss.
		  ○ Chegere et al 2017; Goldsmith et al 2015; Rutten 2014
		• Post-harvest losses depend on many factors that are hard to address, like annual rainfall and the location of a farm relative to the market.
		  ○ Hengsdijk & Boer 2017; Gitonga et al 2013

Gender: Potential of intervention to positively impact women	Medium	• Women are usually responsible for the processing and consecutive storage of agricultural products. The introduction of more effective post-harvest technologies for processing and storage provides women with less physical strain and more free time. o Costa 2015; Zorya et al 2011 • Women often carry the main responsibility in a household for family health and food security. Increasing the amount, safety and shelf life of food helps alleviate and support this task. o Chegere et al 2017 • PHL prevention can lead to the creation of labour opportunities for women through new activities in packaging and processing, but also to the dissolving of manual labor opportunities through increasing technology. o Zorya et al 2011; Rockefeller Foundation 2015
Strength of evidence		
Assessment criterion	**WUR score**	**Rationale for score**
Breadth: amount of rigorous literature that exists on the impact of the intervention	Low	• Many studies predict the possible impact that PHL prevention could have on farmer incomes, instead of measuring the actual impact. o Coker & Ninalowo 2015; Costa 2015; Rockefeller Foundation 2015; Rutten 2014 • Often the assumption is made that more product will automatically lead to higher incomes. o Bhadra 2017; Costa 2015; Rockefeller Foundation 2015
Consistency: Degree to which the studies reviewed are in agreement on the direction of impact (i.e., positive or negative)	High	• Most studies report or predict positive impact or potential positive impact of PHL prevention methods on income or a proxy for income. Of the 19 works that were studied in-depth, 15 were positive (79%). Three categories of 'positive' can be made: o Calculated proof of impact (6) Ansah et al 2017;Costa 2015; Chegere 2017 chapter 2; Fischler 2011; Gitonga et al 2013; Lipinski et al 2013 o Predicted/potential impact (7) Bellagio 2018; Coker & Ninalowo 2016; Van Gogh et al 2017; Kimenju & Groote 2010; Lipinski et al 2017; Rockefeller 2015; Rutten 2014 o Proof of effective technologies (2) Baoua et al 2012; Bhadra 2017 • Three studies indicate that PHL prevention measures do not always lead to net benefits. o Chegere 2017 chapter 1; Goldsmith 2015; Zorya et al 2011

3 Methodology

A total of 65 studies were scanned for relevance. Of these, 19 were selected for in-depth analysis on the basis of 1. Analytic rigour, 2. Publication after 2009 and 3. The presence of some type of assessment or indication of the socio-economic impact of the measure. These 19 works are comprised of (for more detail see reference list):

- 3 meta studies
  - Lipinski et al (2013)
    6 case studies, 3 with proof of impact on income
  - Rockefeller Foundation (2015)
    5 case studies, 0 with proof of impact on income
  - Zorya et al (2011)
    27 case studies, 4 with proof of impact on income
- 1 systematic review
  - Kitinoja et al (2011).
- 5 background studies
  - Bhadra (2017)
  - Bellagio statement (2018)
  - Chegere (2013)
  - Lipinski et al (2017)
  - Van Gogh et al (2017)
  - Rutten (2014)
- 8 case studies
  - Ansah et al (2012)
  - Baoua et al (2012)
  - Coker & Ninalowo (2016)
  - Costa (2015)
  - Fischler et al (2011)
  - Gitonga et al (2013)
  - Goldsmith (2015)
  - Hengsdijk & Boer (2017)
  - Kimenju & Groote (2010)

General issues considering methodology & results

The bulk of literature on PHL prevention only considers the agronomic functionality of technologies, without considering socio-economic context or impacts. A large part of the literature solely offers predictions of the effect of PHL prevention, instead of actual proof of impact. Often impact of interventions consists of scaling; indicating the amount of farmers reached with the intervention instead of indicating the effect of intervention on their livelihoods. When there is measurement of impact, it is often not directly about income but about the amount of PHL that is prevented in terms of product. This entails an assumption that more product will automatically lead to more income, neglecting market and price factors. When impact measurements do consider income, it is often not clear what the income growth in percentages has been. Most of the literature focuses on the effects of interventions which are measured at one point, shortly after introducing or testing the intervention. This does not demonstrate sustainability. Lastly, not all literature looks into interventions, some of it looks at general drivers of PHL and its management (which is useful for policy making considering future interventions but not for analysing existing interventions).

4 Impact

4.1 Effect on income

Farmers can benefit from PHL prevention methods in terms of increased income. The height of the income increase and the way in which this increase is presented in the literature that was analysed (percentages, amounts, welfare increase, Internal Rate of Return) vary strongly. This makes it **challenging to compare or calculate general figures**. The following cases illustrate this.

Lipinski et al (2013) present two clear cases considering income increase. They demonstrate the effect of PICS bags use for cowpea storage in Nigeria to be an average farmer income increase of 48%. The second case is that of tomato growers in Afghanistan who start using plastic crates for handling; the incomes of the families in a community (Karokh) increased by a total of US$75,000 compared to the prior year, recouping more than their own US$60,000 investment.

Chegere (2017) shows the effect of two types of interventions that help maize farmers in Tanzania with storage: provision with hermetic bags and provision with hermetic bags combined with training on good post-harvest practices. The farmers who received a free hermetic bag earned net benefits of USD 9.74 for one season, with the IRR calculated to be 14%. Those who received a hermetic bag and training earned net benefits of 33.87, the IRR is calculated at 35%.

Fischler et al (2011) make an extensive calculation of a postharvest program that was implemented for maize farmers in Honduras, Guatemala, Nicaragua and El Salvador. They specifically looked at the economic impacts of the use of metal silos for storage, compared to non-users. Generally, metal silo users gained 23 percent more than non-users, the benefit-cost-ratio (BCR) was 2.6 and the IRR 22%.

4.2 Intermediate and other outcomes – price & crop loss prevention

In several of the works analysed, the **price paid by consumers for agricultural products to which PHL prevention methods are applied is used as an impact indicator**. Prices increase through improved quality and because farmers can wait for better prices instead of directly having to sell their product after harvesting (Gitonga et al 2013). Price rises in the literature broadly range from 5% to 91% (Costa 2015, Fischler et al 2011, Gitonga et al 2013, Kitinoja et al 2011, Lipinski et al 2013). An example is the use of liners in rough plastic crates for the handling and transport of Guava fruits in India, leading to an increased market value of 12.5 % (Kitinoja et al 2011). For the Karokh tomato growers in Afghanistan described by Lipinski et al (2013), the use of plastic crates lead to buyers paying up to 33% more for Karokh tomatoes.

Another type of outcome that is often measured in the literature is the prevention of crop loss. Improvements in handling, transport and storage that lead to less spoilage and loss can lead to **a higher amount/weight of intact agricultural produc**t, ranging from 4% to 96% in the works analyzed (Baoua et al 2016, Costa 2015, Gitonga et al 2013, Kitinoja et al 2011, Lipinski et al 2013). Costa (2015) presents high numbers for the effect of grain storage in Uganda: new technology resulted in overall average loss of grain of below 1 percent(after 90 days storage), compared to 41.64percent (after 90 days storage) using traditional storage practices. One case study considering PHL prevention for maize growers in Kenya (Lipinski et al 2013) compares metal silos to the use of a basic polypropylene bag for six months. The study found that while the polypropylene bag with no added pesticide experienced crop losses of 24 percent, a metal silo with no added pesticide experienced crop losses of just 1.4 percent. Kitinoja et al (2011) demonstrate how in India a simple

shade structure for field packing results in 1% weight losses for spinach as compared to 5% weight loss when packed during the same time period under sun.

4.3 Applicability of impact – gender and types of farms

Gender

PHL prevention measures have a differential impact on women, compared to men. This is because **the post-harvest activities are often taken care of by women: they are usually responsible for the processing and consecutive storage of agricultural products. The introduction of more effective post-harvest technologies for processing and storage can provide women with less physical strain and more free time** (Bhadra 2017, Costa 2015, Lipinski et al 2013, Zorya et al 2011). Costa et al (2015) laid a specific focus on gender in their study of the impact of a postharvest drying and storage intervention on grain farmers in Uganda. In surveys with participating women, it became clear that 98.3 % experienced increased spare time and 99.1 % experienced increased freedom to leave the house and pursue other activities (also because of increased security of the food stock – the storage unit could be locked). Next to this impact, **women often carry the main responsibility in a household for family health and food security**. Increasing the amount, safety and shelf life of food helps alleviate and support this task (Chegere et al 2017, Lipinski et al 2013, Zorya et al 2011). Important to note is that PHL prevention can lead to the creation of manual labour opportunities for women and thus income through new activities in packaging and processing (Rockefeller 2015), but also to the dissolving of manual labour opportunities for women through increasing technology. In general it is crucial to avoid the assumption that the differential impacts described above always have positive outcomes for women's lives (Zorya et al 2011).

Farmer segments

The impact of PHL prevention measures also differs for different types of farmers. For **subsistence farmers**, PHL prevention mainly contributes to food security and food safety. It helps maintain the food stock for a longer period and especially (hermetic) storage methods help to keep the food from becoming a health risk by preventing the development of aflatoxins and mycotoxins (Costa 2015, Bhadra 2017, Zorya et al 2011). For **pre-commercial farmers**, the possibility to maintain quality and quantity of their products for a longer period of time can help them to move towards becoming commercial farmers. For **commercial farmers**, better post-harvest management makes it possible to obtain higher prices for products through increased quality. Next to that, drying and/or processing and/or improved storage allows them to sell throughout the year instead of only directly after harvest. It also makes it possible to await higher prices for moments in the year to sell the products (Fischler et al 2011, Kimenju & Groote 2010).

Figure 3 from Kimenju & Groote (2010) demonstrates the effect of metal silo adopters on the relationship between consumption and sales by commercial farmers growing maize in Kenya. It shows that food security is maintained: farmers who have the silo do not suffer from two months without maize supply for consumption like those without a silo. They also sell their maize on peak price moments in the year, instead of mainly right after harvesting.

There is quite a clear focus in the crops that are considered in the literature. Most studies encountered in the literature review have a general focus, looking at the dynamics around- and impact of- PHL prevention for a variety of crops including vegetables and fruits (Bellagio 2018, Lipinski et al 2013, Lipinski et al 2017, Kitinoja et al 2011, Rockefeller 2015, Zorya 2011). **Most material on the impact of PHL prevention methods focuses on grains**. 3 of the studies analysed consider PHL prevention for grains in general (Bhadra 2017, Costa 2015, Gitonga 2013). Grains specifically studied are maize (Chegere 2017, Fischler 2011, Kimenju & Groote 2010) and rice (Baoua et al 2012, Coker & Ninalowo 2016). Other crops focussed on are yam (Ansah 2017), soybean (Goldsmith et al 2015) and cereals (Hengsdijk & Boer 2017).

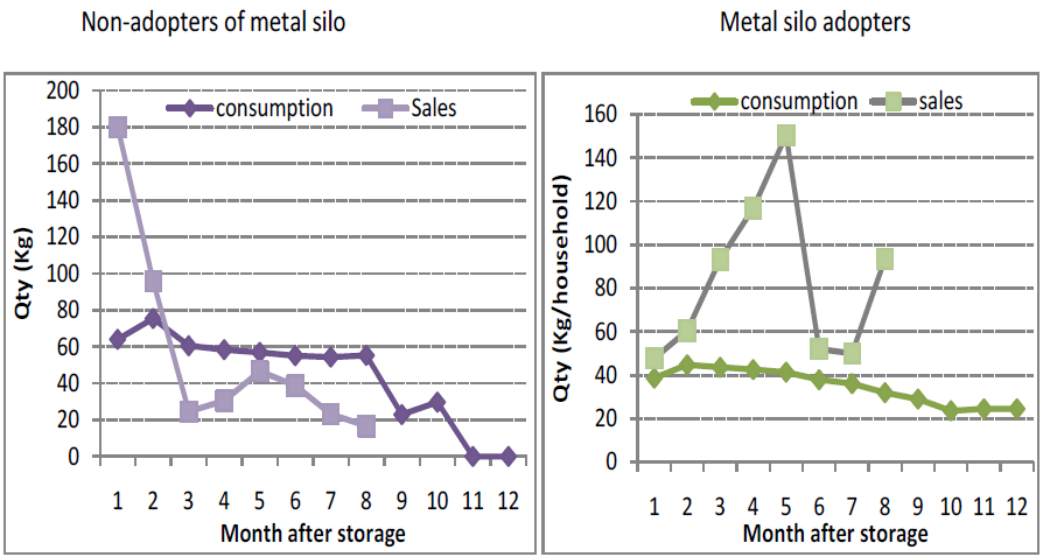

Figure 3 Effect of metal silo on commercial farmers' sales and consumption (Kimenju & Groote 2010).

5 Key success factors

Adapting the intervention to the local context
For PHL interventions to be successful, their acceptability in local culture has to be tested. They need to fit within peoples' daily practices and livelihoods and fit with the needs and capabilities of different groups in society. Next to cultural context, the local context also needs to be assessed in terms of the materials that are available: if technologies are introduced that can only be performed with- or constructed from materials that are hard to come by locally, an intervention will not be sustainable over time. The most successful interventions also are inexpensive in local terms, making them inclusive for poorer and risk averse farmers.

Raising farmer ability to invest
The households which are most likely to successfully adopt PHL prevention measures are larger households, with a higher amount of land and a higher income. Poorer farmers tend to refrain from adoption. Measures that work for PHL prevention measures to be inclusive are to increase access to finance for smallholder farmers and to provide financial incentives to early adopters of the methods.

Awareness raising & basic training
for PHL interventions to be successful, technology introduction has to be preceded by awareness raising. People are often not informed about the possible benefits of PHL prevention. Farmers are reluctant to invest in new technologies when they are not sufficiently informed. Next to that, technologies are often most successful when necessary equipment does not require an extensive amount of training to properly use. Extension work is costly and often areas where smallholders work are hard to reach. Illiteracy can also form a problem when training manuals are extensive. Simply technology that requires a minimum of instructions, which can preferably be spread through demonstrations and word of mouth, works best.

Access to markets and functional infrastructure
A crucial success factor for PHL prevention methods to lead to higher income is proximity of- and access to functional roads and markets. If these forms of access and connectivity are improved, often through investment in infrastructure, the chance is higher of PHL prevention methods being economically interesting for- and adopted by farmers.

6 Barriers addressed

Information
Many of the interventions come with trainings to demonstrate the use and effectiveness of PHL prevention methods, increasing farmers' knowledge and skills. An important part of these trainings, also done in other forms than training, for example through local radio and other media outlets, is awareness raising about the possibilities of post-harvest loss prevention (Zorya et al 2011). A lack of awareness about potential benefits of PHL prevention often leads to risk aversion of farmers (Chegere 2017), which can be lowered through provision of information.

Food quality and safety
PHL prevention contributes to food quality, which increases the marketability and potentially the price of crops (Lipinski et al 2013). When it comes to storage as a PHL prevention method for both home consumption and sales, food safety is also addressed: potentially lethal intoxication of family members by mycotoxins and aflatoxins, common with grain products stored in warm spaces, can be prevented by hermetic storage (Costa 2015, Bhadra 2017).

Food security
Nearly all authors indicate that PHL prevention can lead to general higher food security. Food security for farmers that produce for home consumption can be addressed through storage methods and processing that allows for stocking more food. Also, when more food is maintained after harvest, there is more food on the market and prices could go down – creating more supply of- and access to food for consumers (van Gogh et al 2017).

Availability of technology and information
PHL prevention measures often introduce new technologies that were previously not available or even known in target areas. This increases agricultural production and innovation and stimulates the local economy. The interventions usually make these technologies available for farmers to obtain or buy. They also provide trainings and information on the benefits of the technology and how they are to be used.

The literature demonstrated that many barriers are still not addressed by PHL prevention methods, leading to low adoption by farmers and low impacts (Chegere 2017, Zorya et al 2011). The next and last section presents suggestions for research to help address these barriers.

7 Questions for further research

Testing assumptions
A first clear research need that became apparent in the literature scan is to look into actual impacts of post- harvest loss prevention measures on farmer income. Very limited material exists that presents substantial proof on this impact and compares the local costs and benefits of interventions (Kitinoja et al 2013). A lot of the current material on the impact of PHL measures is based on the ToC presented in the introduction of this report, assuming that PHL prevention will lead to more product, which in turn will lead to more income and more food security. This assumption is challenged by several authors. Goldsmith et al (2015) do this by demonstrating that for some farmers it is more profitable to lose a part of their harvest, when taking into account time and labor needed for PHL prevention. Next to that, Often expensive equipment is needed for PHL prevention, which can form an exclusionary barrier to poor farmers (Fischler 2011, Lipinski et al 2013). More comparable research is needed to test the ToC.

Crops & technologies
Another data gap exists in the crops and PHL prevention methods represented in the literature. PHL management methods for grains are commonly studied when it comes to effect on income, but information on these effects for vegetables and fruits is scarce. This relates to the methods that are studied: the literature mainly considers storage methods – which indeed form a very important part of PHL prevention. But methods considering handling and processing – which are more common for fruits and vegetables – are hardly represented.

Gender sensitive data
The impact of PHL prevention measures on women needs to be more extensively explored. Some studies touch upon this impact, especially Costa (2015) looks into it thoroughly. But, as Zorya et al (2011) indicate, the research base of gender and diversity of PHL reduction needs to be improved; gender sensitive data considering impacts has to be collected. Not only output for women (like having more spare time and income), but also the longer term outcomes of these changes have to be studied (what do they do with this spare time/income? How does their environment react to it?).

Private sector engagement
For decades, NGO's, universities and agricultural platforms have been carrying out PHL prevention programs. Their effect has been limited. The focus on players to drive the process is slowly shifting towards the private sector. Factors that still form barriers are market access, access to finance for the poorest farmers, a continuing lack of awareness on the and poor infrastructure (Ansah et al 2017, Costa 2015, Hengsdijk & Boer 2017, Zorya et al 2011). To make steps to tackle these issues, engagement of the private sector is needed, supported by government, also to combat donor dependency and to stimulate institutionalization of PHL (van Gogh et al 2017). More research is to be done into the roles and potential roles of businesses and governments in combating the barriers to effectively preventing post- harvest loss and improving incomes.

References

Shortlist

Ansah, I. G. K., Tetteh, B. K., & Donkoh, S. A. (2017). Determinants and income effect of yam postharvest loss management: Evidence from the Zabzugu District of Northern Ghana. Food Security, 9(3), 611-620.

Baoua, I. B., Margam, V., Amadou, L., & Murdock, L. L. (2012). Performance of triple bagging hermetic technology for postharvest storage of cowpea grain in Niger. Journal of Stored Products Research, 51, 81-85.

Bhadra, R. (2017). Reducing post-harvest loss in developing countries through the feed the future initiative. Resources Magazine, 24 (3), 12-15.

Bellagio Statement (2018). "BELLAGIO STATEMENT ON POSTHARVEST MANAGEMENT."

Chegere, M. J. (2017). Post-Harvest Losses, Intimate Partner Violence and Food Security in Tanzania (Doctoral dissertation). Retrieved from: https://www.researchgate.net/publication/319187416_Post-Harvest_Losses_Intimate_Partner_Violence_and_Food_Security_in_Tanzania

Coker, A.A. & Ninalowo, S.O. (2016). Effect of post-harvest losses on rice farmers' income in Sub-Saharan Africa: a case of Niger state, Nigeria. Journal of Agricultural Science and Food Technology 2 (3), 27-34.

Costa, S. J. (2015). Taking it to scale: Post-Harvest Loss Eradication in Uganda 2014–2015. UN World Food Programme, Kampala, Uganda.

Fischler, M. (2011). POSTCOSECHA programme Central America: Final report 2011. Bern: Swiss Agency for Development and Cooperation.

Gitonga, Z. M., De Groote, H., Kassie, M., & Tefera, T. (2013). Impact of metal silos on households' maize storage, storage losses and food security: An application of a propensity score matching. Food Policy, 43, 44-55.

van Gogh, B., Boerrigter, H., Noordam, M., Ruben, R., & Timmermans, T. (2017). Post-harvest loss reduction (No. 1751). Wageningen Food & Biobased Research.

Goldsmith, P. D., Martins, A. G., & de Moura, A. D. (2015). The economics of post-harvest loss: a case study of the new large soybean-maize producers in tropical Brazil. Food Security, 7(4), 875-888.

Hengsdijk, H., & De Boer, W. J. (2017). Post-harvest management and post-harvest losses of cereals in Ethiopia. Food Security, 9 (5), 945-958.

Kimenju, S. C., & Groote, H. (2010). Economic analysis of alternative maize storage technologies in Kenya. In: Joint 3rd African Association of Agricultural Economists (AAAE) 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September (pp. 19-23).

Kitinoja, L., Saran, S., Roy, S. K., & Kader, A. A. (2011). Postharvest technology for developing countries: challenges and opportunities in research, outreach and advocacy. Journal of the Science of Food and Agriculture, 91(4), 597-603.

Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R., & Searchinger, T. (2013). Reducing food loss and waste. World Resources Institute, 22.

Lipinski, B., Clowes, A., Goodwin, L., Hanson, C., Swannell, R. & Mitchell, P. (2017). SDG target 12.3 on food loss and waste: 2017 progress report. Champions 12.3, retrieved from: https://champions123.org/2017-progress-report/

Rockefeller Foundation (2015). Perspectives to Reducing Post-harvest Losses of Agricultural Products in Africa. Background paper Feeding Africa Conference, October 21-23 2015, Dakar, Senegal.

Zorya, S., Morgan, N., Diaz Rios, L., Hodges, R., Bennett, B., Stathers, T. & Lamb, J. (2011). Missing food: the case of postharvest grain losses in sub-Saharan Africa. Washington: World Bank.

Longlist

20170919 Impact of reducing food losses and waste_Waarts.pptx	3-5-2018 10:47	Microsoft PowerP...	4,539 KB
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Wageningen Centre for Development Innovation
Wageningen University & Research
P.O. Box 88
6700 AB Wageningen
The Netherlands
T +31 (0)317 48 68 00
www.wur.eu/cdi

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Wageningen University & Research
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The Centre for Development Innovation works on processes of innovation and change in the areas of food and nutrition security, adaptive agriculture, sustainable markets, ecosystem governance, and conflict, disaster and reconstruction. It is an interdisciplinary and internationally focused unit of Wageningen UR within the Social Sciences Group. Our work fosters collaboration between citizens, governments, businesses, NGOs, and the scientific community. Our worldwide network of partners and clients links with us to help facilitate innovation, create capacities for change and broker knowledge.

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 6,000 members of staff and 9,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the various disciplines are at the heart of the unique Wageningen Approach.