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AFLATOXIN IMPACTS AND POTENTIAL SOLUTIONS IN AGRICULTURE, TRADE, AND HEALTH

The issue of aflatoxins found in several African staples is increasingly becoming a matter of concern in the agriculture, trade, and health sectors. The following article presents an overview of the impacts in Africa, as well as the range of solutions that are being developed.

Aflatoxins are naturally occurring toxins produced by certain fungi, most importantly *Aspergillus flavus* and *Aspergillus parasiticus*. They contaminate many African dietary staples such as maize, groundnuts, rice, and cassava, particularly under certain conditions: dry weather during planting, high moisture during harvest, inadequate drying and storage of crops. Countries in latitudes between 40°N and 40°S—which includes all of Africa—are susceptible to aflatoxin contamination.

This contamination of key staples—maize, groundnuts and sorghum—occurs above the safe levels in many countries. Prevalence data suggests that in maize, groundnuts and sorghum, it is higher than the European Union (EU) aflatoxin standard and that of US. However, even aflatoxin exposure at low levels can result in measurable human health impacts.

Impacts on Agriculture and Food Security, Trade, and Health

- Agriculture and food security

Aflatoxin contamination of key staples can affect the agricultural sector output, generally, and each of the four pillars of food security (availability, access, utilisation, and stability), specifically. Contamination in staples such as maize, sorghum and groundnuts can directly reduce availability of food. Producers of the affected crop may also earn less because of product rejection, reduced market value, or inability to gain access to the higher-value international trade market.

Lower farmer income in turn limits ability to purchase food for the family, which translates into reduced access to food. Contamination reduces use options for the affected produce through complete rejection or need to put it to other safe uses. Given the link between aflatoxin and adverse human health impact—particularly the confirmed linkages to liver cancer, synergistic effects with Hepatitis B, and potential association with stunting and immunosuppression—contaminated food presents a clear food security threat.

- Trade

Many countries have established regulations to limit exposure to aflatoxin, typically expressed in parts per billion (ppb). Some countries have different limits depending on the intended use, the tightest applying to human consumption and exports, and the highest to industrial products. These regulations can result in

foregone trade revenues arising from increased cost of meeting the standards – including cost of testing, rejection of shipments and even eventual loss of admissibility into foreign markets.

The direct economic impact results mainly from a reduction in marketable volume, loss in value in the national markets, inadmissibility or rejection of products by the international market, and losses incurred from livestock disease, consequential morbidity and mortality.

Specifically, in the international market, products that do not meet the standards are either rejected at the border, rejected in channels of distribution, assigned a reduced price, or diverted to non-human or even non-fee uses. Similar economic losses may not occur in domestic markets if consumer awareness about the problem rises, if leaders in marketing channels begin to pay more attention, and/or if regulations are either tightened or more strictly enforced.

Under any of these circumstances, premiums for aflatoxin-free commodities may be realized for a limited period of time. In the long run, the premium will eventually vanish as compliance becomes a threshold condition for being accepted as a supplier. While it may seem that tighter phytosanitary standards imply more costs than benefits, in fact once suppliers internalise the economic costs of non-compliance and bear them as a financial cost, greater economic benefits for society will arise in several forms, including larger and more stable markets and reduced burden of disease.

- Health

If aflatoxin-contaminated crops are consumed by humans, aflatoxin poisoning (aflatoxicosis) can occur. Chronic exposure to even low levels of contamination in crops consumed regularly increases liver cancer risk and can suppress the immune system.

Aflatoxin can also enter the human diet through livestock products if the livestock are given contaminated feed. High levels can be fatal. Children can also be affected through breast milk or direct consumption of weaning foods. Some experts suspect association of aflatoxin exposure with child growth stunting.

Prevalence and the relative magnitude of impacts

The relative magnitude of impact on agriculture and food security, human health, and trade for a country depends on the uses of aflatoxin contaminated crops in the country. The economic impact depends on the contribution that the susceptible commodity makes to a country's consumption and income.

In particular, it depends on the commodity's share in the nutrient requirements for the household, its share as a source of income derived via domestic and international trade, and the extent of awareness about the problem within households and markets. If there is general awareness of aflatoxin in a country and there are supporting regulations and institutions, then the human health impact of aflatoxin contamination will be low but market impact will be high.

This is because producers will have to bear the burden of reduced revenues from discarded grains or costs borne for prevention and control strategies. On the other hand, if awareness is low and there are inadequate regulations to control it, aflatoxin-contaminated grain will trade freely, in which case the health impacts will be high—this is largely true in Africa. The majority of maize production in Africa is used for a producer's own consumption, implying that the human health impact will be the greatest if there is lack of awareness.

Aflatoxins disproportionately impact the poor. Food-insecure households are more likely to consume contaminated food rather than sell it at lower prices or discard it. The poor may also not be able to adopt costly control strategies. A well-intentioned awareness campaign can reduce prices for aflatoxin-contaminated food, resulting in direct market losses for the poor and more severe health impacts because

of farmers' own consumption of low-price yielding, contaminated grain. Therefore, policies and regulations require particular care in accounting for the distributional impact.

In many African countries, women make up the majority of the agricultural labour force. Therefore, it is critical to consider how recommendations and mitigation interventions will be accessed by men and women, as gender may influence access to and adoption of agricultural technologies, information, inputs, finance and decision making authority with regard to planting, marketing and harvesting.

Studies in Nigeria and Uganda found that women did make final decisions about pre- and post-harvest production, including storage and marketing practices. Thus, deliberate focus on women in the development and implementation of aflatoxin prevention and control programmes and strategies is crucial.

In addition to information flows, gender roles, flows of income, and divisions of labour, women's access to inputs (insecticides, storage equipment, bio-controls), and finance (loans, credit and savings schemes) as well as time, are key factors affecting their ability to effectively prevent and control aflatoxin contamination at the household and community level.

Further, local customs or regulations affecting land tenure, mandates for extension services, and education for women and girls also determines women's access to and adoption of new technologies and practices. Customs, norms and laws that affect women's access to resources, assets and inputs affect their standing in the household, community and market. Women's standing in turn affects their autonomy to make household health and consumption decisions such as diversifying the household's diet, spending household resources on vaccinations, or using agricultural revenue to invest in promising technologies such as bio-controls, storage cribs, or wooden pallets.

Action is needed now

Crops affected by aflatoxins such as maize and groundnuts are important for household food security in many African countries. Conditions across Africa contribute to widespread aflatoxin prevalence and chronic exposure, which has devastating impacts on farmers, consumers, and economic development. Action is needed now because:

- Even at low levels of contamination of key staples, there is measurable health impact because of high contribution of the staples in the African diet.
- Liver cancer risk attributable to aflatoxins is higher for countries with greater prevalence of aflatoxins.
- A recent study from Kenya shows that populations from all economic strata have high aflatoxin exposure. The level of aflatoxin B1—the most toxic of the aflatoxins—in blood serum was similar across rich and poor, with the highest burden amongst the middle wealth quintile.
- Aflatoxin contamination can result in direct economic impact through export rejections from importers with stringent aflatoxin regulations such as the EU countries. Between 2007 and 2012, the EU alone has issued 346 notifications to African countries.
- Aflatoxin contamination in Africa contributes to the inability of most African countries to access high-value international trade markets. Lowering aflatoxin prevalence in key crops could reduce the barrier to trade in maize and groundnuts especially, and could result in increase in export of maize by Africa.

Potential solutions for aflatoxin control

Actions to mitigate the problem should ensure that information and resources on control are targeted towards areas that result in high impact whether in agriculture, trade, or health. Interventions must recognize that aflatoxin contamination may disproportionately impact the poor. At the same time, poor farmers may not be able to access control strategies or afford commercially available agricultural inputs known to directly or indirectly reduce aflatoxin levels. Design of aflatoxin control strategies must also take into account the role that women play in management of pre- and post-harvest production and household consumption.

The following is an outline of potential solutions that are being developed in some countries, or could be developed, to control aflatoxin in Africa.

Agriculture and food security: Practise good agricultural practices at planting, harvest and post-harvest handling:

- Use aflatoxin-resistant planting materials including conventional and transgenic breeding
- Use bio-controls proven to reduce aflatoxin levels in soil
- Use irrigation, fungicides, herbicides and insecticides for healthier plants that resist fungus
- Adopt moisture-control measures like solar drying, tarp drying, and promote improved storage (including hermetic storage of maize, sorghum).
- Emphasise the importance of sorting and discarding crops with physical flaws and deformities (for example, visible mold or damaged shells)
- Conduct further research on use of aflatoxin-resistant planting materials, including conventional and transgenic breeding.

Explore alternative uses of unsafe commodities:

- Promote research on safe disposal and alternative use of unsafe commodities, such as biofuels or blended feeds (which in the aggregate conform to safe maximum levels) and finishing feeds, which can have slightly higher levels (300ppb) of aflatoxin without harming the animal.
- Conduct further research on ammoniation and other commercial processing techniques
- Incorporate messages about aflatoxin mitigation into agricultural extension messages.
- Evaluate how these recommendations affect labour burdens on men vs. women and recommend labour-sharing strategies for both.

Trade: Awareness campaigns to increase demand for aflatoxin-safe products and incentivise adoption of aflatoxin control strategies along the value chain:

- Increase agro-dealer education and partnerships to promote commercial/subsidised distribution of aflatoxin-reducing inputs (for example, bio-controls, drought and disease resistant seeds) to farmers.
- Collaborate with existing agriculture development projects to promote safe production through improved seeds and other agricultural inputs.
- Educate and persuade retailers and consumers to incentivise safer crops and harvest among buyers and sellers.
- Provide training to traders, processors, manufacturers and livestock producers.
- Food safety control system upgrading
- Establish robust regulatory foundation to address aflatoxin in national food safety standards.
- Establish country-specific standards that account for consumption patterns building on Codex Alimentarius, consistent with the World Trade Organization Sanitary and Phytosanitary Agreement.
- Ensure that official and private food safety standards reflect Good Manufacturing Practices (GMP) and the Hazard Analysis and Critical Control Point (HACCP) approach.

- Adjust national food safety standards based on ranges of consumption of different commodities (for example, Average Daily Intake) and considering the tolerance level of the consumer.
- Set standards for animal feed at higher levels than for commodities destined for human consumption; use grading system to ensure safe levels for both.
- Enhanced laboratory capacity and availability of rapid test kits, trained users, documentation of results, and withdrawal of contaminated products to enable greater separation of contaminated crops in markets, assembly points, export points and prior to processing. This could include carrying out more regular testing of aflatoxin levels in major foods, and establishing reference laboratories for mycotoxin studies.

Improved trader compliance with national regulatory codes

- Widely disseminate specifications for acceptable aflatoxin maximum limits.
- Enhance inspection capacity of the national enforcement agencies for food safety.
- Create public campaigns to increase visibility and perceived value of a certification of inspection, signifying that commodities and products are below regulated levels of aflatoxin contamination.
- Provide technical support to improve capacity of medium to large traders and enforcement agencies to recognise 'mark of quality' by the national enforcement agency.
- Commodity exchange systems. Create warehouse receipts systems to encourage proper detection, culling, warehousing and storage and incorporation of aflatoxin and food safety concerns in the key crop marketing boards.
- Import and export controls. Improve controls on cross-border movement of contaminated products.

Health

- Dietary diversity and food safety promotion to minimise aflatoxin exposure at home
- Reduce excessive caloric dependence on susceptible products,
- Reduce daily and long-term intake of products at risk,
- Conduct multi-sectoral food safety behavioural change campaigns,
- Promote improved household food processes.
- Protect infants through routine testing for levels of aflatoxin in mother and breastmilk.
- Prevent absorption of the toxic effects of aflatoxin through enterosorbents, which capture aflatoxin in the gastrointestinal tract and facilitate its elimination. Some enterosorbents may be appropriate for treatment for acute outbreaks of aflatoxicosis, but not for chronic treatment due to cost and possible side effects.
- Reduce the carcinogenic effect of aflatoxin through use of chemopreventive, which trigger detoxifying enzymes or inhibit enzymes required for the activation of procarcinogens.
- Reduce co-morbidity effects through Hepatitis B Vaccine.
- Promote animal health through use of aflatoxin-safe feed or chemical toxin binders and anti-caking agent in animal feed.
- Conduct advocacy campaigns among major institutional representatives from the health field to shore up awareness and coordinated efforts that include the health sector.
- Conduct population monitoring and mapping of the exposure to aflatoxins using biomarkers.

Conclusion

Comprehensive, multi-sectoral approaches are required to control aflatoxin and improve the health, income, and livelihoods of African farmers, farm households and consumers. A comprehensive programme will include a range of complementary components, including: effective policies, standards and regulations; policy-relevant information from economic, food security and health assessments; campaigns to raise consumer demand for safe, high-quality food; distribution and adoption of improved inputs and improved quality of production; (market) mechanisms to inspect commodities, regulate quality,

and ensure proper storage; access to safe and high quality food ingredients; and efficient withdrawal of and alternative uses for contaminated commodities. Actions are needed at all levels (continental, national, regional and local) to reduce aflatoxin prevalence and exposure in Africa.

This article is from as background paper for a strategy development for the African Union's Partnership for Aflatoxin Control in Africa (PACA). It informed a stakeholder consultation process and it is available at www.rea.au.int/en/sites/default/files/AflatoxinImpactsPapercopy.pdf

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