Extended Abstract

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Paper/Poster Title	Post Harvest Losses and Climate Conditions in Sub-Saharan Africa

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Abstract	*200 words max*

Post–harvest losses (PHL) are particularly critical for developing countries. This is especially evident in Sub-Saharan (SSA) countries, where PHL are estimated to be about 37% of the total food production. Climate is a core determinant of cereal losses, as biodeterioration factors are sensitive to the temperature and humidity. In this paper we analyse to what extent climatic conditions affect PHL. The analysis considers Sub-Saharan countries and focuses on maize production over the period 2000-2020 period. Data on PHL are taken from APHLIS (African Postharvest Losses Information System), which represents a network of cereals and grain experts in SSA countries. Data collected by APHLIS are aimed at improving existing aggregated data on PHL (e.g. FAO data). PHL data quantify the percentage loss for each phase of the post-harvest chain. APHLIS has some unique characteristics, as it provides PHL at the province (Administrative 1 - ADM1) level over time. The main results of our analysis suggest that temperature is the most relevant determinant of PHL in this region, with high-temperature leading to a significant increase in maize PHL. Our results are relevant, especially if we consider that the future projections of climate change indicates a steady temperature increase in this area.

Keywords	Post-harvest Losses; Precipitation; Temperature; Sub-Saharan Africa.
JEL Code	Q54, Q51, Q15

Introduction	*100 – 250 words*

Despite the growing availability of food over the last fifty years, more than one in seven people still does not have access to a sufficient protein and energy intake (Godfray et al. 2010). The need to improve food production is however complicated by the growing threats posed by climate change, and the simultaneous concerns on how the resulting mitigation and adaptation strategies will affect the food system (Godfray et al., 2010). Notwithstanding this critical situation, food waste and losses are estimated to be, on average, about 32% of the global food production (FAO, 2010). Post–harvest losses (PHL) are particularly critical for developing countries. This is especially evident in Sub-Saharan (SSA) countries, where PHL are estimated to be about 37% of the total food production (Kaminski and Christiaensen, 2014). Climate is a core determinant of cereal losses, as biodeterioration factors are sensitive to the temperature and humidity. Climate and storage strategies are therefore correlated: hot and humid climates lead farmers to adopt open storage structure, while in hot and dry climates sealed storage are preferable. If climatic conditions do not guarantee the proper drying setting, PHL may increase substantially. Against this background, in this paper we analyse to what extent climatic conditions affect PHL. The analysis considers Sub-Saharan countries and focuses on maize production over the period 2000-2020 period. Our research question is relevant, as in the near future the high instability generated by climate change may further contribute to PHL growth (Tefera, 2012).

Methodology	***100 – 250 words***

Data on PHL are taken from APHLIS (African Postharvest Losses Information System), which represents a network of cereals and grain experts in SSA countries that has the objective to provide accurate estimate of PHL in these countries at the regional level. PHL data quantify the percentage loss for each phase of the post-harvest chain. APHLIS considers the net weight losses in dry substance occurred after a determined post-harvest activity. We collect data at the highest level of disaggregation available, namely at the province (Administrative 1 - ADM1) level. Among different cereals, the analysis focuses on maize, as it represents the most important staple in SSA countries. Data on rainfall and temperature are taken from the ERA5-Land (Muñoz Sabater, J., 2019, 2021) dataset. It provides monthly gridded data at 0.1° x 0.1° resolution that we aggregate to match the administrative boundaries.

Using these data we test the following empirical specification:

$$PHL_{ijt} = \beta_1 Rain_{ijt} + \beta_2 Rain_{ijt}^2 + \beta_3 Temp_{ijt} + \beta_4 Temp_{ijt}^2 + \gamma_j + \delta_t + \rho_{ixt} + \varepsilon_{ijt},$$

Were, PHL_{ijt} represents the percentage of maize post-harvest losses in country *i*, province *j* in the year *t* ; $Rain_{ijt}$ is total annual rainfall and $Temp_{ijt}$ is average yearly temperature in country *i*, region *j* and year *t*. Both these variables enter in our empirical specification as linear and quadratic, to control for non-linear relationship. We control for a large set of fixed effects: γ_j are province fixed effects; δ_t year fixed effects; we also introduce country specfiic time trends ρ_{ixt} to control for potential un-observable country changes.

Results	***100 – 250 words***

Our preliminary results reveal a positive effect of both rainfall and temperature on PHL. Temperature and water content are known to be the most important determinants affecting the quality of grains during the storage. This is because high temperature and water content are associated to high biological activity, which lead to a more pronounced deterioration of maize, and grains in general (Coradi et al., 2020). Moreover, an excess of drying leads the water content to be below the optimal storage level, inducing to important quality and quantity losses. Our empirical results however suggest that only temperature is significantly associated to higher post-harvest losses. When introducing in the main equation the quadratic rainfall and temperature terms, the results show that the relationship between maize PHL and temperature is non-linear, and assumes a U-shape. While the linear temperature coefficient is negative and significant, the squared term is positive and significant. The estimated turning point is around 29 °C. The coefficients of rainfall variables do not suggest any significant relationship with PHL.

Our analysis also tests the relationship between PHL, temperature and precipitation considering different type of climate, as defined by the Köppen Climate classification. Interestingly, the non-linear temperature effect holds for Warm and Temperate climates, but not for Tropical climate.

Discussion and Conclusion	***100 – 250 words***
The main results of this paper stress the importance of climatic conditions, and temperature in particular, in affecting maize PHL in SSA. The results are particularly relevant if we consider that the future projections of climate change indicate a steady temperature increase in this region. Although our results may be thought as not surprising, this paper is the first one proving this effect empirically on an extensive sample of countries over time. These results thus stress one more time the importance of developing efficient post-harvest strategies in these countries. Effective post-harvest management practices may indeed not only improve food availability, but they could also reduce pressure on natural resources.	