The NUTRI-P-LOSS tool

A prediction of nutritional postharvest losses along crop value chains

ANH2022 Agriculture, Nutrition and Health Academy Week
www.ANH-Academy.org/ANH2022
#ANH2022

IMMANA Innovative Methods and Metrics for Agriculture and Nutrition Actions

Aurélie Bechoff, Apurba Shee, Brighton M. Mvumi, Patrick Ngwenyama, Hawi Debelo, Mario G. Ferruzzi, Loveness K. Nyanga, Sarah Mayanja, Keith I. Tomlins

Introduction: Building food systems that are resilient to climate change, global shocks (e.g. Covid-19), and deliver effectively sustainable and nutritious food is a global priority. Our current food systems often show signs of inefficiency due to high levels of postharvest losses (≈30% according to FAO), negative environmental impact, and lack of focus on healthy and nutritious food. Mitigating postharvest losses for food security crops that feed a large part of countries' population could have a significant nutritional impact. Yet, there is little information on levels of nutrient losses along value chains, e.g. between the time a crop is harvested and sold.

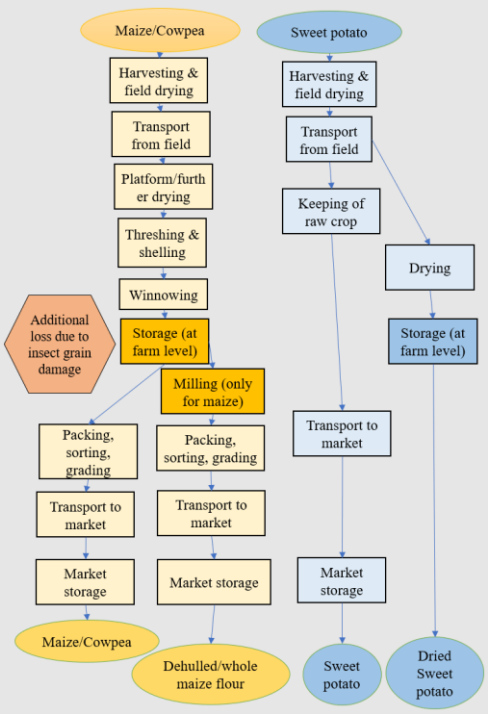
Methods: The IMMANA-funded NUTRI-P-LOSS project (2016-19) built a methodology and a tool to estimate nutritional postharvest losses along crop value chains. Case studies were developed with food security crops including maize and cowpea in Zimbabwe, and sweet potato in Uganda. Predictive models used open data, controlled laboratory experiments, and field trials.

(1) Existing data on physical postharvest losses of maize, sweet potato and cowpea generated by the African Postharvest Loss Information System (APHLIS) were converted into nutrient losses using nutritional composition of food crops collected during laboratory or field trials. Macronutrients (calorimetric energy, protein, fat, carbohydrates) and micronutrients of public health importance (iron, zinc, and vitamin A) were included.

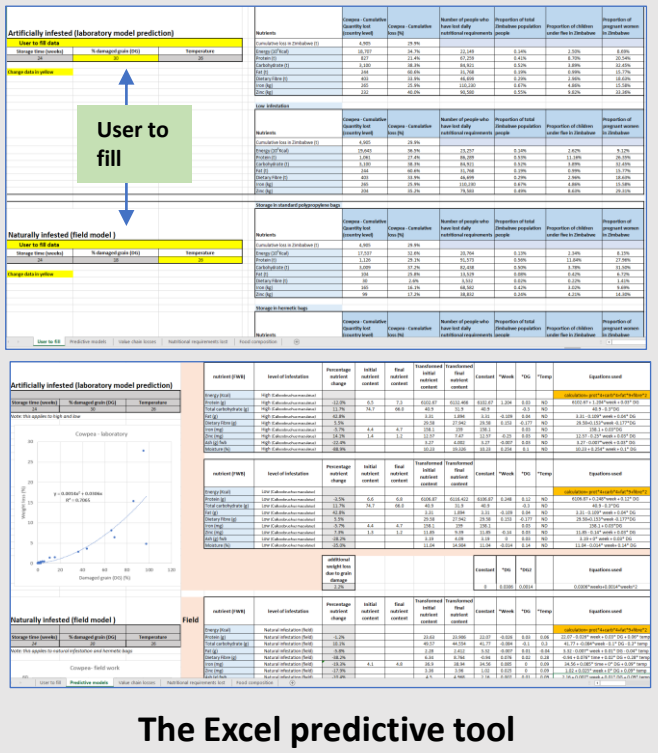
(2) Changes in nutrient levels (due to quality alteration of the product *i.e.* during storage) were measured: (a) in a UK-based laboratory with controlled levels of insect infestation, and (b) in the field in Zimbabwe with natural insect infestation. Nutrient composition of sweet potato collected at different steps of value chain in Uganda was also determined.

'Quantitative' (1) and 'qualitative' (2) models were combined and used to make predictions of nutritional losses at various temperatures, storage times, and levels of insect infestation. Nutritional impact on countries' population was also estimated based on average daily nutritional requirements.

Storage of crops at farm level



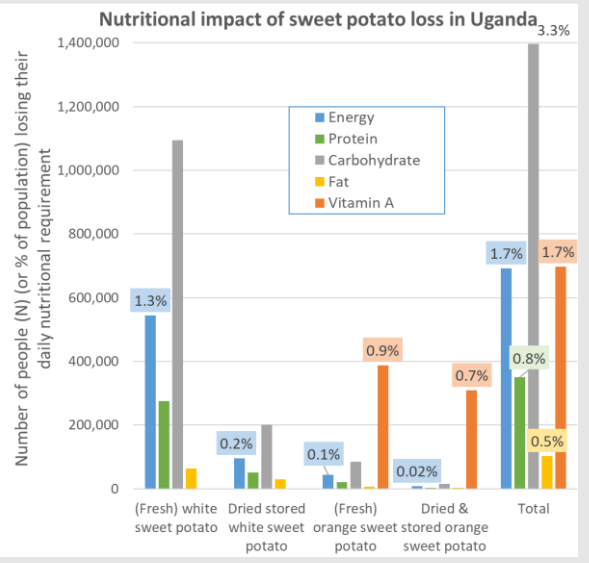
Steps of crop value chains

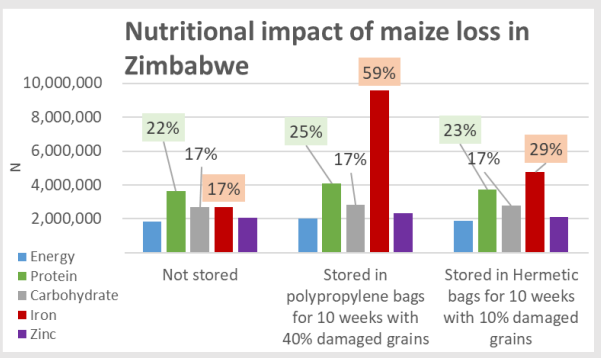


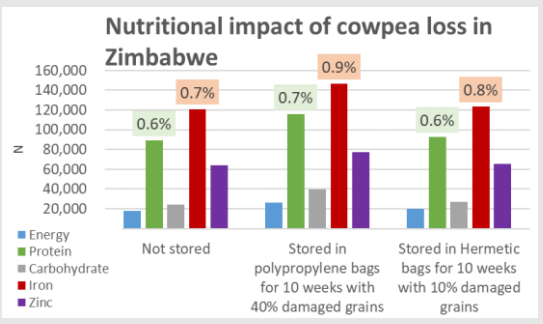
The Excel predictive tool

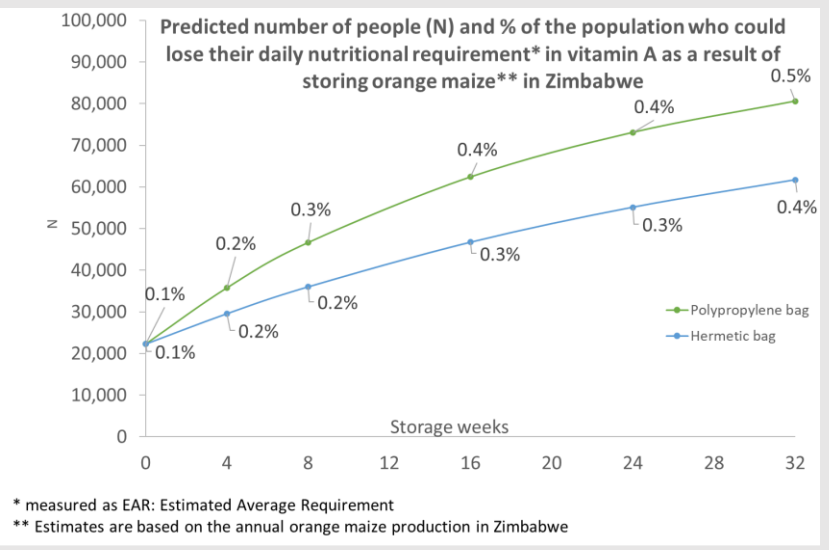
Results: The percentage of the Ugandan population potentially losing their daily nutritional requirement (defined here as Estimated Average Requirement (EAR)) in energy as a result of sweet potato postharvest loss is estimated to around 70,000 people (1.7% of the population).

Despite a small production, orange maize, fresh and dried orange fleshed sweet potato (OFSP) potentially represent a significant source of vitamin A, and their loss could have a nutritional impact at the national level. Sweet potato daily loss in production in Uganda equates to 400,000 and 300,000 people losing their EAR in vitamin A from fresh and dried OFSP, respectively. Loss of white maize would be equivalent to a staggering 17% of the population of Zimbabwe losing their EAR for carbohydrate, and 22–25% of EAR for protein, depending on the type of storage selected. Loss of cowpea would be equivalent to about 2% of the children under five-year-old in Zimbabwe losing their EAR in protein and 0.4% of pregnant women, respectively. For iron, this will represent around 0.9% and 0.2% of children and women, respectively and for zinc, about 1.2% and 0.3%, respectively. According to our predictive model, postharvest losses therefore have significant impact on population's access to nutrients.









* measured as EAR: Estimated Average Requirement
** Estimates are based on the annual orange maize production in Zimbabwe

How were nutritional losses measured?

1. Literature review

Including information from BMGF-funded APHLIS+ project

2. Lab. studies

Conducted at Natural Resources Institute (NRI), UK

3. Field verification

Zimbabwe & Uganda (University of Zimbabwe, NARO Uganda, International Potato Center (CIP), NRI)

What type of nutritional losses?

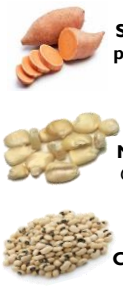
1. Quantitative losses

Building on APHLIS+ weight losses (e.g. Losses during transport. If 100kg maize is lost, the equivalent nutrient content can be calculated)

2. Qualitative losses

Other losses not associated with weight loss (e.g. Losses during storage. Pro-vitamin A levels in sweet potato decrease during storage)

Which crops?



Sweet potato *Root*

Maize *Cereal*

Cowpea *Pulse*

Which nutrients?

- ✓Protein
- ✓Carbohydrates
- ✓Lipids
- ✓Dietary fibre
- ✓Vitamin A
- ✓Iron
- ✓Zinc

Conclusion: This NUTRI-P-LOSS tool presents an original approach to estimation of nutritional postharvest losses of key-food security commodities combining 'quantitative' and 'qualitative' loss predictions. Reconciliation of the laboratory and field data during storage were challenging, in part because of the limited data available, and differences between controlled and field settings. However, at a broader scale, both predictive models led to similar conclusions in terms of nutritional implications. Hence, the complementarity of laboratory and field data strengthen the estimates generated. Based on the model predictions of NUTRI-P-LOSS, policy recommendations to mitigate nutritional postharvest losses in the food system can be elaborated.

Link to 2022 publication: Bechoff, A., Shee, A., Mvumi, B.M., Ngwenyama, P., Debelo, H. Ferruzzi, M.G., Nyanga L.K., Mayanja, S., Tomlins, K.I., 2022. Estimation of nutritional postharvest losses along food value chains: A case study of three key food security commodities in sub-Saharan Africa. *Food Security*, 1-20. https://link.springer.com/article/10.1007/s12571-021-01238-9

UNIVERSITY of GREENWICH | NRI Natural Resources Institute | PURDUE UNIVERSITY | CENTRO INTERNACIONAL DE LA PAPA CIP | NARO | UKaid from the British people