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Review

Review: Food loss and waste in Sub-Saharan Africa

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ABSTRACT

The research, development practitioner, and donor community has begun to focus on food loss and waste – often referred to as post-harvest losses (PHL) – in Sub-Saharan Africa. This article reviews the current state of the literature on PHL mitigation. First, we identify explicitly the varied objectives underlying efforts to reduce PHL levels. Second, we summarize the estimated magnitudes of losses, evaluate the methodologies used to generate those estimates, and explore the dearth of thoughtful assessment around "optimal" PHL levels. Third, we synthesize and critique the impact evaluation literature around on-farm and off-farm interventions expected to deliver PHL reduction. Fourth, we suggest a suite of other approaches to advancing these same objectives, some of which may prove more cost-effective. Finally, we conclude with a summary of main points.

1. Introduction

In September 2015, the United Nations (UN) ambitiously announced a goal of halving worldwide food waste and substantially reducing global food loss by 2030 as part of its Sustainable Development Goals (SDG) agenda. This pledge codifies the huge amount of renewed international attention around reducing the edible losses and waste incurred between farm and fork in the global food system. In Sub-Saharan Africa (SSA), where rural populations depend heavily on food production for their income and food purchases make up a large portion of expenditures in both rural and urban areas, the dialogue is most focused around the theme of "post-harvest losses" (PHL), those that reflect potential consumables that leave farmers' fields but never make their way into consumers' mouths. With so much interest and the prospect for significant resource mobilization aimed at reducing PHL, perhaps especially in SSA, it is important to establish what we already know about PHL and interventions aimed at their reduction. Despite plenty of enthusiasm in the development community, holes in critically synthesizing the abundant research still remain.

This review aims to guide development practitioners, donors, and the research community struggling to identify how to devote their time and resources to PHL mitigation. In so doing, we suggest that this community refocus its approach by first returning to the objectives underlying the desire to reduce PHL levels, of which we offer four (Section 2). Then, since most research and interventions to date are merely guided by the estimated magnitude of PHL, we summarize the current state of our understanding of loss levels, critique the methodologies and gaps therein, and explore the lack of thoughtful assessment around the "optimal" PHL levels for which we should be striving (Section 3). We continue by synthesizing the impact evaluation literature around five on-farm PHL reduction interventions, establishing the many gaps that remain in this evidence base, and detailing some of the unique adoption (and dis-adoption) challenges in this arena (Section 4). Because the impact evaluation literature for most existing PHL technologies remains meager and given substantial work specifically on storage technologies, we also discuss four off-farm interventions that may deliver significant PHL reduction alongside broader benefits (also Section 4). We then return to the four objectives we see as guiding the renewed interest in PHL reduction to suggest a suite of other

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approaches to advancing these same goals, likely with greater cost-effectiveness (Section 5). Finally, we conclude with a summary of main points (Section 6).

We do not attempt to reconcile the competing definitions of food waste, food loss, and PHL or the distinctions between surplus versus loss as proposed by Papargyropoulou et al. (2014). In most work on the topic, food loss refers to anything lost by producers or in distribution while food waste refers to anything lost at the consumer level (de Gorter, 2014), although new work by Bellemare et al. (2017) challenges these existing definitions using a food life cycle approach. These lines are drawn mostly for convenience reasons and are clearly blurred for rural SSA households who often function as both producers and consumers, rendering the categorization essentially meaningless in this context. We prefer to adopt the approach that refers generically to food loss and waste (FLW), a term we use interchangeably with PHL.

2. Objectives underpinning investments in reducing PHL

The reasons for the renewed interest in PHL reduction in SSA are best understood by enumerating the multifaceted objectives underpinning the goal recently announced by the UN. One main finding of our review is the lack of a well-defined objective guiding most research and interventions to date, as echoed by the High Level Panel of Experts on Food Security and Nutrition (2014). Most research is motivated only by invocation of the estimated magnitude of PHL and not by what the magnitude means nor by its consequences. Moreover, even when an objective is identified – for example, expanding the supply of grain available to consumers – the full set of subpopulations that might gain or lose from reducing PHL – farmers, middlemen, consumers, etc. – are rarely considered in full. We start by articulating the four objectives that we see as most important in guiding research and interventions on PHL in SSA.

The first objective is ***to improve food security*** via all four internationally recognized pillars: availability, access, utilization, and stability (FAO, 2008). By definition, reducing food loss increases the quantity of food available which can reduce the need to supplement availability through transfer programs (at household level) or via commercial imports or food aid donations (at national level). An increased food supply, under normal circumstances, should also translate into a reduction in prices for consumers, improving overall access. It is no accident that the surge of interest in PHL reduction emerged with the 2007 and 2011 global food price spikes. Retention of inferior quality products, those most likely to be lost currently, could disproportionately benefit the poor where there are price discounts associated with lower quality food (Kadjo et al., 2016). PHL reduction in the form of food quality, for example due to vitamin or protein decay, can improve food utilization (nutrition) among consumers. An increase in retained food can be especially important seasonally in places where the prices of storable staples commonly increase sharply several months after the harvest period, by improving access precisely when seasonally food insecure households most need it and by providing stability.

The second objective is ***to improve food safety***, as distinct from food security. Plenty of food is lost in our system because the quality deteriorates beyond what is acceptable for human consumption. But sometimes spoilage or contamination is not perceptible to the human senses and goes undetected, leading to adverse health effects when food is consumed. Several well-publicized outbreaks of acute aflatoxicosis in SSA – including the death of 125 Kenyans in 2004 – suggest undetected food spoilage with very severe human health implications. Mycotoxins, in the forms of fumonisin and aflatoxins, can lead to slow-developing esophageal and liver cancers (respectively) and are growth-retarding and immunosuppressive even in doses well-short of the more sensational, and often deadly, acute aflatoxicosis. These food safety concerns, arising from fungal or pest infestations, have major disease and global health implications.

The third objective is ***to reduce unnecessary resource use***. These resources come in the form of on-farm inputs that pose sustainability challenges, including water, chemical fertilizer, agrochemicals, labor, and land. Anticipated PHL by farmers may mean that more of these resources are used than is necessary to meet production or consumption targets. Reducing PHL and, thereby, creating a longer term incentive for farmers to use complementary resources more effectively and efficiently, this line of thinking goes, could ultimately lead to a reduction in the use of scarce resources. Where there may be adverse environmental or human health consequences to use or overuse of inorganic fertilizer (Ayoub, 1999) or pesticides (Sheahan et al., 2017), minimizing unnecessary applications via the reduction of expected PHL could be particularly advantageous. Similar arguments apply to the post-harvest value chain, where reduced PHL could, in principle, reduce fuel costs, transport-related pollution, energy consumption in processing, etc. Not only might limiting input use result in environmental or human health benefits, but it should also reduce costs for farmers, traders, processors, and other actors in food value chains, potentially leading to an increase in profits and a decrease in consumer food prices.

Elaborating on this point, the fourth objective is ***to increase profits for food value chain actors***. The private sector, including smallholder farmers, plays an undeniably central role in making food available to consumers and, at levels above the farmer, establishing a supply chain for producers to utilize. The vast majority of food flows through commercial, not government or non-profit, channels in SSA. Insofar as profit is a natural objective of commercial entities, reducing waste and thereby cost holds natural appeal to private actors in food value chains. In SSA, PHL reduction could mean improving the livelihoods of both smallholder farmers and large-scale agribusinesses. Indeed, recognizing this natural profit motive to reduce PHL that is intrinsic to virtually all actors in food systems in SSA (and elsewhere) is essential to a clear-eyed understanding of the likely benefits to direct interventions that reduce PHL. For the most part, with the partial exception of food safety considerations, private sector actors have a strong material incentive to reduce PHL for their own revenue and profit maximization goals.

3. Estimated magnitudes of PHL

PHL can occur anywhere between farmers' fields and consumers' plates: at harvest, drying, winnowing, cleaning, on-farm storage, handling, milling, processing, transport, larger-scale mixed storage, retailing, and consumers' home storage, meal preparation, and consumption. We provide a generalized picture of the post-harvest environment in SSA in the Appendix, detailing where and how losses occur in each of these nodes. It should be acknowledged, however, that the PHL environment varies significantly by crop, country, and even region within country, necessitating a careful review of specific contexts before investing or offering a one-size-fits-all approach.

The urgency of the need to reduce PHL in SSA depends largely on the magnitude of such losses relative to some estimated optimum PHL levels. Similarly, the ability to assess the impact of PHL remediation strategies also hinges on the ability to accurately measure losses before and after an intervention. The sheer number of existing PHL estimates is dizzying, but one of the important takeaways from our review is the lack of consensus on loss size, both in physical mass and value. In this section, we review some of