Ceres2030
Sustainable Solutions to End Hunger

Implementing SDG 2: Costing effective interventions to reduce post-harvest losses

The Challenge

In 2015, the world's governments adopted a bold agenda committing them to achieving 17 Sustainable Development Goals (SDGs) by the year 2030. [i] The second goal, SDG 2, is a commitment to end extreme hunger, while improving nutrition, doubling small-scale food producer income and limiting environmental harm. One of the ways governments have identified for realizing this ambition is to cut food waste by half, while reducing losses more broadly across the food production value chain.

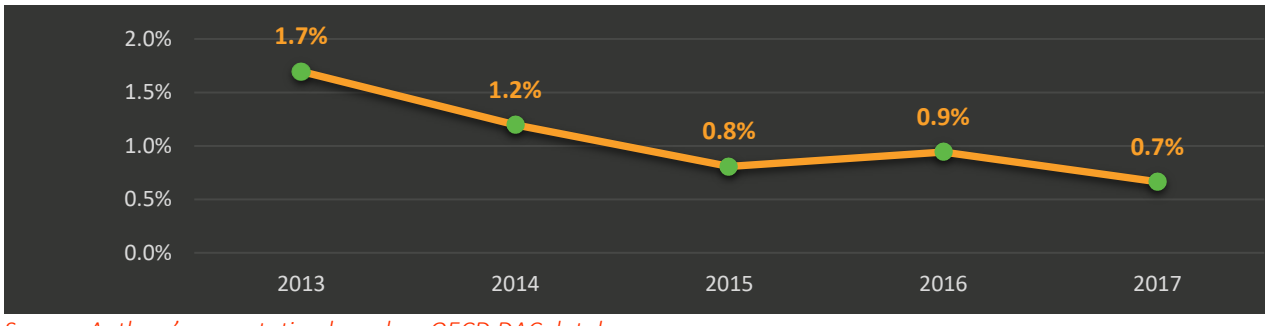
The Food and Agriculture Organization of the United Nations (FAO) defines food loss as the "food produced for human consumption that is not eaten by humans" [ii]. Post-harvest losses (PHL) are one kind of food loss, which also measures non-food crops, such as animal feed. Missing or inadequate systems for food storage or processing lead to post-harvest losses, meaning that there is less food available for sale. A smaller food supply means higher prices for consumers and fewer nutrients to go around. PHL arise, for example, if prices are too low to be worth farmers' time to get crops to market, or if the cold storage does not have a reliable electricity supply.

Post-harvest losses waste natural resources, many of which are already under stress, including freshwater and soil nutrients. Salvaging or disposing of food losses may incur the generation of greenhouse gas emissions, which will be in addition to the emissions that resulted from the initial production. Although reducing supply pushes agricultural prices higher, the economic losses they generate hit smaller-scale farms and processors particularly hard. In the long run, high PHL deter farmers from investing in their production, hurting welfare for all.

Interventions to reduce PHL are crucial for realizing SDG 2. One of their key benefits is that they improve the quality and shelf life of a farmer's product, which increases the farmer's profitability and extends the time a farmer has for selling the product. At the same time, measures to prevent PHL will increase the amount of food that makes it to the market, bringing food prices down and increasing affordability.

The share of official development assistance (ODA) in agriculture allocated to PHL projects has declined to less than 1 percent of the agriculture ODA portfolio (see Figure 1). In 2017, that portfolio was around USD 11 billion. Yet in the last two years, interest among funders has revived. Given the importance of the issue and the availability of technologies to solve it, an increase in public investment for PHL reduction is warranted. Donors will need to fully assess the potential costs and benefits of such an investment. It is here that Ceres2030 makes a difference.

Figure 1. Projects devoted to post-harvest losses, as a share of total agricultural ODA



Source: Authors' computation based on OECD DAC database.

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What does Ceres2030 provide?

Ceres2030 brings together a university, an international food policy research centre, and an international non-governmental organization to answer two big questions: What will it cost governments to end hunger? How should governments best allocate public funds to support the realization of SDG 2?

The project rests on two pillars. The first is an economic cost model that estimates the public spending required to accomplish SDG 2, focusing on the share needed from international donors. The second is a process of evidence synthesis, with researchers evaluating interventions designed to strengthen food security to see which have proven effective and which less so, measured against the SDG 2 targets. That process is supported by machine learning, helping researchers sift through vast amounts of research, highlighting knowledge gaps as well as interventions with a strong evidentiary basis.

Evidence Synthesis: What do we know about which interventions work and why?

Researchers have increasingly started to use various methodologies to assess the state of knowledge in specific policy areas. Ceres2030 has commissioned eight such studies, which we call evidence syntheses. The results will be peer-reviewed and published as a collection in *Nature Research Journals* in the second quarter of 2020.

One of these studies looks at post-harvest losses.[iii] An international team of researchers is reviewing approximately 13,000 papers from academic journals, international organizations, think tanks, and other databases, guided by a research protocol developed and published prior to their analysis.[iv] The PHL study is focused on sub-Saharan Africa and low and middle-income countries of South Asia. Their analysis seeks to answer two central questions:

i) What are the interventions that small-scale producers and associated value chain actors can adopt and/or adapt to reduce post-harvest losses along food crop value chains?
ii) What are the associated barriers and facilitators for adopting interventions that small-scale producers and associated value chain actors can use to reduce post-harvest losses along food crop value chains?

The evidence synthesis gives the researchers an overview of how successful various interventions are, and in which contexts. They can also ask follow-up questions related to specific interventions. They can examine which of the ever-growing range of technologies available to address the problem of PHL have already been studied in depth, and what has emerged from that research, along with which interventions need more study.

Cost modeling: How much will chosen interventions cost and how will they interact?

Post-harvest losses occur along the full value chain of production. The Ceres2030 cost model framework is particularly suited to assessing the economic, social, and environmental effects of reducing PHL because it can capture direct and indirect effects, as well as the potential for mutually enforcing or contradictory effects.

The Ceres2030 team use a dynamic, multi-country, multi-sector computable general equilibrium model that incorporates household-level data. The model simulates the inner workings of the global economy and allows for viewing how public spending channeled through various interventions, such as those aimed at tackling PHL, will

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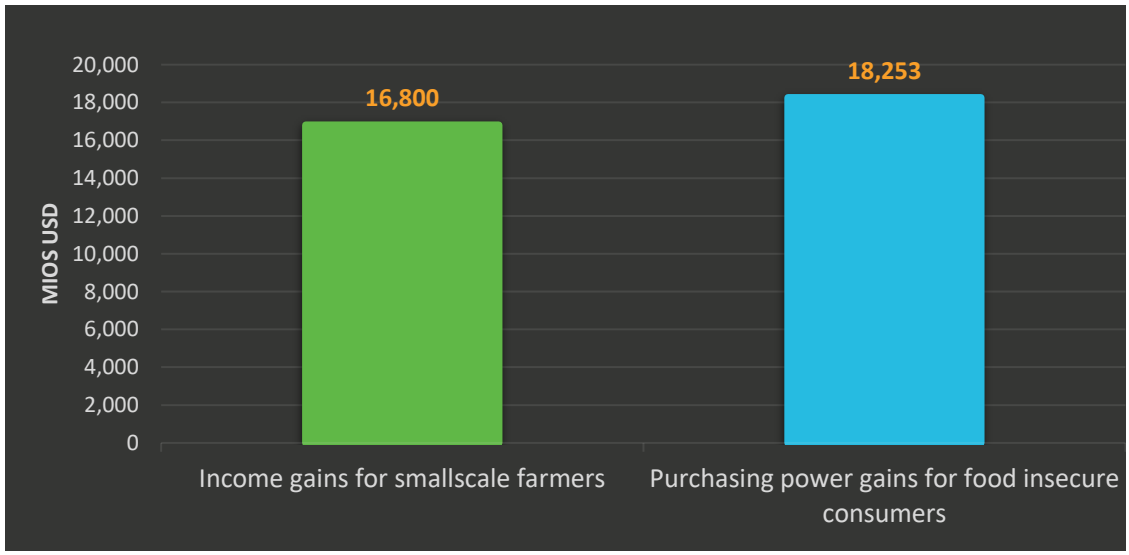
affect the economy as a whole. The model creates an artificial world that demonstrates how interventions have more than cumulative effects. For example, a new technology that boosts crop yield by 20 percent will only realize its full potential if the additional production reaches consumers, rather than spoiling after the harvest.

While the benefits of reducing PHL are relatively intuitive, different interventions are not necessarily alike. For example, a mango harvesting tool that prevents bruising and reduces mold contamination can increase the number of mangoes available for consumption. Cold storage offers the same benefits, but it has a higher environmental cost if it relies on energy generated by fossil fuels. The model can also show dynamic effects: for example, if farm profits rise as a result of reduced PHL, the eventual effect might greater production, and an associated increase in demand on natural resources. That might undermine sub-target SDG 2.4 and the commitment to improve agriculture's environmental performance.

It is neither possible nor desirable to eliminate all post-harvest losses. No technology is perfect, nor are the costs of aiming for perfection merited. Moreover, some element of redundancy helps to reduce risk. Figure 2 uses the Ceres2030 framework to illustrate how a 50 percent reduction in PHL in developing economies affects two populations that are important for SDG 2: food insecure consumers and small-scale farmers. The Ceres2030 economic model calculates the effect of the reduced losses along the value chain. The model shows that the gains are distributed (affecting more than one population), and additive (both consumers and producers benefit).

Figure 2 shows gains of 17 billion dollars (USD, constant 2014) for small-scale farmers worldwide and 18 billion USD for poor consumers, leaving to a total gain of 35 billion USD for the SDG 2 target populations, with a gain of more than 122 billion USD for the world economy.

Figure 2. The impact of reducing post-harvest losses in developing countries by 50 percent



Source: Authors' computation. MIRAGRODEP Ceres2030 simulations

In the final year of the Ceres2030 project (2020), the costs and nature of PHL interventions will be fully integrated in the model. The results will suggest the optimal level of expenditure for PHL interventions, and the extent to which loss reduction will contribute to the objective of achieving SDG2. Note that additional investment in PHL reduction could be warranted for the achievement of other goals, including environmental objectives and raising productivity in food value chains.

Ceres2030: Combining the pillars

The two pillars of Ceres2030 are in constant interaction with each other. The evidence synthesis allows researchers to identify effective interventions and validate data that can contribute to the cost model's assumptions. In turn, cost modellers can use these new parameters to shape their work and generate new questions while assessing the costs, benefits, and environmental effects of a variety of PHL interventions.

The evidence synthesis also provides important contextual information that informs how interventions are incorporated into the model. For example, the synthesis will shed light on what adoption rate it is reasonable to assume, and how the effectiveness of an intervention varies with geography. This context informs the assumptions needed to make to get a good estimate of how an investment in PHL reduction would affect levels of hunger, farmer incomes, and environmental outcomes.

This is an iterative process, and the combination of these two approaches is the core innovation of Ceres2030, and one which we hope can inspire new ideas in the fields of economic analysis and agricultural research.

Conclusion

Achieving the SDGs requires a massive scale-up of ambition, with barely more than a decade left to meet the 2030 deadline. To meet the challenge, policy-makers need new ways to make and inform decisions that will support the achievement of the 17 SDGs and their targets.

The Ceres2030 team is refining a unique set of tools that help to make sense of this complexity for policy-makers and researchers. These tools can be used to look at an extended set of interventions and how they interact. They can simultaneously consider the income constraints that people living in poverty face, while considering the potential for expanding agricultural research and development, extension services, price incentives, and more.

Smart interventions to reduce PHL will boost food system efficiency, which in turn will address several SDG 2 targets, including reducing hunger and increasing the income of small-scale food producers. This is an opportunity for international donors to renew their support for PHL projects. Ceres2030 can help by providing the information they need on costs, the share needed from public funds, and evidence on which interventions are effective.

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[i] The UN 2030 Agenda is detailed here: https://sustainabledevelopment.un.org/post2015/transformingourworld

[ii] http://www.fao.org/platform-food-loss-waste/food-loss/definition/en/

[iii] See https://ceres2030.org/reducing-food-loss/

[iv] The protocol can be viewed here: https://osf.io/xcv4s/