Overview

Common wisdom: Postharvest losses (PHL) of food are seriously large and harm food supplies.

Findings:

- The perceived reality appears quite different from the common wisdom—at least in Malawi, Tanzania, and Uganda. Farmers report PHL levels (for maize) that are significantly lower than previous estimates. Only a fifth of farmers report postharvest losses.
- The average loss ranges from just 1.4 percent of the maize harvest in Malawi to 5.9 percent in Uganda.
- But farmers who experience losses typically report substantial losses, amounting to between 20 and 27 percent of their harvests.
- How much PHL will occur depends on how long the food is stored, and thus on the decisions by farmers about whether to consume it or sell in the marketplace (and when).
- Most farmers report that most losses occur because of pests and insects.
- The study finds the extent of seasonality in food prices, the humidity and temperature of the environment, and the education level of the household head to be significant in explaining PHL.

Policy message: PHL seems to affect a minority of farmers. Targeting interventions to improve postharvest handling techniques (especially those on the farm) will be key. Moreover, scaling up these interventions must be based on a better understanding of the true extent of PHL. The use of nationally representative data is an important step in the right direction. The findings are suggestive that interventions encouraging the use of improved storage and crop protection technologies would be effective in reducing food loss. But this must be weighed against the cost.
Interventions outside the sector are also highlighted—with better market access and postprimary education being critical.

The Issue: How Large is Postharvest Loss Really?

Since the world food crisis of 2007/08, global attention has focused on postharvest losses (PHL) of food production. Initial estimates suggested losses were high, especially in Sub-Saharan Africa (APHLIS 2013; FAO 2011; Lipinski et al. 2013). The oft-quoted Food and Agriculture Organization (FAO) estimate claimed that from farm to fork, these losses amounted to 37 percent of food production. Losses were thought to be so large that reducing them would go some way toward dealing with global shortages. Is this a myth or a reality?

Previous estimates were often based on tenuous assumptions and outdated and inappropriate data. Lipton (1982) already expressed doubts about the evidence for large PHL. And a recent meta-analysis (Affognon et al. 2015) came to similar conclusions—there simply is not enough reliable evidence on PHL for policy and monitoring purposes.

The Analysis: Ask the Farmers

The study takes a fresh look at this situation by using nationally representative household survey data from three African countries (Malawi, Tanzania, and Uganda) collected under the Living Standards Measurement Study–Integrated Surveys on Agriculture initiative (LSMS-ISA). The PHL estimates from the Africa Post-Harvest Loss Information System (APHLIS) and FAO are based on national extrapolations from purposively sampled (and often older) in-depth case studies of on-farm and off-farm PHL. The estimates reported in this study are based on recent nationally representative samples, thus avoiding sample selection bias. This is important, as one is unlikely to go and study PHL in environments where one does not expect to find any.

The key departure from previous studies is that the estimates are obtained directly from the farmers and nationally representative surveys. In the surveys, farmers were asked about the crops grown and the amounts harvested. In addition, they were asked two simple questions: “Did you incur any PHL due to rodents, pests, insects, flooding, rotting, theft, and other reasons?” And if yes, “What proportion of the harvest was lost?”

- Three advantages: farmers know best and might give more accurate estimates of losses; the data provide insights into farmers’ perceptions of the problem, which likely drive their storage and postharvest handling decisions; and the estimates are based on nationally representative data, minimizing sampling biases.
- Three limitations: only three countries are covered, so the results may not apply to Africa as a whole; the focus is on one (albeit a very important) food crop—maize; and it is not clear whether farmers are providing information just about on-farm losses, or including as well marketing losses.
The estimates reported in the study—based on the household surveys—complement and enrich existing information approaches, such as APHLIS. But even so, deriving robust estimates from the surveys is not easy (box 17.1).

**Box 17.1  Estimating PHL from the Surveys**

Given the survey design of the Living Standards Measurement Study–Integrated Surveys on Agriculture, households are visited only once, and that can be at any time in the agricultural cycle. This creates difficulties for estimating postharvest losses (PHL), since losses vary depending on how long ago the last harvest occurred. Some households will be interviewed close to the harvest, and others sometime later. Since the objective is to get good estimates of annual PHL for each household, the study adjusts their responses, to take into account when farmers were interviewed relative to the harvest. In adjusting the data, the study makes all households comparable in their PHL, as if they were all interviewed just before the new harvest of the next agricultural season.

The study therefore predicts what PHL households are likely to incur between the interview and the next harvest, and adds this to the reported PHL. To do so, the study exploits the fact that the survey has been carried out throughout the year. Although each household was surveyed only once, different households were surveyed at different points during the year, with the households sampled so that they would each time constitute a nationally representative sample. By making them observationally equivalent through (cross-sectional) regression analysis applied to the household survey data, the study predicts how much additional loss farmers would have incurred if their reported losses were recorded before the next harvest. The study does the following:

- Uses a Tobit regression to estimate the additional losses for those households reporting PHL at the time of their interview.
- Uses a probit regression to estimate the likelihood that households not reporting losses at the interview might incur PHL between the interview and the next harvest.

The key right-hand-side variable in these regressions is the number of months between the interview and the next harvest, so that the unobserved PHL can be attributed to each household. The regressions also control for other factors (household demographics, market access, climatic conditions, and agroecological zone), and are further used (for Tanzania) to gain a better understanding of the determinants of PHL.

So, what adjustments (or imputations) are made to the PHL reported by the farmers? For farmers who reported PHL at the time of the interview, their PHL is adjusted upward to account for the predicted additional losses between the interview and the next harvest—the latter being estimated to be a cutoff of 11.22 months since the previous harvest. The cutoff is needed because at that stage in the agricultural cycle, the PHL will begin to reflect the next harvest.

And for those who did not report a PHL at the interview, two imputations are made. The first is the likelihood that the farmers would incur PHL between the interview and the next harvest (the cutoff now being 11.64 months since the last harvest). The second is the average PHL the farmers would be predicted to incur in those months.
Georeferencing of all households enables merging the data with the agroecological and geographic characteristics of their habitats. This knowledge is important, as temperature and humidity affect the storability of food when storing in uncontrolled environments. About 90 percent of Ugandan households are in the humid agroecological zones (AEZs)—and 60 percent in the warmer ones. In Tanzania, 65 percent of the households are in tropic warm zones, and 25 percent in cool, subhumid AEZs. Around 10 percent are in semi-arid AEZs. In Malawi, which is drier, 55 percent of the households are in semi-arid AEZs (the vast majority in warm, semi-arid ones) and the remaining 45 percent are in subhumid zones.

The Results: Postharvest Loss Limited, But Concentrated

Are Food Losses Serious?
The farmers report much less PHL than previous estimates suggested (at least for maize production and in these three countries). The proportion of the total maize harvest lost, as reported by the farmers, is 1.4 percent for Malawi in 2010/11, 4.4 percent and 2.9 percent (in 2008/9 and 2010/11, respectively) for Tanzania, and 5.9 percent for Uganda in 2009/10 (figure 17.1). These losses are likely to be mainly losses incurred during on-farm harvesting and postharvest storage and handling, excluding losses incurred during marketing. The losses are much lower than previous estimates—FAO (2011) reports on-farm losses of 8 percent of food production in Sub-Saharan Africa;

Figure 17.1  Self-Reported On-Farm Postharvest Loss Is Low, but Concentrated

Source: Computations from LSMS-ISA data.
Note: PHL = postharvest losses.
APHLIS reports 14 percent for Tanzania, 18 percent for Malawi, and 20 percent for Uganda.

But these are just averages across households. Not all farmers suffer losses—only a minority of them (7 percent in Malawi, between 15 and 19 percent in Tanzania, and 22 percent in Uganda). This minority typically suffers losses ranging between 20 and 27 percent of the (maize) harvest. The overall average therefore is misleadingly low from the perspective of these households. For these farms, PHL is a serious issue, but less so for the farming population or the economy as a whole.

In policy circles, too often the overall food-production-consumption chain is taken to draw attention to PHL issues, while the recommended interventions only address issues related to a subset of the chain (in developing countries, typically on-farm losses). For evidence-based policy interventions, therefore, it makes more sense to focus on on-farm losses.

**What Explains the Losses?**

Although the measured losses in these three countries are much lower than those indicated by conventional wisdom, this does not do away with the fact that they can be a problem, especially for some farmers. Policy interventions should target these farmers. And policies must reflect the specific circumstances in which the losses are occurring. The wide variations in PHL that are observed (emphasized by Stathers, Lamboll, and Mvumi 2013) need to be understood. So what determines the losses?

For food crops, PHL depends on how long the food is stored. When production is marketed, storage time is likely to be short, resulting in less food loss. But this might then lead to other (nonfarm) losses—when transporting the food to the market. When the farm household consumes the food it produces (known as *autoconsumption*), these marketing losses are avoided, but at the expense of higher losses arising from storage, since food would have to be stored for longer. Household consumption will be spread many months after the harvest. The net effect of autoconsumption on food losses depends on which of these counteracting effects prevails—and that is an empirical matter. The use of improved technology in storage and crop treatment, other things equal, will reduce losses, especially when food is consumed by the household. For maize, biophysical studies indicate that without treatment or good storage facilities, losses typically increase rapidly after four months of storage. Consistently, the data suggest that the incentive to employ improved storage technology is greater when food must be stored for longer periods.

The proximate determinants of postharvest food losses (employed in the agronomic literature) are therefore:

- Storage time or, more specifically, the rate of storage depletion
- Choice between autoconsumption and marketing output
- Storage techniques and infrastructure
- Crop protection technology.
These factors are the outcomes of many decisions the farmers must make—how much to plant and harvest, whether to market or consume the food grown, and whether to improve storage or crop protection methods. These decisions in turn depend on farmers’ agroecological and socioeconomic circumstances (for example, where they live, which affects how prone they are to crop deterioration), and the costs and opportunities they face when making these decisions. The study investigates this further through multivariate analysis of observed PHLs in Tanzania. The same probit and Tobit regressions that are used to adjust the PHL estimates for each household (discussed in box 17.1) also provide insights into the determinants of PHL.

In Tanzania, the study finds the following to be important.

- **Economic environment**: two factors play a key role:
  - **Closeness to markets**: Closeness to markets will encourage households to reduce PHL by marketing rather than consuming output (thereby reducing storage time).
  - **Seasonal price gap**: Postharvest prices tend to be low compared with those just before the next harvest (see chapter 16 for a discussion of estimating these seasonal price gaps). The higher opportunity cost of losses during storage (from having to buy maize on the market at a higher price if stocks run out prematurely, or from financial losses from foregoing higher sales prices later in the season) induces households to reduce their PHL. An increase in the seasonal wholesale price gap by one standard deviation reduces the likelihood of reporting PHL by 26 percentage points.

- **Agroecological environment**: The physical environment in which the farm operates also influences the decisions households make, and the consequent PHL outcome. It is the interaction between heat and humidity that is most challenging for preserving food. The effect of both factors is substantial. A 2.3-degree increase, which corresponds to one standard deviation of the average temperatures during the wettest quarter observed in the sample, increases the likelihood of PHL occurring by 21 percentage points, and the predicted level of PHL by 0.95 percentage point (that is, a 25 percent increase in PHL from the household-level annually adjusted average).

- **Household characteristics**: Finally, the characteristics of the farming households will influence the choices made, and their implications for PHL. Two important characteristics were found to be significantly associated with PHL:
  - **Gender**: Female-headed households were found to be less likely to suffer PHL compared with their male counterparts. Other things equal, female-headed households were 4.3 percent less likely to report PHL, and predicted levels of PHL in such households were 12 percent lower.
  - **Education**: PHLs were less likely to occur in households whose heads had postprimary education (not just completed primary). Such households were 8.7 percent less likely to report PHL, and predicted levels of PHL were 27 percent lower.
The Implications

Several messages for policy emerge from these findings.

Better information. These findings add an important note of caution to existing estimates of PHL. The principal concern is that they were often compiled from inappropriate data, using questionable assumptions. The use of nationally representative household survey data (such as the LSMS-ISA) is a step in the right direction, avoiding sampling errors and biases. Such data will complement and inform ongoing measurement approaches, such as APHLIS. But these data are not perfect either. Given the survey design, farmers’ responses had to be adjusted to account for unobserved postinterview losses. And it is not entirely clear whether the farmers’ estimates refer to on-farm losses (mostly storage), or also to losses incurred in marketing. Most estimates of PHL that are typically cited in policy circles cover the whole sequence of food loss, “from farm to fork,” yet the policy preoccupation has been almost entirely with on-farm PHL. And even for the latter, the study’s estimates are only half those currently reported.

Targeting is key. As only a small (although annually changing) proportion of households report a loss, “one-size-fits-all” approaches are bound to fail (as highlighted 30 years ago by Lipton). Understanding why some farmers suffer high levels of PHL and others do not is an essential step in designing the right policy interventions.

Policies outside the sector are important. That low levels of education and lack of market access lead to higher PHL (other things constant) suggests that policy interventions outside the agriculture sector are needed. Improving access to markets, which may also help reduce food price seasonality, and encouraging farmers (or rather their children) to continue to secondary schooling will reduce food waste in the long run.

Gender effect. It is not entirely clear why female-headed households are less prone to PHL than their male counterparts. The implication of this finding would be that extension services designed to influence postharvest practices need to be gender sensitive.

Technology. A range of better postharvest handling techniques is now being tested. In the past, their adoption has often failed. Incorporating farmers’ insights on the benefits of these techniques on the ground when comparing them with the costs of rolling them out will be key.

Behavior. A deeper understanding of farmers’ behavior is also called for. It may well be that farmers do not experience much loss because, in the absence of better storage techniques, they avoid storing beyond four months, when deterioration accelerates rapidly. PHL is then low, exactly because farmers deliberately avoid it, not because it is not an issue. If so, farmers could potentially benefit substantially from better postharvest handling techniques, especially when the seasonal price gaps are substantial (Gitonga et al. 2013).

Going beyond maize. This analysis has focused on maize, which is vital for most farms in Southern and East Africa. Similar work to inform policy is needed for other important staple crops.
Note

1. Following the world food crises of the early and late 1970s, postharvest losses surged to the top of the policy agenda, disappearing to the background again in the following years when food prices came down.

Additional Reading

This chapter draws on:

Other key references:


