

# PICS



Volume 6 Issue 1 2020

## NEWSLETTER

### Purdue Improved Crop Storage

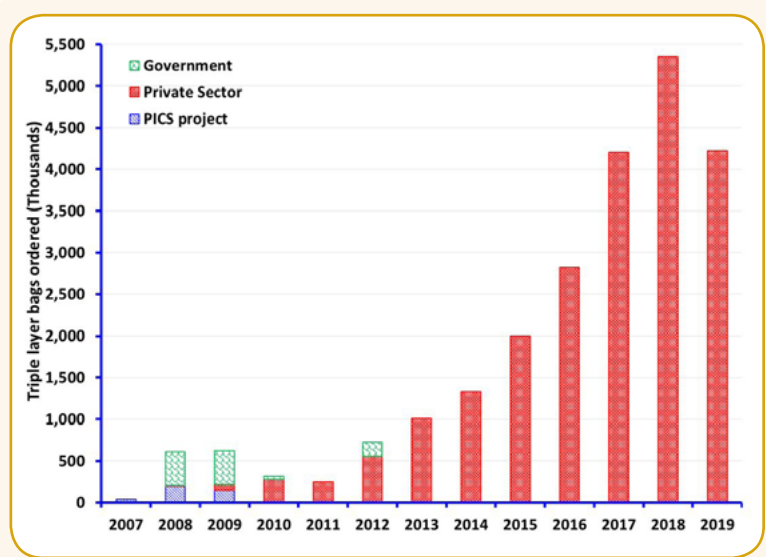
#### SIX YEARS INTO THE PURDUE IMPROVED CROP STORAGE PHASE 3 PROJECT - EXCITED ABOUT OUR PROGRESS

*Dieudonné Baributsa; Purdue University - USA*

As the PICS3 project nears its end, it seems like yesterday when we embarked on this journey of commercializing hermetic technologies in sub-Saharan Africa (SSA). In 2014, the Bill & Melinda Gates Foundation provided US\$10.1 million to Purdue University for the third phase of the PICS (PICS3) project. The aim of the PICS3 project was to commercialize hermetic bags for all grains (mostly cereals and legumes) to improve market access and food security among smallholder farmers in SSA. Though activities were focused in Burkina Faso, Ethiopia, Ghana, Malawi, Nigeria, Tanzania, and Uganda, we have been able to leverage this grant to expand into other countries in SSA and beyond.

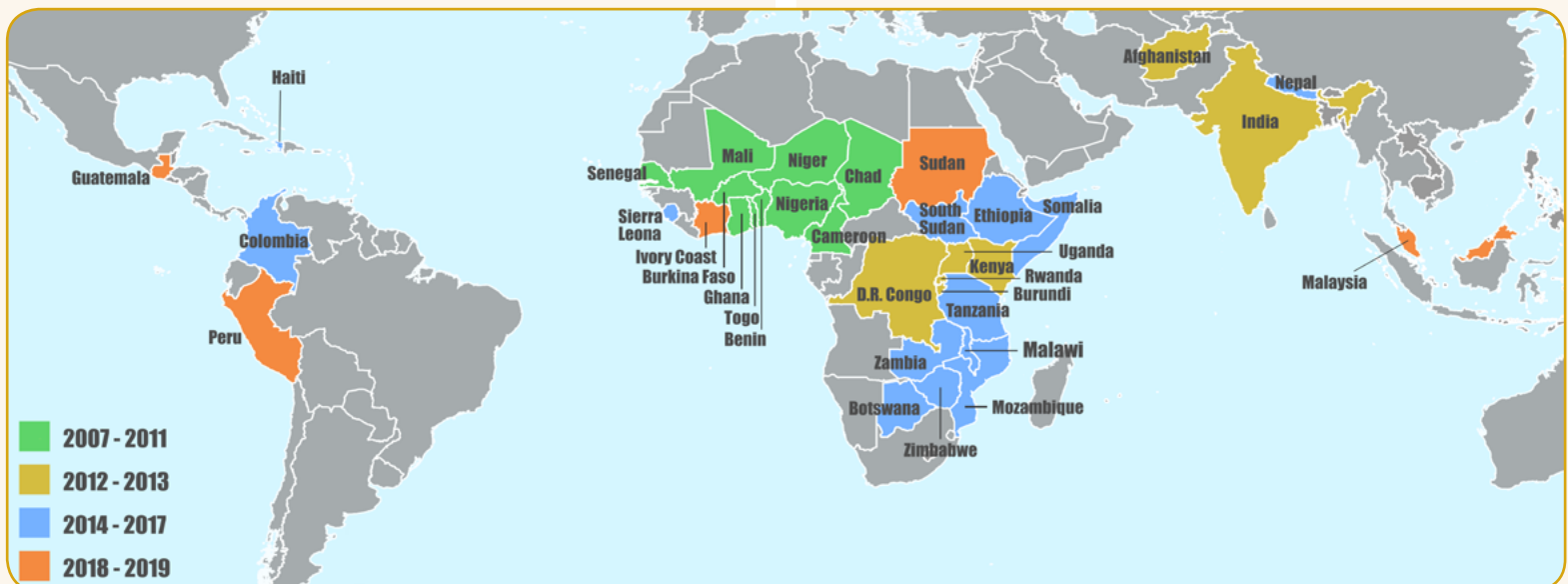
Since the launch of the PICS3 project six years ago, a lot has transpired:

- In collaboration with several partners including national and international research institutions, local and International NGOs, and the private sector, we have expanded PICS activities in East and Southern Africa, Latin America and the Caribbean, and Asia.



*PICS bags sales climbed to 23 million by February 2020.*

- The PICS3 efforts created the demand for hermetic bags through (i) capacity building of local service providers to raise awareness, (ii) training of farmers on how to use PICS bags, and (iii) has thus far reached 11,500 field/extension agents, about 40,000 villages, and more than 2.3 million farmers, of which 48% are women.



*PICS is now active in 34 countries in Africa, Asia and South and Central America.*

- PICS Global ([www.picsglobal.com](http://www.picsglobal.com)), a social enterprise, was created to commercially scale-up the PICS technology and its impact worldwide. PICS Global has expanded licensing of manufacturers and distributors of the PICS bags to reach new countries and regions. PICS Global has now licensed more than 15 manufacturers and distributors around the world.

- Sales of PICS bags have significantly increased since the beginning of the PICS3 project. In the last six years alone (2015-2019), total sales were more than 19.0 million bags, compared to approximately four million bags between 2007- 2014.

- With sales of more than 23 million PICS bags (2007-2019), farmers have made or saved more than US\$1.5 billion (estimates based on a cash flow of US\$25 per 100 kg bag, and each bag is used three times). PICS bag manufacturers, distributors, and vendors have made a profit of more than US\$23 million (margin of about US\$1 on every bag sold). The slight decline in 2019 was the result of a major decline in yield in East Africa that year- bag sales being dependent upon crop production.

- The project has leveraged about US \$15 million (in addition to the \$10.1 million invested by Gates Foundation) through multiple grants and investments. The private sector and service providers have secured additional projects and grants to increase the demand for PICS bags. Furthermore, the private sector has made investments in building new manufacturing facilities or expanding existing ones to improve the availability of PICS bags throughout the supply chain.

### THE PICS BAG, A TECHNOLOGY FOR STRENGTHENING INCOME SECURITY AND SOCIAL COHESION OF HOUSEHOLDS IN NIGER

*Ibrahim Baoua - PICS Consultant, Niger*

In Niger, agriculture is practiced mainly in the form of subsistence family farms. In recent years, its productivity has been affected by the effects of climate change. The sector is also experiencing poor performance due to the marketing of crops. Delayed selling of crops was introduced in the department of Mayahi to enhance the use of the PICS technology and encourage producers to organize the marketing of their agricultural production. This strategy consists of aggregating the agricultural surpluses of small producers so as to constitute collective stocks in order to access remunerative prices. Awareness and training activities were organized. In 2019, after 3 years of activities, it resulted in a marketing network with 120 farmers' organizations using 42 stores. 372 producers (30% women) were mobilized in the first year and 626 producers (27% women) in the second year to build up a stock of 308.5 tonnes of agricultural products. Storage provided producers with a profit margin



*Discussing PICS at a village demonstration in Zambia.*

- Just like previous grants, the PICS3 project demonstrated that there is a substantial market for hermetic storage technologies among smallholder farmers. This has led to more competition – at least five brands of hermetic bags were developed and are being commercialized in several countries in SSA.

- Benefits for farmers who use PICS and other hermetic bags include (i) improving food security and income, (ii) reduction in deaths and illness due to the misuse of insecticides, and (iii) the mitigation of mold growth (leading to aflatoxin accumulation) that causes stunted growth in children as well as liver cancer. The benefits of consuming chemical and aflatoxin-free grains are immeasurable. Farmers often tell us, **'There is no price to life'**. Beyond the PICS3 project, PICS Global and the Purdue team will continue to expand the market to new countries and improve the availability of PICS bags among smallholder farmers.



*Village market demonstration.*

of 29 to 44% for millet and 32 to 74% for cowpeas, a total profit of 22,520,109 CFA francs (about \$40,000 USD). The PICS bag, which secures crops, is also a lever for the fight against poverty and the sustainable improvement of producers' incomes. The adoption of the PICS technology by smallholder farmers will also provide job opportunities for the country's vulnerable youth.

## THE FAST ADOPTION OF PICS BAGS IN ETHIOPIA

Michael Takiru - Shayashone, Ethiopia

In Ethiopia postharvest loss was estimated to be 22-30% in 2014/15, out of which storage loss is estimated to be 10-15%. This is close to 3.6 million MT. In turn, this is estimated to cost around \$600 million USD and also estimated to feed 12 million people for one year. To overcome the postharvest problems in Ethiopia, Shayashone Trading PLC (SYS) has been commercializing PICS bags for the past six years in various parts of the country, following different innovative business models. Shayashone's sister company PHK Trading has engaged in the distribution of PICS bags since 2017.



Awareness Creation about PICS bags at Tigray region, Asgeda Tsimbla Woreda.

### PICS Extension

SYS has been (and is still) working with different governmental development partners on the extension and awareness creation of PICS bags (Ministry of Agriculture, Federal Cooperative Agency) and non-governmental (SG 2000, CRS, SNV, USAID, etc.). Over 9000 village demonstrations and over 870 market demonstrations were done in the past six years. During village demonstrations and different activities such as Bag Opening ceremonies, youth resellers share their experiences and sell the PICS bags to farmers. In addition to village and market demonstrations, ICT-based radio commercials and talk shows are used to promote PICS bags. Through these activities we have aired more than 13,000 radio commercials, around 30 radio talk shows and sent out and received important information about PICS bags through approximately 42,000 SMS's.

### PICS Supply Chain

After building a robust awareness about PICS bags, SYS followed different innovative business models to create a strong and sustainable supply chain system to reach

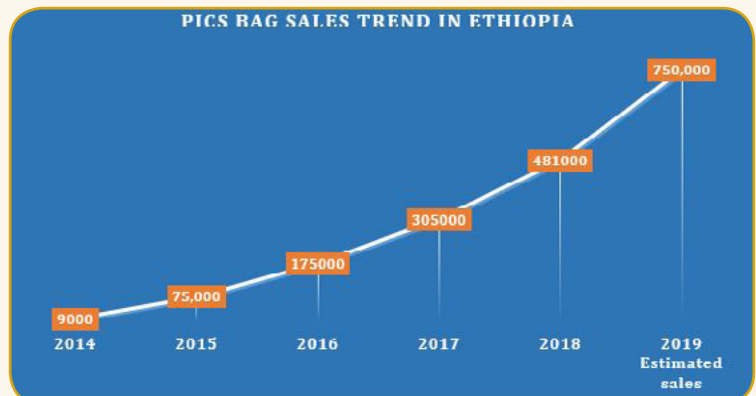


PICS bag opening ceremony at Oromia region, Jimma Zone organized by SYS-FTFEVCA.

SYS is currently working with more than 15 Unions and over 100 farmers' cooperatives to distribute and sell PICS bags to smallholder farmers. During 2018, about 20% of PICS bag sales were made through farmers' cooperatives and unions and we have seen a promising increase in demand of PICS bags by the cooperatives and unions.

***“The last mile distribution of PICS bags has created job opportunities and source of income for local youth in Ethiopia”***

The other business model we follow is the Private Vendor-Youth Reseller business model, which is currently working very well. Under this model we select and train agro dealers at district town level and jobless youths' at Kebele (Peasant Association) level, which is the last government administrative structure. Through this model we have currently 187 vendors and 227 Youth resellers that are selling PICS bags. In terms of youth, the PICS bag distribution approach creates good business opportunities for rural youth which were previously unemployed. The youth reseller system has created a business opportunity for the youths to earn approximately \$0.16 commission from each bag sold. Especially during the peak seasons the youth resellers can get an attractive benefit since one youth can sell



PICS bag sales trend in Ethiopia.

out to the smallholder farmers with PICS bags. SYS have two business models: the Union-Cooperative business model and the Private Vendor-Youth Reseller.

***“Farmers’ cooperatives and cooperative unions are effective at channeling bags to smallholder farmers”***

*continued on next page*

about 200 PICS bags per day which equals \$33 USD profit. This can strongly contribute in reducing youth unemployment which is the major challenge in Ethiopia.

### **PICS Sales Trends in Ethiopia**

During the first years, sales in Ethiopia were very low and limited to development partners which were promoting PICS bags. Starting from 2017, PICS bag sales are showing a drastic increase. Including 2019 early season sales, we have distributed around 1.2 million bags in Ethiopia, which contributed to the saving of around 15,000MT of grain which would otherwise have been eaten by insects. This shows that the introduction of PICS bags to Ethiopia has contributed to the food se-

curity of the country by saving grain which can feed 50,000 people for one year. During 2019, the sales were expected to reach 750,000 PICS bags, making the total sales around 1.75 million.



*Village demonstration at Amhara region, East Gojam zone.*

### **BUNDLED TECHNOLOGIES FOR NIGER**

*Claudia Canales Hholzeis - Kirkhouse Trust, Niger*

The Kirkhouse Trust (KT) was established to promote the improvement of legumes, important for food security in African countries. "You reap what you sow," they say, and that is just what we mean to do by starting with healthy seed varieties which are resistant to weeds, pests and disease. This is a crucial first step in the promotion of food security. We do this by funding research in African plant breeding institutions, establishing molecular laboratories and keeping them stocked, and providing scholarships for PhD and Master students.

The focus in West Africa over the last decade has been cowpea. These efforts have borne fruit: teams in Burkina Faso, Ghana, Nigeria, Mali and Cameroon have together released twenty improved varieties, with five more expected by the end of 2019. These are local landraces improved to resist aphids and Striga, the parasitic weed responsible for huge losses in cowpea production.

A successful crop is still vulnerable to complete destruction and can easily become unsafe for consumption when storage pests are present. This is why the PICS and KT teams are looking into options for joining

forces for win-win solutions. Either practice (using improved seeds or PICS bags) alone will increase the profit farmers make, but using both will be particularly beneficial. Farmers investing in improved seeds are likely to want to protect that investment during storage, and vice versa, it makes sense for farmers who have bought PICS bags to also want to invest in better seeds for a better product.



*UAM Masters student infecting grains with Fusarium in the lab.*

The first step in this joint exploration, with Ibrahim Baoua from Sahel Bio as our in-country partner, is determining the current use and demands for cowpea seed and PICS bags in Niger. This will allow us to establish a baseline for the testing of different business proposals.

We thank Bill Jones for his support to this project.



*Improved cowpea varieties after storage in PICS bags.*



*Women farmers viewing new cowpea varieties, SARI 2015.*



## IN MALAWI: FIGHTING HUNGER WITH PICS BAGS

Shelix Munthali - USAID Feed the Future AgDiv, Malawi

As one of the poorest countries in the world, food security is a major challenge in Malawi - 46 percent of Malawians reported skipping meals to cope with food shortages in a 2017 survey. In this context, the loss of even 10% of a household's grain supply can be catastrophic.

The Feed the Future Malawi Agricultural Diversification Activity (AgDiv) - funded by USAID and implemented by Palladium - immediately recognized the potential of PICS bags to improve food security for farming households, and for the country as a whole. In the three years since AgDiv began promoting PICS bags, sales of the bag in Malawi have gone from 62,151 bags to nearly 600,000 - protecting 1.4 metric tons of grain from post-harvest loss. To create this change, AgDiv has spearheaded a multi-media demand generation campaign, including intensive demonstration activities at the community level, and worked with suppliers and distributors to improve access.

Even though AgDiv has a mandate in only 8 of Malawi's 28 districts, the project recognized early on that in order to have a sustainable impact on food security in Malawi, it would need to work with the private sector to commercialize the bags, which required addressing both demand and supply-side barriers at a national level.

### Strengthening the supply chain for PICS bags

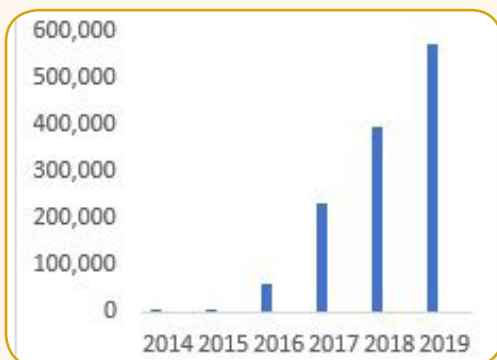
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An extension worker from Farmer's World - a private sector agro-dealer - conducts PICS bags demonstrations and sales at the community level.

addressing both demand and supply-side barriers at a national level.

In the first year of the project, the bags were only available at wholesale level, and the supplier was not prepared for the volume of demand created by AgDiv's intensive awareness campaigns. To address this, AgDiv worked hand-in-hand with the local supplier and agro-dealers to improve forecasting and develop distribution channels that brought PICS bags from the national level to rural trading hubs. As demand for the bags grows, this network continues to expand, with new partnerships being established with farmer cooperatives and extension workers to bring PICS bags all the way into rural communities.



Sales of PICS bags in Malawi since introduction in 2014.



Members of the Nachikunga Community Grain Bank in Dedza, Malawi are proud to show the quality of maize stored in their PICS bags

Moving forward, the regional PICS supplier (PICS ESA) is considering restructuring pricing to improve profit margins for distributors; incentivizing sustainable growth of the supply chain.

### Campaigns for demand generation

As a new technology, allowing farmers to see the impact of PICS bags for themselves has been a key to adoption. Since 2017, AgDiv had distributed 285,000 bags for demonstration at the farmer level. Each demonstration is followed by a "bag-opening" ceremony during which the entire village - including farmers who received sample bags and those who did not - congregate to open bags of grain stored in PICS bags for three months or longer, and compare it with grain stored in conventional bags. Bag-opening ceremonies have led farmers in some areas to purchase 5 or more additional bags after seeing the benefits.

Entire communities are shifting towards improved grain storage. In Dedza, Lenato Chimkanda is the secretary of a community grain bank; "Before we started using PICS bags, all of our grain was infested by weevils. Even though we would apply chemicals, we would still end up with only 18 bags worth of grain out of 24 saved" In 2019, PICS bags saved the community 825kg of maize - the equivalent of a month of food for more than 16 households. "Fewer people now have to walk long distances in search of food during the lean season," says Lenato. "Even those that have not managed to keep enough grain are able to borrow maize to eat from the grain bank."



Farmers admire grain quality during a bag-opening ceremony.

## TESTIMONY OF BUDIKADIDI ON THE USEFULNESS OF PICS BAGS, KASAI, DR CONGO

*Katherine Overcamp & Elizabeth Fisher CRS - D.R. Congo*

In the province of Kasai Oriental, a large part of agricultural producers' harvests is lost each season due to poor conservation conditions for agricultural products, including grain and seeds. To reduce post-harvest losses, Catholic Relief Services (CRS) introduced and popularized the use of Purdue Improved Crop Storage (PICS) bags by communities in Kasai DRC. The adoption strategy consists of public demonstrations of the closing and opening of PICS bags for members of farmers' organizations and other village members in the presence of customary and political-administrative authorities at the territorial level. The objective of these public demonstrations is to demonstrate the effectiveness of PICS bags in ensuring good crop conservation and thus encourage the adoption of PICS bags by communities.



*A PICS bag demonstration in the Budikadidi intervention area.*

To date, some 7,350 people in 98 villages in the Budikadidi intervention area have attended these demonstrations directly, during which more than 3.5 metric tons of maize and cowpea seed have been stored in PICS bags. At the end of these 98 public bag opening sessions,



*CRS agents illustrate how to properly tie a PICS bag at a village demonstration.*

which took place about 3 months after their closure, all the seed was fully intact and free from any post-harvest pest attack. Before the implementation of the PICS technology, post-harvest losses could be quite significant for local farmers, sometimes up to 100% of their harvest, especially for cowpeas.

Agricultural producers in the Budikadidi intervention zone are unanimous in their support for the adoption of the PICS technology. However, its accessibility remains limited due to the absence of suppliers throughout the province of Kasai Oriental. Another limitation is the high price per unit, which is out of balance with the local population's standard of living.

The Budikadidi team is actively working on increasing access to PICS bags in the Kasai region through private service providers. Local citizen groups are working with value chain specialists to set up meetings with service providers in the hopes of establishing a local supply chain for PICS bags. The ultimate goal of this effort is to establish a seller for PICS bags in each of the three health zones with affordable prices for farmers.

## PICS WORKSHOPS IN TANZANIA

*Holly Fletcher-Timmons, Purdue University - USA*

PICS held a series of workshops in Dar es Salaam, Tanzania on February 24-28, 2020. Over 75 people attended, representing 20 countries and 40 organizations. A Lessons Learned meeting took place on February 24



*Breakout groups discuss successes and challenges at the Lessons Learned workshop.*

& 25 and allowed participants (about 32) to share experiences and lessons learned in scaling-up the adoption of PICS/hermetic bags to benefit low-resource farms by reducing postharvest losses in grains and food stuffs. The objectives of this Third PICS Lessons Learned Workshop were to:

- Provide a platform for partners in the commercialization of PICS/hermetic bags to discuss lessons learned in scaling-up the commercialization of PICS/hermetic bags for storing cereals, grain legumes and other food products;
- Develop new approaches/strategies to cost-effectively commercialize PICS/hermetic bags among farmers in developing countries; and
- Identify future challenges/opportunities, and collaborations/partnerships required to increase the adoption of PICS/hermetic bags.



Group photo at Lessons Learned Workshop.

On Wednesday, February 26, 2020, a partners meeting was held with prospective local partners and was attended by 30 participants including a representative from the Tanzania Ministry of Agriculture. The goal of the meeting was to share experiences and discuss opportunities to scale-up PICS bags to reduce postharvest storage losses among farmers in Tanzania. The Fifth PICS Supply Chain Workshop was held on February 27 & 28 and was attended by 45 participants including manufacturers, distributors, business and media consultants, and key individuals who have been involved in supply chain development. The main goal of the workshop was to review progress and plan for growth of the PICS business. The Workshop provided a platform for the private sector to share learnings and experience in improving sales. PICS Global led discussions on the role of the private sector in growing the PICS business.



Dieudonné Baributsa and Laurie Kitch present the Award for Creative Marketing to Yared Sertse from Shayashone.



Group photo at Supply Chain Workshop.

*Special Thanks to Bernadette Majebelle, Carole Braund, Holly Fletcher-Timmons, Jorge Valderrama, and Bradley Smith for organizing the workshops. A big thank you to the staff of the Doubletree Oyster Bay Hotel for the support provided during the workshops.*

On the final day of workshops, the PICS program recognized individuals and companies for their contributions to the commercialization of the PICS bags.

**Award Recipients:**

- **Manufacturing Improvement Award**  
Pee Pee Limited, Tanzania (PPTL)
- **Distribution Innovation Award**  
Pradeep Purushothaman, Malawi
- **Outstanding Business Consultant Award**  
Bernadette Majebelle, Tanzania
- **Outstanding Sales Award**  
Lela Agro, Nigeria
- **Creative Marketing Award**  
Shayashone Trading PLC, Ethiopia
- **Outstanding Leverage Award**  
Bell Industries, Kenya

- **Outstanding Contribution Award**  
Dr. Tahirou Abdoulaye, IITA - Nigeria  
Dr. Ibrahim Baoua, University of Maradi - Niger  
Dr. Bokar Moussa, INRAN - Niger  
Dr. Clementine Dabire, INERA - Burkina Faso  
Mr. Ahmed Kaumi, Lela Agro - Nigeria



Certificates of Recognition were presented to attendants honoring their contributions to the success of the PICS program.

## DEVELOPMENTS IN THE USE OF HERMETIC BAGS FOR GRAIN STORAGE

Dr. Baributsa (Associate Professor of Entomology, Purdue University) and Mrs. Ignacio (Assistant Professor, University of the Philippines Los Banos) recently published a book chapter on the developments in the use of hermetic bags for grain storage, as part of a book entitled, "Advances in postharvest management of cereals and grains".

**ABSTRACT:** Smallholder farmers' interest in hermetic bags has been driven by the need to reduce grain storage losses due to insect pests and limitations (inefficacy and health risks) of current storage methods. Hermetic bags commercially available for grain storage include single-, double-, and triple-layer plastic bags. For the last 12 years, more than 20 million hermetic bags have been sold to smallholder farmers and other users in sub-Saharan Africa (primarily) and Asia. The rapid increase in the use of hermetic bags is due to the scalability of both awareness activities, namely training to create demand and the supply chain efforts to improve availability through the private sector. Hermetic bags have several benefits including: (i) preserving grain without the use of insecticides, (ii) keeping grain in good quality from several months to at least 2 years, (iii) providing farmers with the flexibility to sell grain when prices are high, and (iv) allowing farmers to store grain and seed using the same technology. Challenges to increase the adoption of hermetic bags include limited awareness and unavailability of the technologies in rural areas, variability in the quality of the hermetic bags, and a lack of standards to ensure effectiveness across different products.

BURLEIGH DODDS SERIES IN AGRICULTURAL SCIENCE

### Developments in the use of hermetic bags for grain storage

Dieudonne Baributsa, Purdue University, USA; and Ma Cristine Concepcion Ignacio, Iowa State University, USA and University of the Philippines Los Baños, The Philippines



[Click here to link to the full version PDF.](#)

**CITATION:** Baributsa, D., Ignacio, M.C.C.D. 2020. Developments in the use of hermetic bags for grain storage. In Maier, D. E. (ed.), *Advances in postharvest management of cereals and grains*, Burleigh Dodds Science Publishing, Cambridge, UK, 2020, (ISBN: 978 1 78676 352 5; [www.bds-publishing.com](http://www.bds-publishing.com)).



## COVID-19 AND SEED SECURITY GUIDANCE: STORAGE

Dieudonné Baributsa; Purdue University - USA



The COVID-19 pandemic reminds us all of the importance of preserving seeds for future production and grain for household consumption. Development practitioners and government agencies need to recognize and support the efforts by farmers to preserve their seed and grain.

[Click here to link to the article.](#)

## SEED SECURITY RESPONSE TO COVID-19: NOW AND BEYOND

Louise Sperling, Niels Lauwaars, Orlando de Ponti, Melinda Smale, Julie March, Dieudonné Baributsa, Jacob van Etten

COVID-19 brings new challenges worldwide, including to smallholder farmers and their seed systems. In response, an escalating number of seed projects are being planned to deliver immediate aid or to alter current seed production programs. This statement aims to steer both the immediate aid and more developmental planning towards



wiser, better and more informed practice--and to stop unproductive or even harmful decisions.

[Click here to link to the article.](#)

## PICS VIDEO FOR LATIN AMERICA (in Spanish)

<https://www.youtube.com/watch?v=YzEqDMrpAlk>



## PICS RELATED PEER-REVIEWED PUBLICATIONS (2019- AUGUST 2020)

Baributsa, D., Bakoye, O. N., Baoua, I. B., L., Murdock, 2020. Performance of five postharvest storage methods for maize preservation in Northern Benin. *Insects* 11 (8), 541. <https://doi.org/10.3390/insects11080541>

Baributsa, D., Njoroge, A.W. (2020). The use and profitability of hermetic technologies for grain storage among smallholder farmers in eastern Kenya. *Journal of Stored Products Research*. 87. 101618. <https://doi.org/10.1016/j.jspr.2020.101618>

Kadjo, D., J. Ricker-Gilbert, J. Shively, and T. Abdoulaye. 2020. "Food Safety and Adverse Selection in Rural Maize Markets." (Forthcoming) *Journal of Agricultural Economics*. <https://onlinelibrary.wiley.com/doi/full/10.1111/1477-9552.12350>

Quellhorst\*, H.E., Njoroge, A.W., Venort, T., Baributsa, D. 2020. Postharvest Management of Grains in Haiti and Gender Roles. *Sustainability* 12 (11), 4608 <https://doi.org/10.3390/su12114608>

Bakoye, O, Baoua, I., Sitou, L., Moctar, M., Amadou, L., Njoroge, A.W., Murdock, L.L., Baributsa, D. 2019. Groundnut production and storage in the Sahel: challenges and opportunities in the Maradi and Zinder regions of Niger. *Journal of Agricultural Science* 11: 25-34. <https://doi.org/10.5539/jas.v11n4p25>

Channa, H., A. Chen, P. Pineda, J. Ricker-Gilbert and D. Stein. 2019. "What drives smallholder farmers' willingness to pay for a new farm storage technology? Evidence from an Experimental Auction in Kenya." *Food Policy* 85:64-71. <https://www.sciencedirect.com/science/article/pii/S0306919218306353>

Nkhata, S. G., D. Ortiz, D. Baributsa, B. Hamaker, T. Rocheford, M. G. Ferruzzi. 2019. Assessment of oxygen sequestration on effectiveness of Purdue Improved Crop Storage (PICS) bags in reducing carotenoid degradation during post-harvest storage of two biofortified orange maize genotypes. *Journal of Cereal Science* 87: 68-77. <https://doi.org/10.1016/j.jcs.2019.02.007>

Omotilewa, O., J. Ricker-Gilbert, and J.H. Ainembambazi. 2019. "Subsidies for agricultural technology adoption: Evidence from randomized experiment in Uganda." *American Journal of Agricultural Economics* 101(3): 753-772. <https://academic.oup.com/ajae/article/101/3/753/5355101>

Njoroge, A., IB Baoua, D. Baributsa. 2019. Postharvest Management Practices of Grains in the Eastern Region of Kenya. *Journal of Agricultural Science*; Vol. 11, No. 3; ISSN 1916-9752 E-ISSN 1916-9760. <https://doi.org/10.5539/jas.v11n3p33>

Njoroge, A.W., Mankin, R.W., Smith, B., Baributsa, D. (2019). Effects of Hypoxia on Acoustic Activity of Two Stored-Product Pests, Adult Emergence, and Grain Quality, *Journal of Economic Entomology*, toz110, <https://doi.org/10.1093/jee/toz110>

Kharel, K., L. Mason, L. L. Murdock, D. Baributsa. 2019. Efficacy of Hypoxia Against *Tribolium Castaneum* (Coleoptera: Tenebrionidae) Throughout Ontogeny. *Journal of Econ. Entomology*. <https://doi.org/10.1093/jee/toz019>

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Holly Fletcher-Timmons

If you have a PICS story to share,  
please contact us at  
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