

Additional responses to participant questions from the Agrilinks Post-harvest Webinar.

Responses from PHLIL team, and

**Green text represents responses coming directly from Vestergaard, the producer of the ZeroFly hermetic bags.*

Q: A main constraint is that hermetic bags need careful handling not to be torn, which removes the hermetic properties. Careful handling is not how bags are typically handled in Africa. What is your experience with usage of bags by multiple actors who may not have incentive to do careful handling along supply chains?

A: We tell those who purchase ZeroFly Hermetic (ZFH) bags that they use the bags only in their establishment (business or household) for safe long-term storage. After the maize is received, it is checked to make sure it is at the correct moisture content, cleaned, and then it goes into the ZFH bag. After the bag is emptied and maize used for feed preparation, the bags are stored away safely until they are required for use again within the same establishment. This prevents careless handling by multiple actors.

Q: What is the shelf life of Maize kept in ZFH bags and what is the life of the ZFH bags?

A: The ZFH bag has a longevity or viability of 2 years, from the time use for storage commences. Most poultry farmers and stakeholders purchasing the bags in Ghana store maize in them for usually no more than 6–8 months each cycle. Hypothetically the maize could be in the bag for at least 2 years. After two years, while the deltamethrin pesticide may have been expended, the bags are still hermetic so long as they have not been damaged.

Q: Are the ZeroFly hermetic bags designed for moving up the value chain or retained at the farm? If moving up the value chain and thus farmers have to pay full price for single use? If single use by farmers what percent of the value of a 100kg bag of maize is the cost of the bag?

A: Our message to poultry farmers is that, at the current stage we are in the scaling of hermetic bags, the bags should remain at the same establishment (business or household), for repeated use, for the recommended 2-year longevity of the hermetic bag. The ZFH bag is for use over a few storage cycles, usually 4 cycles, if storage is for 6 month and the bag has a longevity of 2 years. You can divide the price of the bag at purchase by 4 (at least) and then factor in the price of a bag of maize to get the answer to your question.

Q: Please describe what tests were conducted to assess the quality of ZFH bags.

A: A suite of tests were conducted to ensure physical, chemical, residue, toxicological, and bio efficacy in lab and field studies in all key agro-ecological zones, on different types of dried food grains, plus no detrimental impact on germination. See

<https://www.ars.usda.gov/research/publications/publication/?seqNo115=326739>.

Q: Are there any cases/concerns with resistance to deltamethrin?

A: There have been no issues thus far; however, options for insecticides with new modes of action are being developed and optimized.

Q: Can the insecticide coating on the bags get into the grain?

A: Approved by FAO and WHO for various uses, deltamethrin is popularly used in the control of insect pests in agriculture, public health, veterinary, industrial and other sectors. Deltamethrin is registered for use on a range of crops (e.g., cotton, corn, cereals, soybeans, and vegetables) for pests including mites, ants, weevils, and beetles. Deltamethrin is non-persistent and hence does not accumulate in the environment. Deltamethrin falls under GHS category 5: low acute toxicity. Deltamethrin residues in grains stored in these bags has been analyzed, falling well below the Codex Alimentarius MRLs of 2 mg/kg of stored grain (average residues were only <0.05 mg/kg of grains). Use of ZeroFly® Hermetic bags is significantly safer than repeat spraying or other direct application of insecticide; use of these bags obviates the need for direct pesticide application, and thereby safeguards end users' health against higher risk methods of application.

Q: Are there any tools provided with the Chombo model to ensure that the grain being stored is of good quality?

A: Yes, the GrainMate moisture meter is included in the Chombo model to ensure that grain is at a proper moisture content before storing in the ZeroFly hermetic bags.

Q: I would be keen to understand how Grainmate is different from other moisture probes available in China. The price points seems similar.

A: The Grainmate was compared with several other commercially available moisture meters. It performed well, and was more accurate than some popular commercial moisture meters. See: https://www.researchgate.net/publication/329371105_Comparative_evaluation_of_novel_low-cost_moisture_meters_suitable_for_grain_moisture_measurement.

Q: What percentage of poultry farmers were engaged in this project? Of those farmers participating in the study, what was the adoption rate of the ZeroFly bags?

A: In the Dormaa, Berekum, and Sunyani area of Ghana, there are a total of 316 poultry farms registered. To date we have offered one-on-one training to approximately 80 poultry farmers. Of these, 22 have purchased GrainMate moisture testers. For ZFH bags, 39 have purchased from a few to 1,750 bags. We believe the number of poultry farmers and bags purchased would be much higher if the Nigeria land borders had not been closed since October 2019. There are a number of pending orders for bags because we have not been able to obtain them from Nigeria where they are made. That being said, the 22 who have purchased GrainMate moisture testers and 39 who have purchased ZFH bags represent early adopters of the technologies. As the more risk averse poultry farmers and other stakeholders see and hear about the experiences of these early adopters, it is likely they will jump on the bandwagon.

Q: How are the interventions engaging private sector to ensure that the bags are available in remote areas?

A: We are supporting local agents as the pioneers to sell the bags in northern Ghana. Their success will help establish that this is a profitable enterprise that successfully reduces post-harvest losses for the smallholder farmers, and be used to explore finance options that could be available to agents.

Q: How do you manage the high cost of measuring aflatoxins or pesticide residues in grain?

A: Aflatoxin and pesticide residue analysis can be expensive, especially with some of the mark-ups some sales agents add in some parts of Africa. Some options can cost a few dollars a test for commercial kits, and other methods have been explored which would eliminate the need for expensive chemistry. This brief is several years old, but still generally accurate and gives an idea of different options: <https://www.ifpri.org/publication/improving-diagnostics-aflatoxin-detection>. For our research activities, PHLIL supported the establishment of a mycotoxin testing laboratory at Kwame Nkrumah University of Science and Technology.

Q: Please give examples of alternative uses of grain contaminated with mycotoxins.

A: Depending on the levels of mycotoxins, some countries like the U.S. have differentiated levels for food vs. different feeds. Also, contaminated kernels can be decontaminated (review article: <https://espace.library.uq.edu.au/view/UQ:411171>) or sorted out with spectral sorters (e.g. <https://www.ncbi.nlm.nih.gov/pubmed/32150943>).

Q: Do you have any examples from the Chombo model?

A: Yes, Vestergaard piloted the Chombo model in western Kenya. In addition to the discussion in the presentation, this short video also provides a nice overview of our pilot results: <https://youtu.be/QguJhrg73-s>.

Q: Are you expecting farmers to market full bags or partial bags and what is the overall time over which farmers will market a crop?

A: We are expecting smallholder farmers to store their maize in ZFH bags until when they need to use that maize for food or income. If the latter, they can transfer the maize from the ZFH bag into an ordinary polypropylene bag and then sell. They can then store the empty ZFH bag well until the next time they have maize intended for long-term storage, then reuse the bag. If the former, the recommendation is that they not open the hermetic bag until 21 days have elapsed from when sealed. They can then open the bag quickly, take out what is needed for food, and quickly re-seal the hermetic bag. In both cases, it should not really matter so much whether the bag is full or not. Of course, the recommendation would be to completely fill the hermetic bag before sealing and storage. We are expecting poultry farmers to store their maize in full ZFH bags until when they need to use that maize for poultry feed, then they empty the bag and store the empty bag well until the next time they have maize intended for long-term storage, then reuse the bag. The ZFH bag has a longevity or viability of 2 years, from the time use for storage commences. Most poultry farmers and stakeholders purchasing the bags in Ghana store maize in them for usually no more than 6–8 months each cycle. Hypothetically the maize could be in the bag for at least 2 years.

Q: Technology dissemination is as important as technology development, what are you doing to reach out to the farmers?

A: PHLIL is reaching farmers through one-on-one training of poultry farmers, aggressive marketing, and taking technologies closer to customers (demand). In the Dormaa, Berekum, and Sunyani area of Ghana, there are a total of 316 poultry farms registered. To date we have offered one-on-one training to at least approximately 80 poultry farmers. Of these, 22 have

purchased GrainMate moisture tester. For ZFH bags, 39 have purchased from a few to 1,750 bags. The number of poultry farmers and bags purchased would be much higher if the Nigeria land borders had not been closed since October 2019. There are a number of pending orders for bags because we have not been able to obtain them from Nigeria where they are made. That being said, the 22 who have purchased GrainMate moisture testers and 39 who have purchased ZFH bags, represent early adopters of the technologies. As the more risk averse poultry farmers and other stakeholders see and hear about the experiences of these early adopters, it is likely they will jump on the bandwagon. In Ghana, PHLIL is conducting research to optimize distribution channels, including how to get ZFH bags closer to customers (demand) and ways to aggressively market the bags — which has elements of disseminating information on cost and increasing awareness in the wider population.

Q: What are the main challenges faced to disseminate these technologies to smallholder farmers?

A: Availability and access are significant challenges, and with this establishing local small and medium enterprises (SMEs) for manufacture and distribution of these technologies. By working with both meso (aggregators, millers, poultry farmers, etc.) and smallholder level actors in the value chain, as well as local and international private sector in the post-harvest space, PHLIL is working to help seed supply chains for technologies that are profitable to local SMEs and effectively reduce post-harvest losses in multiple points in the value chain. In addition, we and others are conducting research on price risk and access to credit, such as testing multiple payment or guarantee options for a new technology.

Q: Do you find adoption of the this technology among farmers challenging?

A: Change usually happens slowly. The most challenging part is getting enough early adopters of the technology on board. Once you have a critical mass of these early adopters, other stakeholders who are usually more risk averse jump on the bandwagon. I think in Ghana, we are getting more and more early adopters on board, building momentum towards facilitating successful scaling. In Ghana, PHLIL is conducting research to optimize distribution channels, including how to get ZFH bags closer to customers (demand) and ways to aggressively market the bags — which has elements of disseminating information on cost and increasing awareness in the wider population. Data from this research should also facilitate successful scaling.

Q: We now have a lot of innovations and technologies to address PHL at specific points and along value chains. What seem to be lacking are strategies at national or program levels developed or being implemented to address PHL. How can this be addressed?

A: This is an important question especially now with the pandemic and its aftershocks in food security. PHLIL is working with national leaders in the post-harvest space, to help provide the government and national system with information to drive evidence-based policy and programming decisions. For example, in Ethiopia, PHLIL in-country lead Professor Fetien Abay played a leading role in establishing the government's Post-Harvest Advisory Committee, with high ranking members of the Ministry of Agriculture and the national agricultural research system. This helps them assess and prioritize actions to address post-harvest losses. PHLIL was also asked to review and update the national post-harvest mycotoxin extension manual, which

we are now doing. At the continental level, aligning with initiatives such as the African Union Commission's Partnership for Aflatoxin Control in Africa helps ensure that our efforts are contributing to a larger strategy. Overall, more needs to be done to develop national and regional strategies.

Q: How do you ensure trust and transparency between Chombo entrepreneurs and farmers?

A: Using blockchain, similar to Airbnb, there is a built in accountability to the app.

Q: What are the risk sharing strategies for the Chombo model (who bears the higher risk)?

A: In the Chombo model the Chombo agent takes most risk, and therefore the higher proportion of the profit.

Q: Can the ZeroFly hermetic bags be used for products other than maize?

A: Yes, the ZFH bags have been tested for a wide variety of cereals and pulses. Other hermetic storage testing has proven effective for millet (<http://ftic.co.il/2016NewDelhiPDF/PP274-279-A049-SESSION05.pdf>).

Q: Would you consider large capacity hermetic containers?

A: Vestergaard produces all sizes of hermetic bags from 5kg to 1 tonne. As standard, 25, 50 & 100kg bags are produced. However, Vestergaard can, depending on order size, produce other sizes.

Q: Has any work been done to make the bags more gender-friendly (senior, female citizens can find them hard to use)?

A: PHLIL is working with AgReach on assessing gender considerations and barriers for technologies (<https://www.agrilinks.org/post/reducing-postharvest-losses-through-better-gender-integration>). One consideration is certainly manufacture of smaller bags, which in Bangladesh for example women use for storing rice seed for sale and planting in the next season. More needs to be done in this area.

Q: To what extent are you anticipating the bags will be used in a commercial storage warehouses vs. being retained at home?

A: In commercial warehouses where storage is for periods of 3 months or longer, we anticipate increased use of hermetic bags. This is especially the case if the offtakers are quality sensitive. In many poultry farms in Dormaa, the goal is usually safe long-term storage of maize to escape wide maize price fluctuations. Significantly increased use of hermetic bags by poultry farmers seems feasible given the number of early adopters we now have on board.

Q: In the Chombo pilot area, did you observe an effect during the season on the wider market price? Did Chombo disrupt the market?

A: The pilot was not large enough to see a wider market difference. Hopefully in future testing we will be able to measure any resulting market shifts.

Q: If I was an extension agent, why would I promote use of ZeroFly bag which requires chemical treatments when other bags don't have such treatment?

A: The chemicals are already integrated into the bags, from which they slow-release over time to protect from insects outside of the bags. Hermetic bags without pesticide do kill the insects already inside the bags, but they are susceptible to insects boring through the bag from the outside to get to the grains, which destroys the hermetic seal. The ZFH bag provides an additional layer of protection to the insects outside the bag.

Q: What is the profit per bag for these intermediaries or Marketing agents for the ZFH bags?

A: Part of what we are currently doing is optimizing distribution channels, including figuring out what the most suitable price for retailing the ZFH bags will ultimately be based on all costs involved with distribution. However, to answer your question, right now the intermediaries or marketing agents are getting at least GHS1.00 per bag (US\$1 =GHS5.5). The new ZFH bags that cost \$0.50 to manufacture should probably give better profit for intermediaries or marketing agents. The retail price of the new bags will be determined based on shipping, freight, duty, tax, number of bags and the number of steps to reach the farmer from port arrival – but may be significantly lower than the price of currently available hermetic bags in the market, including Vestergaard's first generation of hermetic bags.

Q: Does the \$0.50 cost represent just the manufacture cost? What is the cost for delivery to farms in a commercial operation?

A: Yes, \$0.50 is the cost to manufacture. The total cost depends on shipping, freight, duty, tax, number of bags and the number of steps to reach the farmer from port arrival – but it may be significantly lower than the price of currently available hermetic bags on the market, including our own first generation.

Q: Did you subsidize the purchase of the equipment or you include any element of financial support?

A: In Ghana, GrainMate Moisture testers and ZFH bags are not sold at a subsidized price. The current prices of the triple layer 50- and 100-kg ZFH bags are similar to those of PICS bags of the same capacity in the market. In some of our other work, such as with the BAU-STR small batch grain dryer in Bangladesh, we partnered with the Government of Bangladesh to include the dryer in an existing farm machinery subsidy program.

Q: What is the environmental impact of the bags? Can the ZFH bags be recycled?

A: The bags can be recycled, and through the Chombo app/ platform we plan to recycle old bags into news ones reducing environmental impact/carbon foot print and price of bags. The ZeroFly Hermetic bags are multi use unlike standard polypropylene bags and with this new patented technology are now using over 60 % less plastic than PICs and 50% less than any other hermetic bag technology available today – this has a positive impact on price to the farmer and the environment.

Q: Where are ZeroFly hermetic bags manufactured? Where can one get ZeroFly bags in Ghana, in Nigeria, in Zimbabwe?

A: We have local production Vietnam, Thailand, India, Pakistan, Nigeria, Kenya, and soon several others including Mexico. More information at <https://www.vestergaard.com/zerofly/>.

You can obtain ZFH bags in **Ghana** by contacting:

Kwabena Adu-Gyamfi
Agri Commercial Services Ltd
1 Manyo Plange Avenue (off Farrar Avenue)
P.O.Box KA 16385
Airport. Accra.
Ghana.
Tel +233 20 872 7777
Cell+233 24 434 0366
E-mail:kwabena_adugyamfi@yahoo.com
wenchifresh@gmail.com

In **Nigeria**, ZeroFly Hermetic bags are currently made by Bagco in Kano, Nigeria (<https://fmnplc.com/group/bagco/>)

Vestergaard has a distributor in **Zimbabwe**; please contact him with questions: Nathaniel Makoni <nathanielm@abstcm.com>

Q: What about genetic approaches (disease/pest resistance)? Shouldn't they be considered or explored?

A: These are being explored by breeding programs, including by Feed the Future Innovation Labs focused on breeding; this is an important part of the overall agricultural development strategy. Once those programs ensure a good harvest, drying and hermetic storage are key strategies to safeguard that harvest from post-harvest insect pests. At that stage, genetics can contribute some to reducing losses but in general they are not nearly as effective as drying and hermetic storage.

Q: Are there other techniques and strategies that you can speak to for different crops? The presentation was focused largely on grains. What about other crops, such as vegetables?

A: One great source of information for post-harvest challenges and solutions for vegetables is the Horticulture Innovation Lab: <https://horticulture.ucdavis.edu/>.

Q: Could you talk about some of the problems for growers in south India regarding pest during storage?

A: India has tropical environmental conditions which are very conducive for insect population growth — optimal temperatures and relative humidities that encourage stored-product insect proliferation. This would be the case for fungal pests as well, especially if commodities that are not properly dried are stored. Fungal pests can lead to increase in mycotoxin levels well beyond threshold levels deemed safe for food and feed. There are also issues of rodents, which I am

sure exist in India as well. Therefore, some of the solutions referenced during this webinar could be options in addressing insect and fungal problems in India as well.