

Technologies to Mitigate Aflatoxin
APPENDIX A: PRODUCT DETAILS

Preharvest

No.	Product name	Technology type	Crops	Rating	Details (Price, Application quantity, Capacity)	Advantages	Disadvantages
1	Farmyard manure	Soil amendment	Groundnut	2	Cost: \$46.15 USD per Acre (Parimi et al., 2018). Application: 5 t/ha should be applied to ground nut crop.	Applying Farmyard Manure to groundnut helps to prevent aflatoxin contamination. It can reduce the contamination by 42% (Alenyorege, 2015).	The farmyard manure used should be totally decomposed. Partially decomposed Farmyard manure does not have much effect in reducing aflatoxin reduction.
2	Gypsum application	Soil amendment	Groundnut	3	Cost: \$19.23 USD per Acre (Parimi et al., 2018). Application: Applying gypsum (500 kg/ha) at the time of flowering, reduce A. flavus invasion of pods and subsequent aflatoxin contamination.	Applying gypsum to the groundnut can reduce the Aflatoxin by 40% (Alenyorege, 2015).	-
3	Biocontrol using competitive fungi		Maize and Groundnut	3	It costs \$4–\$5/acre (\$10 to \$12 per hectare ₦0.52–₦0.63/kg) (Nigeria) for Maize. It costs \$17–\$32/acre [Afla-Guard™] ₦0.21–₦0.39/kg (USA) for Groundnut It costs costing \$6–\$16/acre [AF36] ₦1.50–₦4.00/kg USA) in cotton seed (Khangwiseta & Wua, 2011).	Aflatoxin can be reduced by 60-87% in Maize, 70-91% in Ground nut and 80% in Cottonseed (Khangwiseta & Wua, 2011).	-

Harvest

Sr./ No.	Product name	Technology type	Crops	Rating	Details	Advantages	Disadvantages
4	Simple Plucking machine	Harvester	Groundnut	2	Stripping/plucking is the process of removing the pods from the plants.	The process of plucking could be quickened up with the aid of simple plucking machine figure.	-
5	CTI Lifter	Harvester	Groundnut	3	The lifter consists of a frame with a blade. The lifter blade sinks below deep into the soil to cut the roots of the groundnut vines and it loses the soil as the oxen or small tractor pulls forward. It takes 10 days to harvest 1 hectare using a Hand Hoe, but it only takes 2.5 days with CTI lifter.	Compared to hand It can harvest four times faster (CGIAR). Alleviate drudgery. Provide new income for women.	-

					<p>This helps to have profit percentage about 166%-432% in one season.</p> <p>In order to make it available at an affordable to farmers CTI is working with C to C Manufacturing in Malawi using the tools available locally.</p>		
--	--	--	--	--	---	--	--

Post-Harvest

Sr./ No.	Product name	Technology type	Crops	Rating	Details	Advantages	Disadvantages
6	CTI Stripper	Stripper	Groundnut	3	<p>It is comprised of an A-shaped frame covered with a woven metal screen, similar to chain link fencing (CTI).</p> <p>It takes 16 days for manual stripping to strip 1 hectare. whereas the CTI stripper strips within 5 days</p> <p>This helps to have profit percentage about 824%-1747% in one season.</p>	<p>The stripper works three times faster than hand stripping (CGIAR).</p> <p>Alleviate drudgery.</p> <p>Provide new income for women.</p>	-
7	CTI Sheller	Shelling Technology	Groundnut	2	<p>A shelling technology developed for groundnut shelling by CTI and ICRISAT.</p> <p>For shelling made using hand it takes 80.5 days to process 1 hectare whereas using CTI sheller the same task could be accomplished within 4.5 days only.</p> <p>This helps to have profit percentage about 55%-210% in one season.</p>	<p>The sheller developed by CTI and ICRISAT can shell 18 times more quantity in one hour than hand shelling (CGIAR).</p> <p>It shells the groundnut keeping the pods dry.</p> <p>Alleviate drudgery.</p> <p>Provide new income for women.</p>	-
8	Easydry M500 Maize Dryer	Shallow bed Dryer	Maize	2	<p>Its priced at \$850 - \$1660 USD (Acdivoca).</p> <p>Capacity: 500Kg</p> <p>Estimated cost of manufacturing in: Kenya: \$850 Tanzania: \$1100 Rwanda: \$1660 Uganda: \$1100</p> <p>It is generally owned by service providers who visits each farm in drying season.</p>	<p>Portable</p> <p>Suitable for all weather conditions (Has a roof)</p> <p>Drying is done in only 3 hours.</p> <p>Less laborers required.</p> <p>Easy to operate.</p> <p>Maize is dried thoroughly and therefore can be stored longer.</p> <p>Most suitable for small batch drying therefore adequate for small scale farmers.</p> <p>Good control over the drying process.</p>	<p>Bulky hence transport costs are incurred.</p> <p>High operating cost - the fan is powered by 5 litres of petrol per day.</p> <p>Requires trained individuals to operate.</p> <p>High cost</p> <p>Low capacity - Not suitable for large scale drying.</p> <p>Requires frequent attention during drying unlike solar drying.</p>
9	Column Dryer	Dryer	Grains	2		<p>High efficiency and speed.</p> <p>Has portable units that can be moved from</p>	<p>High acquisition cost.</p> <p>Requires trained personnel.</p>

						one place to another. Can generate very high temperatures which are sufficient for drying maize. Independent of weather conditions.	
10	Solar Dryer	Dryer	Grains	2	Capacity: 1T[48]. Construction: Its consists of a solar collector: made up of black plastic sheet, a duct structure: made up of plywood and a solar chimney: made up of a wood frame [48].	Relatively low cost Environment friendly method (AflaStop – Grain Drying).	Slow. Low capacity. Non-mobile. Dependent on weather conditions. Labour intensive construction required during installation (Aflastop – Grain Drying).
11	Tarpaulin sheet for pod drying	Dryer	Groundnut	2	Its costs \$1.15 per acre.	Proper drying of pods on tarpaulins will cut the contact of pods with the soil after harvest.	Its cost is \$1.15 per acre. Can be costly when it comes to large capacity.
12	Motorised Thresher by soybean Innovation Lab	Threshing Technology	Maize, Rice, Soybean, millet, beans, sorghum, pigeon peas.		Cost: Costs \$2,000 USD.	This machine is locally built so its less costly than the imported ones and all the parts are available locally. Comparing with traditional stick beating thresher this machine threshes soybean 40 times faster (Soybean Innovation Lab). Produces near zero machine loss of grain Does not split seed	
13	CTI Thresher	Threshing Technology	Perl Millet		Cost: It costs about \$300 USD (Agtech). Feed Rate: 20kg/hr.	The thresher allows to process 1kg of grain in 3 minutes (Agtech). Reduce the drudgery of the farmers	
14	Purdue Improved Crop Storage (PICS) bags	Storage Technology:Hermetic Bags	Grains (maize, sorghum, wheat, millet, rice, common bean, cowpea, peanut, Bambara nuts, pigeon pea, mungbean, chickpea, sesame, etc.)	3	Cost: It costs \$ 2.5 USD per bag. Life Span: About 3 years (Hodges & Stathers, 2015).	Inhibit Aflatoxin growth Control pests and microorganisms without the need of toxic chemical fumigation. Allow prolonged preservation by maintaining moisture and air content. Can store produce for a long period of time. The bags can be re-used for 2-3 seasons before replacement. Hermetic bags are relatively affordable and available for small scale farmers at a cost of \$ 2.5 USD per bag.	Can be costly when it comes to large capacity storage. If the hermetic bags are not properly treated, they can be damaged by grain borers and rodents thus rendering them ineffective. Require the grains to be properly dried before storage in order for them to be effective

15	Metal silo	Storage Technology: Metal Containers	Maize, cowpea, sorghum, beans, millet, Paddy rice (Hodges & Stathers, 2015).		Cost: For 312kg it costs about \$144 USD Cost per kg of storage is \$0.46 It is manufactured locally and has a capacity which ranges from 200kg to 1000kg (AflaStop – Drying & Storage). Life Span: 15 to 20 ±5 years (Hodges & Stathers, 2015).	These are durable with life span of 7+ years Robust and resistant to fire Rodent proof Easy to fumigate grain inside it. Can be locally made in a rural area Occupies a small space. Choice of different capacity sizes (Hodges & Stathers, 2015).	Care required each time during closing. Must be kept closed for a period to generate hermetic effect, before grain can be removed Must be full so that volume of oxygen is low, so drum size must match quantity to be stored. Grain being stored must be below 14% mc Handle with care during transport/ needs roof. Not hermetic, some farmers fumigate it indoors. Often hard to seal in/outlets to make hermetic (Hodges & Stathers, 2015).
16	Plastic silo	Storage Technology: Plastic Containers	Maize, cowpea, sorghum, bean, millet, pigeon peas and beans, rice (Hodges & Stathers, 2015).		Cost: For 350kg it costs about \$92 USD Cost per kg of storage is \$0.26 (AflaStop – Drying & Storage). It is manufactured locally by ‘Kentainers’ with heavy duty reinforced plastic as material Life Span: 15-20 yrs (Hodges & Stathers, 2015).	Low initial investment. These are durable with life span of 7+ years. Insect control without chemical pesticides. Choice of different capacity sizes. Relatively difficult to remove grain thus easy to control consumption & ‘unwanted removals’. No harvest of natural resources each year (Hodges & Stathers, 2015).	Susceptible to rodents and rough handling. Capacity/ size is often limiting. Care required each time during closing. Must be kept closed for a period to generate hermetic effect, before grain can be removed. Must be full so that volume of oxygen is low, so drum size must match quantity to be stored. Grain being stored must be below 14% mc. Stored grain requires regular monitoring. Loading &/or off-loading grain can be difficult (Hodges & Stathers, 2015).
17	Grain Pro Grain Safe II - Bulk Bag	Storage Technology			Cost: For 1300kg it costs about \$260 USD Cost per kg of storage is \$0.20 It is manufactured by grain pro and is imported in Africa as duty free. It is made out of patented plastic technology. and has a capacity which ranges from 800kg to 1300kg (AflaStop – Drying & Storage).		

18	Grain Pro Super Grain Bag	Storage Technology: Hermetic Bag	Maize, sorghum, millet, Fonio, Rice, Cowpea, Groundnut, soya, Coffee, cocoa (Hodges & Stathers, 2015).		<p>Cost: For 90kg it costs about \$2.50 USD (along with additional PP bag costing about \$0.5) Cost per kg of storage is \$0.03 It is manufactured by grain pro and is imported in Africa as duty free. It is made out of patented plastic technology. and has a capacity which ranges from 90kg to 100kg (AflaStop – Drying & Storage). Life Span: Minimum 1+ years (Hodges & Stathers, 2015).</p>	<p>Low initial investment. Insect control without chemical pesticides. Easy to use. Convenient and portable in case it suddenly needs to be moved for sale or due to flood. Easily adaptable to the quantity of grain to be stored, and location Multi-purpose packaging. (transportation, handling and storage) Easy to monitor for insect damage. Easy to calculate amount of grain in stock. Anti-slip weaving helps in stacking (Hodges & Stathers, 2015).</p>	<p>Susceptible to rodents and rough handling. May not withstand typical handling methods. Care required each time during closing. Must be kept closed for a period to generate hermetic effect, before grain can be removed. Grain being stored must be below 14% mc. Environmental concern -short lifespan/ plastic. Requires a pallet to keep them off the ground (Hodges & Stathers, 2015).</p>
19	poly-propylene (PP) bag	Storage Technology: Open Weave Bag	All cereals, pulses and oilseeds (Hodges & Stathers, 2015).		<p>Cost: It costs about \$0.5 for 15kg Cost per kg of storage is \$0.03 (AflaStop – Drying & Storage). PP bags are non-hermetic bags Life Span:- 1 - 2 years (Hodges & Stathers, 2015).</p>	<p>Low initial investment. Easy to use Convenient and portable in case it suddenly needs to be moved for sale or due to flood. Easily adaptable to the quantity of grain to be stored, and location Multi-purpose packaging (transportation, handling and storage). Easy to monitor for insect damage. Easy to calculate amount of grain in stock. Formal market trading unit (when filled). Easily available locally, even at village level. Wide adoption, good supply chain efficiency. UV resistant PP bags do not become brittle. Anti-slip weaving helps in stacking. Bag does not break during quality sampling (Hodges & Stathers, 2015).</p>	<p>Susceptible to rodents and rough handling. Prone to insect attack. Grain being stored must be below 14% mc. Insect infestations in the grain bulk continue to develop during storage if no pesticide added. Stored grain requires regular monitoring. Stored grain may be affected by ambient moisture[49].</p>