Reducing maize-based aflatoxin contamination and exposure in Zimbabwe

The challenge

In Zimbabwe, testing of harvested maize has revealed significant levels of contamination by aflatoxins. Consumption of contaminated grain can affect human health; babies are also at risk through their mother's breast milk. In young children, aflatoxins can cause stunting, poor cognitive development, and greater susceptibility to infectious diseases. While various technologies have been developed to reduce post-harvest losses, their effectiveness in reducing aflatoxin contamination in grain and exposure in humans is poorly understood.

Objectives

To investigate the efficacy of hermetic storage technologies in reducing aflatoxin contamination in maize grain and exposure to humans.

The solution

- The project used a randomized control trial to test the efficacy of two technologies – metal silos and thick plastic hermetic 'super bags' – against the use of conventional storage methods such as polypropylene bags and mud huts.
- Households selected from 12 wards in the Makoni and Shamva districts were randomly assigned to either an 'intervention' group – using the new technology – or 'control' group – using conventional storage.
- Researchers assessed the extent of aflatoxin contamination in grain using both types of storage on a quarterly basis for two seasons.
- Aflatoxin exposure in mothers and children was assessed through a quarterly analysis of aflatoxin M1 as a biomarker in urine samples, and in the breast milk of mothers.
- In conjunction with the Department of Agricultural Mechanization, 12 artisans were trained to fabricate the metal silos which were distributed to farmers in the intervention group.
- Researchers worked with the Ministries of Health and Agriculture to promote the technologies and disseminate nutrition information to communities.

Key results

Increasing production and reducing post-harvest loss

- The results showed that hermetic technology is more effective at preventing the development of aflatoxin B1 (AFB1) in stored maize, as the occurrence and levels of AFB1 in hermetic storage were less than in conventional storage facilities.
- During the 2014/2015 storage season, the occurrence of AFB1 increased from 0.68-8.8% in hermetic metal silos, 0-8.2% in hermetic bags, and 1.7-14.4% in conventional storage facilities.

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Farmers using hermetic metal silos to store maize have seen a reduction in loss of quality in the grain

- The average maize grain weight loss due to insect contamination was 6.11% for conventional storage, 3.54% for metal silos and 2.54% for hermetic bags.
- The study concluded that hermetic technologies are better than conventional methods and can therefore be used to reduce economic loss due to insect damage.
- Due to training provided by the project, farmers are adopting various good pre- and post-harvest practices to minimize aflatoxin contamination of grain, e.g. drying grain on the bare ground has reduced from 61% at the start of the project to 2% at the end.

Increasing access to resources, markets and incomes

- Conclusions made during the analysis of economic loss when using the improved post-harvest technologies indicate that hermetic technologies increase incomes, as households can hold onto their produce after harvest when there is surplus maize and sell when prices are good during the lean period.
- During the lean period a 20 kg bucket of maize grain stored using conventional methods sells at US$4-US$5.50, in comparison the same amount of maize stored using hermetic technology sells at US$7-US$7.50.

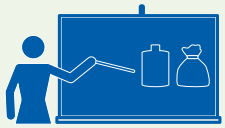
Gender equity and empowerment of women

- Both male and female household members have shown increased collaborative partnerships when carrying out pre- and post-harvest tasks at the household level. For instance, in baseline studies, 68% of respondents stated that maize de-husking was carried out by both men and women. This percentage increased to 92.5% in an endline survey.

- The introduction of hermetic technology is saving women time and labor by removing the need for chemical protectant application to control insect infestations, and subsequent maize cleaning prior to milling.

Health outcomes

- Although the levels of aflatoxin exposure to humans increased with increasing storage time of the harvested crops, results indicated a lower occurrence and concentration of aflatoxin M1 in the urine samples of women and children from households that used the hermetic technology, compared to the urine samples of women and children from households using conventional storage facilities.
- Awareness of aflatoxins and their associated health risks increased among women from 36% in a baseline study in 2015 to 99% in an endline study in 2016.



941 farmers (594 women and 347 men) trained in post-harvest management and use of hermetic technologies

Grain weight loss was reduced from 6.11% in conventional storage to 2.54% in hermetic bags

Women's awareness of aflatoxins and associated health risks increased from 36% in 2015 to 99% in 2016

Grain stored using hermetic technology sells for US$2-3 more than grain stored conventionally

Capacity and policy influence

- Interactions with the Ministry of Health during the development and implementation of the research project resulted in the inclusion of a mycotoxins component in the 2015 national survey on rural livelihoods by the Zimbabwe Vulnerability Assessment Committee.
- Results were presented in June 2017 to the Ministry of Agriculture, Mechanisation & Irrigation Development (MAMID) and the Ministry of Health and Child Care (MOHCC), where policymakers, government researchers, agronomists and engineers were in attendance. Ministry directors have invited the research project to deliver another presentation for higher management (where all ministers and heads of departments within the ministries will be present) so that a way forward can be mapped on mycotoxins in Zimbabwe.
- A total of 941 farmers (594 women, representing 63%) were trained on post-harvest management and on how to use and handle hermetic technologies. These trainings have increased farmers' knowledge on good farming practices, which in turn will increase agricultural productivity.
- It is envisaged that the project will directly contribute to better policies to govern pre- and post-harvest management, as well as mycotoxin regulations in Zimbabwe.
- MAMID and MOHCC realized that there is need to include mycotoxin information in the training manuals of Agritex extension workers, who equip farmers with information and knowledge on agricultural practices to increase productivity.
- The research has contributed to a national strategy called Zimbabwe's Agenda for Sustainable Socio-Economic Transformation, in which the Government of Zimbabwe is aiming to, among other goals, improve storage of harvested crops and food quality.

Conclusions and recommendations

- The analysis concluded that hermetic technologies are better than conventional methods and can therefore be used to reduce economic loss due to insect damage.
- It is recommended that training and education on good pre- and post-harvest management practices, and health risks associated with consumption of food contaminated with aflatoxins, be institutionalized by relevant government ministries.

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