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The U.S. Government's Global Hunger & Food Security Initiative

Integrating Gender and Nutrition within Agricultural Extension Services

Technology Profile

Type of Technology:

Biological

Aflasafe™

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This profile was compiled by Alyson Young, University of Florida, with input from Cultural Practice, LLC.

The **Integrating Gender and Nutrition within Agricultural Extension Services (INGENAES)** project works to improve agricultural livelihoods focusing on strengthening extension and advisory services to empower and engage smallholder farmers, men and women. The technology profiles support INGENAES's goal of improving the dissemination of gender-appropriate and nutrition-enhancing technologies and inputs to improve women's agricultural productivity and enhance household nutrition. The technology profiles identify issues and opportunities to make technologies more attractive for men and women farmers, to increase men's and women's benefits from using technologies, and to design distribution models for extension agents, input suppliers, and mobile devices to get the technologies into men's and women's hands.

Sixty percent of Zambians live in fairly remote rural areas with very limited infrastructure in the way of roads, water or electricity. Poverty and stunting levels are very high across the country, and particularly in Eastern Province where the technology assessments were conducted. Agricultural productivity is particularly low in Zambia with only 50% of agricultural enterprises using fertilizer.

In Zambia, 78% of women are engaged in agriculture whereas 69% of men are engaged in agriculture (Sitko et al. 2011). Women are also responsible for domestic food production and household nutrition. However, women farmers in Zambia often do not own or control most productive resources, are disproportionately excluded from decision-making processes, and are less likely to benefit from of public services, such as extension services (Sitko et al. 2011). Few women have land in their own name (USAID n.d.). They are disadvantaged by poor access to information, communications, infrastructure and markets, and reduced access to training and education. Limited access to and control of resources and services frequently results in lower crop yields for women, and women's income-generating abilities are also constrained by their primary task of producing agricultural products to meet household consumption needs (Sitko et al. 2011). Results from the Women's Empowerment in Agriculture Index showed that only 40% of women in households with both adult men and women in the Eastern Province Zone of Influence have achieved gender parity. Lack of control over use of income and limited access to assets were particularly strong contributors to this lack of parity (Feed the Future FEEDBACK 2013).

Zambia would benefit from improvements in small-scale agricultural production and reaching women is a necessary approach given their active participation and potential. This assessment examines men's and women's access to and benefits from a biopesticide, Aflasafe, which has the potential to reduce the prevalence of mycotoxin development in farmer crops, particularly maize and groundnuts

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INGENAES Integrating Gender and Nutrition within Agricultural Extension Services

Technology Design and Dissemination

Aflasafe is a biocontrol method for the management of aflatoxins produced primarily by *Aspergillus flavus.* Aflatoxins are identified as a pre-harvest problem that can be exacerbated by post-harvest practices. The fungus affects widely grown crops (e.g. maize, groundnut, cashew, cassava) in Sub-Saharan Africa (and other parts of the world), and the associated aflatoxins (B1 and B2) have significant economic and health impacts. Exposure to high levels of aflatoxins in Sub-Saharan Africa is common and much of the exposure occurs among many resource-limited and low-income farmers (PACA 2015).

Aflasafe was first developed by the International Institute of Tropical Agriculture (IITA) in conjunction with the Agriculture Research Service of the U.S. Department of Agriculture, University of Bonn, University of Ibadan and several other national research partners in Africa. Aflasafe and other biocontrol methods for aflatoxins are based on the ecological principle of "competitive exclusion" or the idea that when two species compete for the same critical resources within an environment, one of them will eventually outcompete and displace the other (Yin et al. 2008). Aflasafe involves the introduction of carefully selected atoxigenic strains of *A. flavus* that outcompete the toxin-producing strains. Twelve safe and effective atoxigenic strains were identified and four were further tested and eventually developed into the Aflasafe product distributed in Nigeria, Senegal, Burkina and Kenya. Strain development is still being conducted in Mali, Ghana, Tanzania, Mozambique and Zambia (ICRISAT-ZARI 2013; IITA 2015).

The purpose of Aflasafe distribution is to reduce pre- and post-harvest aflatoxin contamination in crops and its associated health and economic impacts. Aflasafe is not yet commercially available in Zambia; it can only be obtained through field trials. IITA has standardized these field trials so that they are all conducted on crops grown in farmer's fields and individual farmers apply Aflasafe. The sizes of the field trials range between 0.25 and 15 hectares and involve a paired plot design where each treated field is paired with a companion control field. Soil is sampled before treatment and the aflatoxin levels of treated and control crops are compared at harvest and again after several months of storage (IITA 2011).

IITA teamed up with PROFIT+ in 2013 to disseminate Aflasafe to women farmers in three districts of Eastern Province. The field trials in three districts in Eastern Province (Chipata, Petauke and Katete) were chosen because of the high prevalence of aflatoxin contamination and child undernutrition as well as the infrastructural support available through local development partners, who had an interest in mitigating aflatoxins in groundnuts using Aflasafe. Working with local partners allowed access to well-established networks and infrastructure for distribution of inputs to farmers. Despite the relatively high level of groundnut production, Eastern Province remains one of the poorer areas of the country and has chronically high levels of child undernutrition (Mofya-Makuka and Shipekesa 2013).

Field trials were designed per IITA guidelines and both Profit+ and IITA participated in training farmers. Seeds and Aflasafe were distributed with an information card that included directions for application. There was no follow up to analyze soil samples, however, due to budget constraints and coordination difficulties between IITA and Profit+.

Gender analysis

This assessment analyzed differences and constraints in women's use of Aflasafe, in terms of changes in household food composition and consumption and in time and labor associated with agricultural production (including harvest, storage, and processing), as well as the impact of Aflasafe on women's income. The controlled nature of the Aflasafe trial (as opposed to a marketed technology) and distribution of Aflasafe directly to women farmers through District Women's Associations in Eastern Province made it challenging to get a representative sample of men and women who had experience with Aflasafe. As a result, this analysis focuses primarily on women farmers who applied Aflasafe for groundnut crops in 2013/14 season.

This analysis is based on fieldwork in eastern Zambia in August 2015 where Aflasafe was distributed by IITA/PROFIT+ in 2013/14. During interviews and focus groups, participants were asked open-ended questions about the distribution and use of Aflasafe, and it is perceived benefits and impacts on time, labor and resource allocation in the household. In addition, participants were asked about their knowledge of aflatoxins and the post-harvest activities related to grading, use, and sale of groundnuts.

Food availability and quality

All of the women interviewed had a clear understanding of child nutrition and a rudimentary understanding of the risks of aflatoxins for child health. The primary issues with nutrition they identified included overall lack of calories, lack of dietary diversity, and inadequate or early introduction of weaning foods. Men in Petauke indicated that there was adequate food (calories) for children but lack of knowledge and processing facilities to produce food that children could eat.

Food quality

Almost all of the women identified that groundnuts treated with Aflasafe looked healthier than plants that were not treated, which they thought would translate into better health for children. Healthy groundnuts were identified by healthy foliage, reductions in insect infestation and fungus, seedpod size and number, seed color, and how well the seed filled the pod.[1]

While women identified that the quality of their diets had improved because they believed they were eating fewer aflatoxin-contaminated groundnuts at home, there is no evidence supporting this. No analysis of the soil levels of aflatoxin contamination was conducted. Understanding changes in contamination levels is important, because aflatoxins have no taste or smell and exposure can occur as a result of direct consumption of contaminated foods (such as groundnuts) or indirect contamination through consumption of milk or meat from animals that have eaten contaminated foods. Furthermore, the greyish-green mold associated with *A. flavus* looks similar in both the toxic and atoxigenic varieties (Figure 1), making it hard for farmers to distinguish between plants that are safe and those that are contaminated. While women identified eating fewer contaminated foods, the extent of improvement in household food quality should be examined more closely.

Food availability and seasonality

The quality of groundnuts produced does not necessarily translate into increased food quantity or diversity within the household. All of the women reported either selling or storing the highest-grade (best quality) groundnuts and saving the lowest-grade (worst quality) of groundnuts for home consumption. One man stated, "We are more concerned with business than babies. Good seed goes to market. Bad seed stays home." When probed about whether the changes in income had led to increased dietary diversity (through purchase of nutritious or more diverse foods), women stated that it had not. Almost all of the women agreed it was hard to obtain diverse foods locally, even if they had the money.

Farmers did not indicate that increased yield had improved household food security. The variety of groundnut seed used in the Aflasafe trial (MGV-4/5) is primarily used for cooking oil[2] and is not considered a good type of groundnut for porridge. So, most of the groundnuts produced using Aflasafe were sold or used to repay loans/seeds borrowed for planting. Almost all of the women reported saving some seed for the next planting season. It's important to note that the viability of second-generation MGV-4/5 seeds is reduced, suggesting limited improvement of household food security through seed banking.

[1] Other crop improvements attributed to Aflasafe included a decrease in the presence of aphids and other pests and a change in the fertility of the soil.

[2] 48-50% oil with Oleo/Linolinic ratio of 1.5 (EFPC 2015)

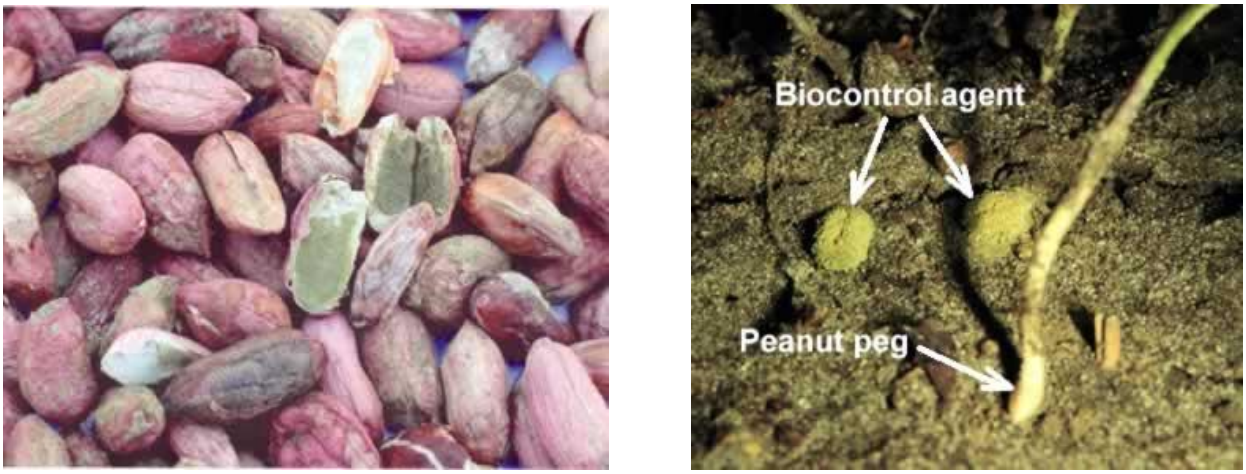

FIGURE 1. AFLATOXIN MOLD ON PEANUTS (LEFT) AND ATOXIGENIC STRAIN (RIGHT) (PHOTOS COURTESY OF USDA-ARS 2015)

Time and labor

Most of the women felt that Aflasafe had reduced their overall workload. The primary contribution of Aflasafe to workload reduction came from the reduction of time devoted to sorting out rotted or potentially contaminated groundnuts from viable pods during harvest and storage. Women sort pods during harvest based on the following characteristics: size of the pod, how well the seed fills the pod, and what the seed looks like inside the pod. According to the women, a healthy groundnut plant has more pods per plant, shiny green leaves, and fewer insects (like aphids or ants) infesting the plant. A healthy seed is large and fills the shell completely and is "heavy." Women indicated that when shaking the pod, it shouldn't be light and there should be no rattling. The shells of healthy plants are also stronger; unhealthy pods shatter and fray easily. Healthy pods should also "come together better," meaning the cotyledons meet and fuse neatly when the seed is developing. When women described reductions in workloads associated with sorting they are describing the efficiency of sorting, not necessarily the total amount of time they spend sorting. Groundnuts pods do not all mature at the same time, so the ideal time to harvest is when there are a number of healthy plants with many mature pods. After Aflasafe application women felt that they collected more healthy mature pods per plant, more healthy plants per hectare, and the pods themselves were larger.

Time spent shelling and threshing increases as yield increases, but shelling time was also partly determined by the use for the seed. Seeds for oil extraction were shelled, but seeds being sold on the market could be shelled or non-shelled. All of the participants reported relying on manual threshing of the plants, but were drying and storing the groundnuts at home in their shells.

Aflasafe application did not substantially affect planting or weeding times. Since it is applied after the first weeding, the planting times were driven by the amount of seed being planted and the plot size, and weeding was determined by the plot size and the density of plants. The application of Aflasafe was seen as simple and comparable work to applying fertilizer.

Income and assets

Women identified that the yield and quality of the groundnuts grown in Aflasafe treated fields was better than in untreated fields and that the Aflasafe-treated groundnuts yielded a higher profit because they were larger, looked healthier, and had better yields. One woman elaborated on yields explaining, "I used to harvest six bags of groundnuts from this field and now I harvest ten!" With correct application of Aflasafe, a well-developed value chain, and proper testing, the potential exists for significantly increasing income from groundnuts. However, even in the trial stage, yield increases through better management and healthier plants and pods can contribute to increased sales and better prices.

Women did not report any changes in use or control of the income generated by using Aflasafe, however they reported having more money available to help with household needs. For example, one woman stated she had more money to help pay for school for her family.

Additional considerations

The trial participants in Petauke represented an exception to the overall positive responses from women in other areas in relation to the impacts of Aflasafe. Women in Petauke said they did not see a decrease in the amount of aflatoxin contamination nor did they see an appreciable increase in profits associated with Aflasafe-treated seeds (see concluding remarks for more information). Discussions with farmers in Petauke underscore the importance of extension in the use of Aflasafe. One of the groups interviewed in Petauke did not have a participating Community Agro-Inputs Dealer (CAD), one of the PROFIT+ project's primary extension mechanisms. This community did not send a representative to the aflatoxin trainings, had the least amount of knowledge about aflatoxins and appropriate use of Aflasafe and were struggling to pay back the seed they borrowed for planting.

Issues and opportunities

A better understanding of the gender dimensions of Aflasafe use would require additional input from women farmers who did not use Aflasafe, and men who were involved in the Aflasafe maize trial in the same communities. Having information from both men and women would help identify places where gender plays an important role in education and practice related to aflatoxin reduction.

Another important gender issue for future investigation will be constraints in marketing and dissemination of Aflasafe. Currently the product is disseminated only for field trial purposes and is not available through markets. Women did not report gender disparities in access to or use of Aflasafe in this trial, but there is a potential that gender disparities in access will emerge when the product is marketed and sold. The marketing strategy will need to consider both income and gender constraints to purchasing the product.

Finally, while Aflasafe can help reduce aflatoxin contamination, it is only one part of the agricultural process where aflatoxin contamination can occur. Improper harvesting, storage and processing practices such as adding water to shells during shelling or not allowing adequate drying time before storage increases the risk of aflatoxin contamination. The women interviewed in this study described a range of Aflasafe application techniques and other post-harvest practices which may interfere with the effectiveness of pre-harvest biocontrol reduction process. For this reason, it is important to note that the impacts of Aflasafe on the food product have to be examined in conjunction with other practices that are used for reducing aflatoxin contamination. The rapid assessment conducted by PROFIT+ following the aflatoxin mitigation and prevention training conducted in 2013 suggests that awareness campaigns have been successful in promoting better practices (PROFIT+ 2015). Commendably, both IITA and the PROFIT+ programs are reaching out to women with agricultural practices and technologies. INGENAES will continue to work with them to analyze gender issues and improve the benefits of technology adoption for both men and women.

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