Mitigating Maize Postharvest Losses Through Participatory Training in Rural Uganda

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Introduction/Need for the Study

Maize is the most-grown food crop in eastern Uganda where this study was conducted and mostly grown by small-scale farmers on the subsistence level for sale and home consumption (Ikendi et al., 2024). However, these farmers are affected by postharvest losses along the value chain necessitating the provision of information through participatory training (Brumm et al., 2021). The participatory approach involves the full participation of farmers with their educators in identifying the problems and brainstorming solutions (Rogers, 2003); leading to community empowerment as espoused by John Dewey (1938) in his problem-solving approach and the role of education in community development. Agricultural extension agents organize and conduct group discussions, demonstrations, and visits to model farmers to share improved postharvest technologies. Focusing on the expressed needs of farmers improves knowledge uptake, implementation, and acceptance of innovative ideas. This study assessed the impact of the participatory postharvest training of farmers on mitigating maize postharvest losses, aligned with the U.S. national agricultural education research priority seven focusing on solving complex problems (Andenoro et al., 2016) and research value of international initiatives (AAAE, 2023).

Conceptual Framework

Postharvest losses along the maize value chain pose threats to food security, challenging the goal of achieving zero hunger (Shee et al., 2019). Our study was founded on the *leaky food pipeline* concept modified by Abass et al. (2014) indicating different causes of losses at each stage of the maize value chain. Maize postharvest losses occur along the value chain nodes including losses at harvest, drying, shelling, transportation from the field, transportation to market, and during storage. The losses at any of these stages are mainly due to improper handling, insect infestation, and inefficient storage facilities (Bbosa et al., 2017; Brumm et al., 2021; Shee et al., 2019; Sserunjogi et al., 2021; Taku-Forchu et al., 2023; Tibagonzeka et al., 2018). The *leaky food pipeline* indicates that 15% of losses occur in the field; 13-20% loss occurs during processing, and 15-25% during storage (Abass et al., 2014). A study in eastern Uganda also affirmed that the largest proportion of losses are experienced during drying and storage (Tibagonzeka et al., 2018).

Methods

This study was a cross-sectional survey carried out in Kamuli, Uganda where the Center for Sustainable Rural Livelihoods (CSRL), a U.S.-based non-governmental organization, partners with Iowa State University Uganda Program, and Makerere University to implement livelihood education programs including grain storage/postharvest to end hunger (Ikendi et al., 2023; 2024). Nonprobability sampling criteria were utilized to identify potential participants. Program coordinators led the research team to target maize farmers where 80 households were accessed and interviewed. While the study was broad, this paper focuses on the data on maize losses estimated by farmers that occur at each node of the maize value chain (Abass et al., 2014) and participation in the postharvest extension education programs. All questions were asked and interpreted in Lusoga, a local dialect. The data collected were entered into Excel, cleaned, coded, and analyzed using SPSS version 28. Total maize losses were determined by adding up all the estimated kilograms at each stage of the chain and expressed as a percentage of the total harvest. The loss at each stage was calculated using the reported total maize losses at each stage divided by the total amount of loss and expressed as a percentage. The chi-square test at p=0.05 was used to establish the association between participation in training and total maize losses.

Results and Discussions

The total maize losses were 12.9% (7,050kgs), distributed by stages as 3.6% at harvest, 1.3% in transportation from gardens, 1.5% at drying, 1.8% during shelling, 0.4% at the cleaning stage, and 4.3% lost at storage. These results are supported by Hodges et al. (2014) who found an overall postharvest loss of at least 12%. Estimates of farmers' self-reported perception of maize loss in qualitative and quantitative terms, show that most losses occur at harvest (28.1%) and storage (33.3%). The other stages had losses of 14.0% at shelling, 11.5% at drying, 9.9% during transportation from the field, and 3.3% during cleaning. These findings are comparable to those of Tibagonzeka et al. (2018) who also asserted that high losses were experienced at harvest and storage. The study found that vermin like rodents were the main cause of losses at harvesting and storage; spillage at transportation and cleaning; and breaking of grains at cleaning. In training, we found a strong association between training and total loss (χ^2=12.844, *df*=1, *p*=0.000) where 37.7% (*n*=29) of trained farmers were more likely to get below-average total losses compared to 23.4% (*n*=18) of non-trained farmers. Abass et al. (2014) support these findings and link increased postharvest losses to a lack of training, knowledge, and skills in postharvest food management. Adopting improved grain storage and postharvest handling practices reduces postharvest losses in low-income communities which ensure food security (Bbosa et al, 2017; Brumm et al., 2021; Ikendi et al., 2024; Taku-Forchu et al., 2023; Tumutegyereize et al., 2022).

Conclusions

Postharvest losses are seen to occur at all stages of the maize value chain from harvest to storage reducing the amount of food that reaches the consumers. It can be deduced that harvest and storage are the crucial stages in postharvest loss reduction since the highest quantitative and qualitative losses occur at these stages. The major causes of losses are vermin where maize is consumed by birds at the harvest stage, and rodent and insect damage at the storage stage. Participatory training in grain storage and postharvest handling technologies is an important strategy to reduce the losses (Ikendi et al., 2024); moreover, members of the households who participated in the program's agronomy and postharvest training were more likely to be food secure within this study area (Ikendi et al., 2023). Training is important in influencing the adoption of good postharvest technologies and the use of improved technologies such as drying on tarpaulins and storage in metallic silos are effective in the mitigation of these losses.

Implications and Recommendation

To reduce postharvest losses along the value chain of maize farmers, participatory approaches to capacity building are paramount. While efforts have been invested in extension education programs by the government of Uganda, there is a need to bolster partnerships with non-government programs to complement government efforts. In the study area, we see such efforts in capacity building towards food and nutrition security in different livelihood programs including postharvest (Ikendi et al., 2023; 2024). Dewey (1938) on the role of education asserts that community empowerment is achieved through brainstorming ideas between educators and the community, a practice that influences the adoption of innovative ideas that blend technical knowledge and indigenous knowledge (Rogers, 2003). Further research should be carried out to evaluate factors that determine the adoption of improved postharvest technologies after training and also assess the levels of adoption as prescribed by Rogers (2003). The findings of such continued studies will influence the extension agents' planning and prioritizing of their services.

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