ETHIOPIA
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Ethiopian Development Research Institute (EDRI)

STRATEGY SUPPORT PROGRAM | SYNOPSIS OF ESSP WORKING PAPER 115 | RESEARCH NOTE 71 | October 2018

Synopsis: Farmers' grain storage and losses in Ethiopia: Measures and associates

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RESEARCH OVERVIEW

Storage losses of crops on the farm are often assumed to be an important contributor to presumed large post-harvest losses in developing countries. However, reliable and representative estimates on these losses are often lacking. We study farmers' storage decisions and self-reported storage losses for grain crops based on two recent large-scale household surveys conducted in major grain producing areas in Ethiopia. We show that a relatively large share of grain production is stored, mainly for own consumption, and that storage technologies are rudimentary. We find that farmers' self-reported storage losses amount to an average of 4 percent of all grains stored and 2 percent of the total harvest. These storage losses are shown to differ significantly by some households' socio-economic characteristics and wealth and also by crop and prevailing humidity levels. We further see strong spatial heterogeneity in storage losses, being significantly higher in the southwestern part of the country. Efforts to scale up the adoption of improved storage technologies to reduce storage losses at the farm level should take into consideration these characteristics.

INTRODUCTION

Wastage and post-harvest losses (PHL) in food value chains are increasingly being debated, along with the design of policies to reduce this waste (World Bank 2011; FAO 2011). The debate is receiving increasing attention for two reasons. First, it is assumed that reduction of food wastage and PHL will improve food security by ensuring the availability of more food at lower prices. Second, using water, land, fertilizer, and other resources for producing food that is ultimately wasted raises important environmental issues. Reducing food wastage and losses would alleviate these environmental concerns.

The literature provides limited and varying estimates on PHL at different stages of the food value chain, especially so for developing countries. In this study, we focus on understanding grain storage and losses that occur in storage. We assess factors associated with storage decisions and perceived losses during storage of grain crops in Ethiopia using data from two recent large-scale rural household surveys. Although not all food losses occur at the storage stage, it has been found that an important share of losses happen during storage (Minten et al. 2016), making this a potentially promising area of intervention. Most producers store with the intention of consuming their own produce later using simple on-farm storage structures and they may not necessarily have the resources to control pests or prevent rotting. Consequently, better storage options might have important implications for both improved income and improved food security.

This study is important for two reasons. First, losses during storage are assumed to be large in these settings. Given the importance of seasonal stress in rural Ethiopia, a better understanding of food storage behavior and losses during storage is important to inform the food policy debate towards improved food security. Second, improved storage technologies are increasingly becoming available at reduced costs. For example, hermetic closed bags have been adopted quickly in some areas in Ethiopia. Information from this analysis might therefore help in improving the targeting of efforts towards widespread adoption of improved storage technologies.

We investigate five research questions:

1. Patterns (types, proportion, and duration) of grains stored, characteristics of households that store or do not store grain, and storage methods used.
2. Factors associated with households' decision to store grain crops.
3. Self-reported losses of grain crops in storage.
4. Factors associated with losses during grain storage.
5. Prediction of average grain losses during storage for all administrative zones in the country.

DATA

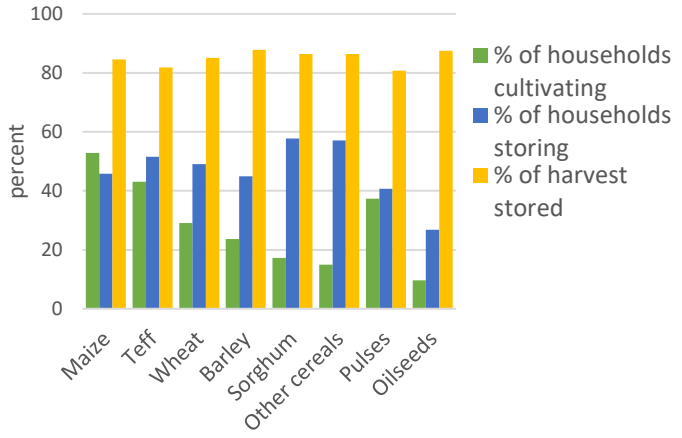
This study relies on two household survey datasets. The first was collected in the midline survey of the Feed the Future (FtF) program. The survey was conducted in July 2015, pertains to the 2014/15 *meher* (main cropping) season, and covers 84 *woredas* (districts) in five regions of the country. This study examines data from 5,092 sample households in Tigray; Amhara; Oromiya; and Southern Nations, Nationalities, and Peoples' (SNNP) regions who produced at least one of 22 types of grain crops. This survey sample subset represents 4.6 million households in 79 of the 84 districts surveyed. The second was collected in the midline survey of the Agricultural Growth Program (AGP) in June 2013. It pertains to the 2012/13 *meher* season, and covers 93 woredas of Tigray, Amhara, Oromiya, and SNNP. The sub-sample analyzed for this study consists of 5,749 grain producers, which represented 7.0 million households residing in all 93 *woredas* covered in the AGP midline survey.

FINDINGS

Patterns of households' grain storage

As shown in Figure 1, 53 percent and 43 percent of grain-producing households cultivate maize and teff, respectively; while fewer, 17 percent and 10 percent, cultivate sorghum and oilseeds. 56 percent of grain-producing households store harvests of one or more crops: 45 to 57 percent store cereals, 41 percent store pluses, and the lowest, 27 percent, store oilseeds. In addition, households store between 80 and

Figure 1: Crop cultivation and storage (*Meher* 2014/15)



Source: Authors' analysis using FtF midline (2015) survey dataset.

90 percent of their harvested grain. Households produce cereals and pulses mostly for own consumption – 84 percent of sorghum harvested is used by the household and 66 percent for pulses and teff. Teff is the most commercialized cereal with 25 percent of output sold. Most oilseeds (73 percent) are sold. Moreover, patterns of grain utilization are similar among storing and non-storing households with 72 percent and 70 percent used for own consumption, and 19 percent and 18 percent sold, respectively.

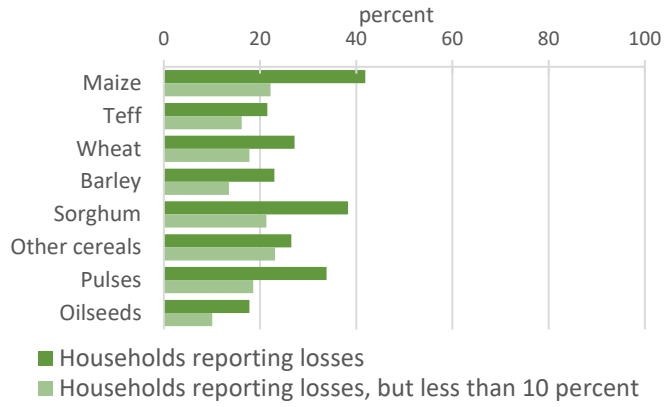
Crop storage duration is similar across different grain crops and is on average 6 months. The majority (83 percent) of storing households use rudimentary storage methods, with 49 percent of them using locally made traditional storage and 36 percent using sacks or open drums to store grains. The order of importance of the storage techniques used holds for all crops, except that modern storage is more important than unprotected piles for oilseeds and other cereals. Moreover, households that employ improved locally made or modern storage techniques are wealthier than those that use rudimentary storage methods.

Storage losses

About 29 percent of storing households reported losses of stored grains. More households reported losses for maize, sorghum, and pluses and fewer for barley, teff and oilseeds (Figure 2). For all grains, and for over half of the cases where losses were reported, the losses were less than 10 percent of stored grains.

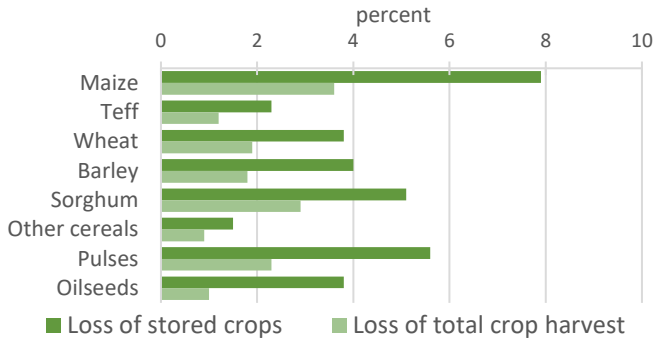
The loss during storage is on average 4.2 percent of stored grains, with the highest in maize (7.9 percent), followed by pulses and sorghum, and the lowest in teff and other cereals (Figure 3). Accounting for all crops, stored and not stored, the

Figure 2: Households reporting storage losses (*Meher* 2014/15)



Source: Authors' analysis using FtF midline (2015) survey dataset.

Figure 3: Percentage loss of stored grains and total harvest (*Meher* 2014/15)



Source: Authors' analysis using FtF midline (2015) survey dataset.

reported loss during storage accounts for 1.9 percent of the total harvest, based on the FtF data.

Associates of losses during storage

Humidity is among the most important and consistent variables in influencing the occurrence and extent of storage losses, in addition to its significant effect on the storage decision. Under higher relative humidity, stored grains are more likely to be damaged and the extent of losses is higher.

In terms of household characteristics associated with storage loss, the evidence from both datasets suggests that households with heads that had some secondary education are less likely to incur damage and have lower losses compared with those with illiterate heads. This is likely as more educated heads could grasp written materials, among others, on proper crop storage methods.

The results show that wealthier households not only are associated with higher likelihood of storing grains, but also have a lower likelihood and less extent of damage occurring to the grain they store. This may be in part due to wealthier households having better storage technology than poorer ones.

Finally, households living farther away from larger towns are more likely to report storage losses and have a greater extent of loss. The negative relationship between price gaps and the likelihood of the occurrence of storage damage may stem from the economic incentive that motivates better care and/or improved storage techniques for stored grains.

Mapping zonal grain losses during storage

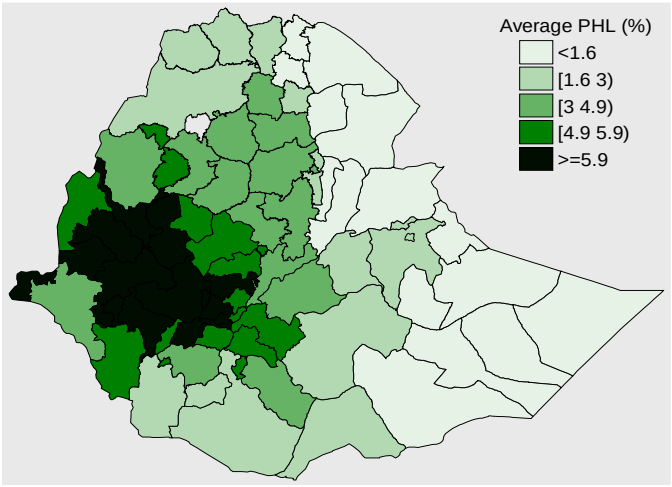
We use the estimate of relative humidity in a storage loss equation developed from analysis of the FtF dataset together with the data on relative humidity to make a simple prediction of grain losses during storage.

We map the results obtained from this exercise in Figure 4, which depicts the zonal average predicted grain losses during storage. The map indicates that the eastern parts of the country, such as areas in Afar, Somali, Harari, and Dire Dawa regions, which receive relatively lower rainfall and are drier, are expected to experience the lowest losses in grain storage. In contrast, Gambella and Benishangul-Gumuz regions, and northern SNNP, which generally have higher average relative humidity, are expected to have the highest storage losses. The predictions indicate that western parts of Oromiya and southern Amhara have fairly high grain storage losses.

CONCLUSIONS AND POLICY IMPLICATIONS

Policies aimed at improving storage capacity will likely have an impact on food security by increasing food availability and reducing seasonal stress for rural households, because they overwhelmingly use their grain for own consumption. When

Figure 4: Predicted zonal average damage to grain during storage



Source: Authors' analysis using FtF midline (2015) survey dataset.
PHL = post-harvest loss

designing storage policies, it is therefore advisable to consider their impact on food security at the household level in its widely recognized four dimensions—availability, access, utilization, and stability. There is considerable potential to increase the share of households that store grain crops and use improved storage technologies.

Nonetheless, most households use rudimentary storage technologies despite the availability of better technologies. It is important to assess the benefits and costs of adopting different storage technologies, and investigate the factors influencing households' adoption. Such research is needed so that policies will be more effective in incentivizing adoption and promoting effective use of these technologies.

Farmers' perception of storage losses matters for their decision to store and invest in improved technologies. Households' self-reported losses during storage are low in this study, which may indicate a lack of awareness by farmers of actual losses. It indicates the need to raise the awareness of storage losses and of benefits of improving storage capacity, as well as the need to assess actual storage losses using objective measures.

Households with more educated heads are more likely to store grains with less frequent and lower reported losses. These educated and innovative farmers could be valuable in promoting storage practices and sharing their experiences. This suggests that knowledge and its applications are important to the storage decision and the effective use of storage. Extension services can be crucial for raising awareness and knowledge about the benefits of and returns to grain storage and of suitable and effective storage technologies. Therefore, extension programs that can inform farmers about storage practices or technology and can effectively transfer the knowledge and skills are likely to have an impact on the adoption and effective use of the technology.

Engaging and empowering women in households' decisions on grain storage has potentially important implications for smoothened seasonal food consumption and increased household income. This is because female-headed households generally are more likely to store grains to consume or sell later.

Households that reside in more humid areas are less likely to store grains. Higher relative humidity is found to increase both the likelihood and the extent of storage losses. Effective solutions to address storage losses due to humidity, especially for humid regions of the country, should be sought.

Households respond to price incentives by storing grains and taking better care of stored grains. Storage policies could also have implications for increasing rural incomes because households could potentially have more produce for sale, store their crops longer, and sell them at better prices. Hence, it is advisable to consider storage policies in tandem with those that improve market access and functioning of the market and incentive mechanisms.

Household characteristics, the types of crops they produce, households' crop production characteristics, economic incentives, market access, and ecological and climatic conditions are all relevant factors associated with households' grain storage behavior. Therefore, strategies and solutions that address food losses and storage issues should adapt to households' and communities' needs and conditions. It is important to identify those most in need and prioritize resources and support accordingly. On the other hand, it is advisable to target relevant solutions at households that are most likely to adopt improved storage practices and technologies. These are female-headed, educated, wealthier households growing cereals and pulses, or those households living in areas that are more humid, remote, or have considerable seasonal price gaps. These households could also play an important role in promoting and diffusing storage practice and technologies in their communities.

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The Ethiopia Strategy Support Program (ESSP) is managed by the International Food Policy Research Institute (IFPRI) and is financially supported by the United States Agency for International Development (USAID), the Department for International Development (DFID) of the government of the United Kingdom, and the European Union (EU). Financial support for this research was also received from the Monitoring and Analysing Food and Agricultural Policies (MAFAP) program of FAO. The research presented here was conducted as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by IFPRI. This publication has been prepared as an output of ESSP and has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and do not necessarily reflect those of IFPRI, the Ethiopian Development Research Institute, USAID, DFID, the EU, FAO, PIM, or CGIAR.