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Executive summary

Evidence generation to inform policy is at the heart of the Partnership for Aflatoxin Control in Africa (PACA) of the African Union Commission. As a result, PACA has commissioned studies at the regional level both in the COMESA and ECOWAS region to assess aflatoxin control capacities at the country level. This study, focusing on the ECOWAS region, assesses the food safety systems, related policies and regulations, as well as human and laboratory capacities in aflatoxin control in ECOWAS Member States.

This report is based on questionnaires administered in all15 ECOWAS countries on present aflatoxin regulation, policy standards, and existing aflatoxin testing capacities. The report includes:

- An introduction of the aflatoxin problem, including technologies to reduce contamination, impact on health and trade, and efforts of the Partnership for Aflatoxin Control in Africa (PACA) in the ECOWAS region.
- A short literature review on past actions for improvement of the food safety system and aflatoxin control in the region.
- Descriptions of aflatoxin prevalence in commodities and in humans by countries, without specifying exposure levels.
- Regulatory systems and differences between Anglophone and Francophone systems, as well as the global context of food safety standard setting are explained.

Eight (53.33%) of the 15 countries have food safety legislation in place. Only, 20% of the countries (Benin, Nigeria and Ghana) have a specific standard for aflatoxin. Most of the other countries use codex limits or the limits required by major trading partners, such as China (for Senegalese groundnut exports) or the European Union (EU) standard. For each country, the report summarizes the standards and regulations that are in place and the different institutional authorities that implement food safety laws and undertake food safety control. The CILSS region has an existing regulation for biopesticides, while Nigeria is in the process of developing a regulation.

The report describes actions to raise awareness on aflatoxin in the region. Most countries have run awareness campaigns. But, these campaigns are not continuous and country- or region-wide, which dissipates their impact. PACA could play a major role in raising awareness in the region.

A last country-specific section describes the national testing capacity, and the human capacity and infrastructure that are available for aflatoxin testing in the countries, including methods and accreditation. Presently, only three laboratories in Ghana and Nigeria are accredited, with many others in the process for accreditation. Many laboratories participate in ring-testing. The

human capacity in most countries is low in number and often also in level of academic qualification, with the exception of Cote d'Ivoire and probably very soon, The Gambia who are in the process of recruitment for their food safety authority. In the last decade, many projects have focused on capacity building so that staff is well prepared. But, staff often lacks the necessary routine. Many risk assessment experts are available in the countries, but they do not necessarily work in government institutions on developing national risk plans. Most laboratories use HPLC (high-performance liquid chromatography), while others use cheaper methods for routine analysis like VICAM, TLC (thin layer chromatography) and ELISA (enzyme-linked immune-sorbent assay) (see Annex 3 for clarification). In many countries, either EU or ISO (International Organization for Standardization) specifications are used when undertaking aflatoxin testing.

The final section of the report lists key gaps and recommendations for actions on aflatoxin control and management and improved institutional arrangements for aflatoxin management. The report makes the following recommendations:

- Gather, share, and scale lessons learned from successful efforts to reduce aflatoxin in West Africa. Such as the successful Nestle campaign as documented below
- Develop a regional code of practice (standard operating procedure) for the prevention and reduction of mycotoxin contamination for high risk commodities such as maize, groundnut, rice and sorghum in 'mono-modal' and 'bi-modal' rainfall regions.
- Evaluate the cost/benefit and stakeholder opinions on already successful aflatoxin awareness & control campaigns – like the one led by Nestlé and IITA-Benin through independent sources including costing of development of technology.
- Pre-package aflatoxin awareness and control material and send to all projects on the continent working on value chain development of relevant products. Associate all chain actors in control efforts.
- Create awareness on the role of quality control in safeguarding people's health & well-being.
- Involve policy and decision makers in decentralized campaigns for awareness creation and aflatoxin control; include aflatoxin control in the national nutrition action plans.
- Collect data on exposure to other mycotoxins and the risk of multi-mycotoxin exposure; and their health impact. Develop research for development programs to address other food safety risks.
- Improve coordination between ECOWAS food safety desk and the UEMOA partner institution. Explore a potential regional aflatoxin standard and its potential economic and social benefit.
- Identify or create one entity responsible for food safety per country, which coordinates and implements all food safety activities in collaboration with other entities.

- Look into the development of standards that reflect national consumption patterns and specific consumer groups. Include researchers, and their national line ministry, in standard setting.
- Collect more data on exposure of the population to aflatoxin and its health effects in the ECOWAS countries especially from non-staple crops.
- Deploy field-based kits (blue-box of WFP) and rapid test kit based equipment to farmer organizations and rural and urban markets.
- Establish a well-equipped central regional lab as the service provider, training and reference lab for mycotoxin analysis.
- Develop national food safety plans. Aflatoxin control plans could be a starting point to show the way ahead for national food safety plans.
- Develop an example budget for aflatoxin awareness and control activities for an 'example country.' So that countries have guidance about the minimal cost of minimum activities.

Implementation of aflatoxin regulation and control on its own is not sustainable. Therefore, quality control should be integrated into a value chain approach that eventually gives higher benefits to small scale producers who do everything to produce higher quality and safer produce, getting paid higher prices for better quality, thus effectively cutting out middlemen and shortening value chains. Stakeholders need to be informed on effective methods for control aflatoxin using simple means, which should be specified in a regional code of practice. The most important action is to implement aflatoxin awareness and control strategies on a regional basis so that efforts are more sustainable.

INTRODUCTION

Food security is not always guaranteed in many African households, this includes access to safe and nutritious food. One of the risks to food security and food safety are mycotoxins, which are produced by fungi more frequently under tropical conditions. Mycotoxins are among the most potent mutagenic and carcinogenic substances known. More precisely, the International Agency for Research on Cancer in 1992 classified aflatoxins as category 1 carcinogens. Aflatoxins pose chronic health risks; prolonged exposure through diet has been linked to cancer, liver and immune-system related diseases. Furthermore diets in many developing countries are more heavily reliant on crops that are susceptible to aflatoxins, such as maize and groundnut, so that people are exposed at a higher frequency than people consuming a more varied diet. Aflatoxins are the most prevalent mycotoxins they are produced most often by toxigenic strains of the fungi *Aspergillus flavus* and *A. parasiticus*. Farmers and other actors will actually sort out and throw away parts of the crop, since they show mold leading to quantitative losses. Aflatoxins can develop during production, harvesting, or storage of grains, nuts, and other crops.

Aflatoxin producing fungi are found in the soil as well as on grains, nuts, dairy products, tea, spices and cocoa, as well as animal and fish feeds. Aflatoxins are more prevalent in hot, dry climates (+/- 30 to 40 degrees latitude, see map on cover) which, includes the ECOWAS region, and their occurrence is often related to drought, delayed harvest, insufficient drying and poor post-harvest handling. Environmental factors, including weather and insect infestation, can also contribute to contamination. Low-input farming practices compound fungal and aflatoxin contamination of crops.

The United Nations Food and Agricultural Organization (FAO) found that 25% of the world food crops are affected and over 4.5 billion people are at risk of chronic aflatoxin exposure, impacting health, trade and food security. Exposure to foods contaminated with high levels of aflatoxins can cause acute toxicity. Chronic ingestion of low to medium levels of aflatoxins leads to a gradual deterioration of health through liver damage and immune-suppression, and have adverse effects on reproductive health. Aflatoxin has been associated with child stunting and linked to kwashiorkor, a disease caused by protein-energy malnutrition. The severity of malaria and HIV/AIDS may also be affected by aflatoxin levels. There seems to be some links between micronutrient uptake and aflatoxin.

Furthermore aflatoxins are a trade barrier actually reducing exportable quantities of staples which are used for domestic consumption. They can result in foregone trade revenues and 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 of aflatoxin contamination in crops 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.

Aflatoxin contamination is a complex problem that requires a comprehensive set of solutions. There are several strategies to reduce aflatoxin contamination. Field management practices that also increase yields can reduce the risk of aflatoxin development. They include use of resistant varieties, crop rotation, well-timed planting, weed control, pest control especially control of insect pests, and avoiding drought and nutritional stress through fertilizer application and irrigation. Measures to stop the infection process by controlling aflatoxin causing fungi in the field are achieved through use of pesticides and atoxigenic fungi to competitively displace toxigenic fungi, and timely harvest. Postharvest interventions that reduce aflatoxin include rapid and proper drying, proper transportation and packaging, sorting, cleaning, drying, smoking, postharvest insect control, and the use of botanicals or synthetic pesticides as storage protectants. Another approach is to reduce the frequent consumption of 'high risk' foods (especially maize and groundnut) by consuming a more varied diet, and diversifying the diet into less risky staples like sorghum and millet, although recent evidence suggests that other toxins with still unknown health risks might be a bigger problem in those crops. Chemo-preventive measures[1] that can reduce aflatoxin effects, like liver cancer in humans, include daily consumption of chlorophyllin or oltipraz and incorporating hydrated sodium calcium alumino-silicates eg. clay supplements that can be added to animal and human diets. Reduction and detoxification of aflatoxin is often achieved physically (sorting, physical segregation, flotation etc.), chemically (e.g. calcium hydroxide, ammonia and others) and microbiologically by incorporating probiotics or lactic acid bacteria into the diet. Millers and feed-millers can use blending of less and more contaminated products to reduce the overall risk, but there is need for aflatoxin determination in the lots so that actual levels of contamination are known. This is most relevant for processing units, which also need to create value from contaminated material, so that they implement quality control and sort out such raw materials. In most African countries, these solutions are rarely applied mainly due to lack of knowledge or funds for implementation which are not accessible. Large scale implementation of management practices for risk reduction reaching a high percentage of the staple crops is needed in Africa. Public education and awareness can sensitize the population on aflatoxin risk and its management including the use of already established codes of practice (next page).

In advanced food systems, where most people rely on products marketed through supermarket chains or processed products for their nutrition, aflatoxins are controlled through standards and regulation since chain actors are implementing quality control at all stages of the food chain. International standards for aflatoxin levels for products vary according to whether the product

[1] The use of a drug or compound to interfere with a disease process, for example, cancer chemopreventive agents — agents used to inhibit, delay, or reverse carcinogenesis

will be directly consumed by humans or further processed. Levels of aflatoxin are generally regulated according to parts per billion (ppb) or μg/kg. US standards allow for a maximum of 20 ppb in food for human consumption on a lot-by-lot basis and for animal feeds other than corn or cottonseed meal, while Australian and European Union (EU) standards are set at 15 ppb for products to be processed and 4 ppb for those products intended for direct consumption. Key to reducing mycotoxins is the implementation of codes of practice to reduce mycotoxin contamination, which are essentially recommendations how to reduce mycotoxins from planting to consumption. The set regulations and standards need to be complemented with these codes of practices or standard operating procedures to give stakeholders concrete tools for reducing aflatoxin levels in their foods (see below). Sadly very often the socio-economic and food security status of the majority of inhabitants of sub-Saharan Africa leaves them few options for producing and choosing low-risk and high quality products.

Codex Alimentarius FAO/WHO Food Standards - CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF MYCOTOXIN CONTAMINATION IN CEREALS, INCLUDING ANNEXES ON OCHRATOXIN A, ZEARALENONE, FUMONISINS AND TRICOTHECENES
CAC/RCP 51-2003

1. The complete elimination of mycotoxin contaminated commodities is not achievable at this time. The elaboration and acceptance of a General Code of Practice by Codex will provide uniform guidance for all countries to consider in attempting to control and manage contamination by various mycotoxins. In order for this Code of Practice to be effective, it will be necessary for the producers in each country to consider the general principles given in the Code, taking into account their local crops, climate, and agronomic practices, before attempting to implement provisions in the Code. It is important for producers to realize that good agricultural practices (GAP) represent the primary line of defence against contamination of cereals with mycotoxins, followed by the implementation of good manufacturing practices (GMP) during the handling, storage, processing, and distribution of cereals for human food and animal feed.

2. The recommendations for the reduction of mycotoxins in cereals are divided into two parts: recommended practices based on Good Agricultural Practice (GAP) and Good Manufacturing Practice (GMP); a complementary management system to consider in the future is Hazard Analysis Critical Control Point (HACCP) principles.

3. This General Code of Practice contains general principles for the reduction of various mycotoxins in cereals that should be sanctioned by national authorities. National authorities should educate producers regarding the environmental factors that promote infection, growth and toxin production in cereal crops at the farm level. Emphasis should be placed on the fact that the planting, preharvest and postharvest strategies for a particular crop will depend on the climatic conditions of that particular year, taking into account the local crops, and traditional production conditions for that particular country or region. There is need to develop quick, affordable and accurate test kits and associated sampling plans that will allow testing of grain shipments without undue disruption of operations. Procedures should be in place to properly handle, through segregation, reconditioning, recall or diversion, cereal crops that may pose a threat to human and/or animal health. National authorities should support research on methods and techniques to prevent fungal contamination in the field and during harvest and storage.

The prevention and control of aflatoxins, therefore, requires a comprehensive, systematic, integrated and multi-sectoral approach involving a broad range of stakeholders in Africa and globally. This recognition led to the establishment of the Partnership for Aflatoxin Control in Africa (PACA). PACA was established at the 7th Comprehensive Africa Agriculture Development Program (CAADP) Partnership Platform meeting held in Yaoundé, Cameroun, in March 2011. PACA has developed a 10 year Strategy 2013-2022 that focuses on five

complementary strategic thematic areas (STAs): a) generating and promoting research and technology for the prevention and control of aflatoxins; b) developing policies, legislation and standards for the management of aflatoxins; c) growing commerce and trade and protecting human health from aflatoxins; d) enhancing capacity for effective aflatoxin prevention and control; and e) increasing public awareness, advocacy and communication.

It should also be mentioned that regulation and monitoring will only regulate the formal food production and trading system in respective ECOWAS countries which is less than 10% of the commodities. Most of the foods that are produced and consumed in rural households are uncontrolled and similarly foods that are traded in the informal system, these foods will not be touched by regulatory systems, even those that are well staffed and highly trained, so that other options than regulations need to be developed to solve the aflatoxin problem in Africa.

What is the Partnership for Aflatoxin Control in Africa (PACA) and its key actions in the ECOWAS region

PACA aims to provide leadership and coordination for Africa's aflatoxin control efforts, acting primarily as a convener, knowledge manager, and resource mobilizer. PACA's mission is to support agricultural development, safeguard consumer health and facilitate trade by catalyzing, coordinating and increasing effective aflatoxin control along agricultural value chains in Africa. One focus activity identified in PACA's 10-Year Strategy and Strategic Direction is to collaborate with Regional Economic Communities (RECs[2]) and national governments on the review, formulation, and harmonization of regulatory frameworks for aflatoxin control.

The Economic Community of West African States (ECOWAS) is a regional integration group of fifteen African Nations[3]. On 18-20 November 2013, the Economic Community of West African States ECOWAS, in collaboration with the African Union through the Partnership for Aflatoxin Control in Africa (PACA) and other key partners including the Forum for Agricultural Research in Africa (FARA), the International Institute for Tropical Agriculture (IITA) and West and Central African Council for Agricultural Research and Development (WECARD/CORAF) convened a workshop on the "Aflatoxin Challenge in West African States." Approximately 40 experts from agriculture, health, and trade met in Accra, Ghana to set regional priorities to address the aflatoxin challenge in West African States. The delegates assessed the status of member states' efforts to develop comprehensive solutions to control aflatoxin, and to set

[2]There are at least 14 Regional Economic Communities (RECs) in Africa that are officially or unofficially recognized by the African Union (AU), some of which overlap in membership. Those RECs include AMU (Arab Maghreb Union), CEMAC (Communauté Economique et Monétaire des Etats de l'Afrique Central), CEN-SAD (Communauté des EtatsSahélo-Sahariens), COMESA (Common Market for Eastern and Southern Africa), EAC (East African Community), ECCAS (Economic Community of Central African States) ECOWAS (Economic Community of West African States), IGAD (Intergovernmental Authority on Development), SADC (Southern African Development Community), SACU (Southern Africa Customs Union) and UEMOA (Union Economique et Monétaire OuestAfricaine).

[3] Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo and Cape Verde

regional priorities for the development of a regional action plan on aflatoxin mitigation to benefit ECOWAS countries. The workshop benefited from the regional experiences from ECOWAS and COMESA, which were present at this meeting. Workshop participants identified the following interventions as high priority for mitigating the human health impacts of aflatoxin:

Capacity Building

- Build human and laboratory capacities for risk analysis, management and communication.
- Establish a regional mechanism (e.g. Regional Food Safety Authority) within ECOWAS to coordinate Member States' food safety management.
- Make Food Safety Authorities within Member States autonomous in order to harmonize the linkages between agriculture, health and industry to effectively manage aflatoxins and other food safety issues.

Setting Standards and Regulations (including regulatory bodies for the informal markets)

- Set up committees to draft standards and regulations for both human food and animal feed.
- Validate draft standards and regulations at country level.
- Establish institutions to administer the standards and regulations.
- Create awareness on the standards.
- Monitor the effective enforcement of the regulations and compliance to the standards.
- Organize workshops and seminars to harmonize countries' standards and regulations into regional standards and regulations.

Infrastructural Development

- Set up a committee of experts to take stock of existing national and regional infrastructure as well as available human resources.
- Conduct a needs assessment and identify the gaps.
- Mobilize financial and human resources and fill the identified gaps.

One of the challenges faced in PACA's efforts to facilitate the mitigation of aflatoxin is the limited existence and enforcement of aflatoxin regulation. Food quality control systems almost never reach households that produce and consume their own food. Moreover, the aflatoxin regulations in many of these countries currently do little to protect public health, due to limited awareness creation on food safety regulations and code of practices for risk reduction, especially in communities where food quality is rarely formally inspected. The problem is exacerbated by a lack of routine and funding for monitoring of aflatoxin levels by the personnel of regulatory agencies in at-risk crops and foodstuffs. To mitigate this, PACA decided to undertake a study to find out more about existing regulatory regimes in the region and efforts to improve food safety capacity.

Study Objectives

The objectives of this survey are to assess:

1) Policies, regulations and standards on aflatoxins in the ECOWAS region; and
2) Existing aflatoxin testing capacities (both laboratory facilities and technicians) in ECOWAS Member States.

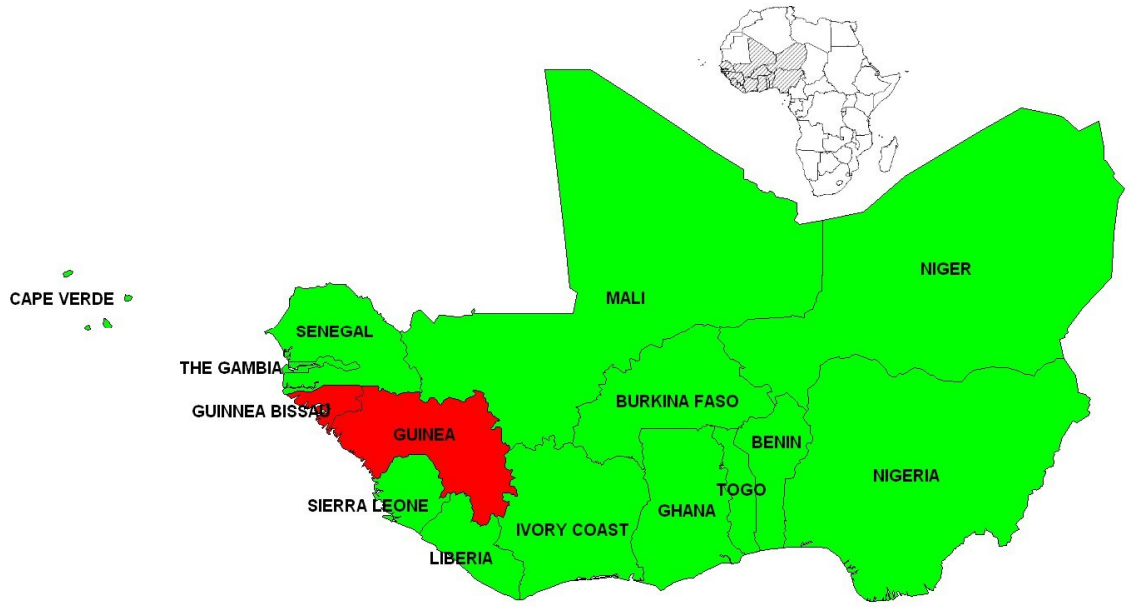
The findings of the study can be used by ECOWAS and other stakeholders to identify priority areas for action for aflatoxin control in the region, including strengthening the regional ECOWAS Aflatoxin Control Action Plan. Study findings will also be used as a reference document for PACA.

METHODOLOGY

Focus Countries

The study focused on the ECOWAS countries.

Figure 1. Map of countries that responded to the questionnaire (in green) and those that did not (in red)



Tool

The tool used to collect data from the ECOWAS countries was a questionnaire (Annex 1). The questionnaire was based on the version used in the COMESA scoping study[4] and expanded, with input from the PACA secretariat. The questionnaire covered the policies, regulations and standards in place as well as the technical and infrastructural capacity for aflatoxin monitoring in the different nations. A questionnaire was chosen as the tool for data collection due to time and budget constraints. For each country, the aim was to get respondents that are based in the regulatory agency, the government laboratories, researchers and private sector. The latter category was the most difficult to survey, due to limited contact between these companies and institutions like PACA and RECs.

These contacts were selected from the PACA contact list, including those involved in the PACA strategy development inception workshop from the focus countries, but also supplemented by codex contact points and with private contacts of the consultant. The list of contacts can be

[4] http://www.aflatoxinpartnership.org/uploads/Scoping%20Study_Overview%20for%20PPM.pdf

found in Annex 2. The information from the filled-in questionnaires was complimented by secondary sources published prior to the scoping study.

Limitation of the study

The methodology for getting the information described in this report was through a targeted questionnaire, mainly due to time and financial limitations. The questionnaire was sent to people previously identified as knowledgeable about aflatoxin and aflatoxin regulation in the focus countries. Overall 43 out of the 94 people contacted in the 15 countries responded to the questionnaire, with the most number of questionnaires received from Nigeria. Mali had 100% response rate with 3 people. However, based on the information and level of detail provided, it appears that many respondents were not very well informed about the information requested from them and could not provide all the requested information even though they are working in the respective regulatory agencies in the countries. The consultant suggests that PACA and other institutions invest in capacity building of national food safety personnel, so that they can become more knowledgeable. In most countries a larger number of respondents, including those placed in research and the private sector were able to overcome these limitation. Furthermore, the consultant included information from other resources to strengthen the provided information. Some respondents might have had a secondary agenda and effectively gave ambiguous answers to the questions. Also, the format and language of the questionnaire might have been uncertain, so that answers were not clearly formulated, especially after the French translation which did not convey the main message[5].It was remarked that some of the respondents in one country teamed up and effectively sent the same questionnaire responses, which reduced the level of information that was collected.

[5]The contracted translator translated food safety (securite sanitaire des aliments) with food security (securite alimentaire) which could have changed the perception of the questionnaire tool

LITERATURE REVIEW

What actions have been implemented in ECOWAS to improve food safety and aflatoxin control?

The following components have been identified as key 'building blocks' in an effective food safety system:

- **Food laws and regulations**: Modern food laws which recognize the needs to apply preventative control measures need to be present. The detailed controls on such things as food composition, additives, hygiene, labeling are often contained in separate technical regulations or standards and are ideally based on international standards
- **Food control management**: A national system must exist to provide the overall management and coordination of the system. There may be a national policy led by one or more ministries, in other cases there may be a separate body which is given responsibility to develop the system (e.g. a Bureau of Standards, Food Safety Agency).
- **Inspection services**: Enforcement is a key tool to ensuring compliance with legislation. The inspection services therefore require competent staff with sufficient resources to enable them to be seen to prevent legislative abuse and to inform stakeholders about remedial measures.
- **Laboratory services**: Main objectives are food monitoring and generation of epidemiological data. Reliable and efficient laboratory analysis is an important part of the control system. For enforcement to be effective, it is necessary to have a system in place to provide a quick indication of whether a food fails to meet legal requirements – whether in terms of its composition, a chemical contaminant or the presence of a food pathogen. In addition to the provision of this formal certification requirement, the laboratory services should also be capable of providing more general data on the overall level of food safety problems, including the incidence of food-borne disease in the country within the scope of risk assessment. The relevant laboratories may be spread amongst different organizations; but this would require effective cooperation.

Several initiatives were developed to improve food safety in the Union Economique et Monétaire Ouest Africaine (UEMOA)[6] mainly through collaboration with the European Union (EU). The EU funded two phases of the "Programme Qualité", which was implemented by UNIDO. The countries where activities were implemented were: Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo. The funding for Phase I (UEMOA, 2001-2005)

[6] Union Economique et Monetaire de l'Afrique de L'Ouest (West African Economic and Monetary Union): Member countries are Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo.

was €12,001,425, while in Phase II (UEMOA-ECOWAS, 2007-2012) €16,500,000 were spent. The project strengthened regional economic integration and trade in West Africa by enhancing competitiveness of enterprises and ensuring compliance with international trade rules and technical regulations. National and regional infrastructure for quality, standardization, conformity assessment and accreditation in accordance with international good practice are to be developed and harmonized.

Achievements and results of UEMOA Qualité project

- National quality policies have been supported in Burkina-Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Sierra Leone, Togo and process for Regional Quality Policy initiated.
- Food Safety related legal and regulatory frameworks have been established and existing legislation reviewed in several countries;
- A UEMOA regional certification scheme has been established;
- A general UEMOA mark of compliance management rules is underway;
- Harmonization of 36 national standards has been achieved in UEMOA countries, and 30 projects of standards are being finalized prior to their adoption;
- 71 product testing and metrology/calibration laboratories in all 16 countries have been accompanied for the quality (ISO 17025) approach and many laboratories provided with testing equipment; testing methods have been harmonized within the region;
- Inspection services have been trained and inspection procedures harmonized;
- Metrology equipment has been provided to all 16national calibration laboratories or structures;
- Three technical regional centers for meat, milk and dairy products have received assistance and a pilot unit for cheese production has been installed in the regional centre in Burkina Faso;
- 100+ enterprises in all 16 countries have been supported for ISO 9001 and ISO 22000 certification and for the development of their hygiene and quality management (HACCP program).

Harmonization of sanitary and phytosanitary (SPS) standards and measures in theECOWAS Region is intended to increase market access of agricultural products into the global trading system, increase safety of consumers of agricultural food products as well as minimize the introduction of foreign pests and diseases into the farming systems of its member states.In this regard, the UEMOA, a regional organization of eight contiguous, francophone, countries in West Africa that share a common currency, commenced a program of SPS harmonization in early 2003in three SPS areas namely (a) consumer food safety norms, (b) animal health norms and (c) plant health norms. The harmonization program focuses on preparation of the legislative framework and associated treaties, training of officials to interpret and implement the treaties, and strengthening of quality-control laboratories. ECOWAS has also worked with UEMOA in the development of food and agricultural standards for 25 commodities. These standards were approved by the Ministers of Industry in Ghana in 2015.

The West African Trade Hub (WATH)[7] has completed several studies on SPS and SPS capacity in the UEMOA region published in 2007 and 2008. Reports on SPS capacity in Liberia, Sierra Leone, Cape Verde, The Gambia, Nigeria, Ghana and Guinea used to be available on the web, but have been taken down. Upon contact, the WATH confirmed that they will become available again when a new website will be constructed. Furthermore there have been some efforts to improve national capacity to respond to food safety requirements through bilateral funding like the Belgian Development Agency (CTB) project to improve the national food safety system in Benin to improve compliance with EU standards for fish and shrimp imports. These efforts are usually accompanied by major efforts to support infrastructure and human capacity building development. Similar efforts have been implemented in other ECOWAS states usually based on one commodity chain, like mango in Mali or groundnut in Senegal, often through EU funding. In all these efforts, aflatoxin has been one of the food safety issues that projects have focused on since it is well known that high aflatoxin infestation rates have been observed in the region.

Aflatoxin levels and affected commodities (evidence from the ECOWAS region)

A range of studies have been conducted to determine aflatoxins in food and feeds in West Africa, countries with several research groups working on aflatoxin in Benin, Ghana, and Nigeria who have published data on aflatoxin prevalence on multiple commodities and over several years (Table 1). Lesser studied countries are Guinea, Senegal, Burkina Faso, Cote D'Ivoire, Mali, Togo and The Gambia with some occurrence data for some commodities. Little to no research has been documented from the other countries e.g. Liberia, Cape Verde, Sierra Leone, Guinee-Bissau and Niger.

[7] http://abtassociates.com/Projects/2014/Trade-Hub-and-african-partners-network.aspx

Table 1. Presence of aflatoxin in commodities in ECOWAS countries as documented by the literature

Commodity	Country
Maize & maize products	Benin, Burkina Faso, Côte d'Ivoire, The Gambia, Ghana, Guinea, Nigeria, Senegal, Togo
Groundnut & groundnut products	Benin, Burkina Faso, Côte d'Ivoire, The Gambia, Ghana, Guinea, Mali, Nigeria, Senegal, Togo
Cassava & cassava products	Benin, Côte d'Ivoire, Ghana, Nigeria
Yam chips	Benin, Nigeria
Sorghum & sorghum products (beer)	Benin, Burkina Faso, Côte d'Ivoire, Mali and Nigeria
Millet	Burkina Faso, Côte d'Ivoire and Nigeria
Fonio	Nigeria
Rice	The Gambia, Nigeria
Melon seed	Nigeria
Cowpea	Benin
Sesame	Senegal, Nigeria
Cashew	Benin, Nigeria
Sheanut	Benin
Spices	Benin , Nigeria
Dried vegetables	Benin, Togo, Mali
Prepared foods	The Gambia
Milk	Nigeria

It should also be mentioned, that the work has been published in 80% of the cases by researchers based at Universities or International Research Institutions, while some are based at National Research Institutions. Very little data has been published by the National Food Control labs. These labs conduct a number of aflatoxin analyses based on quality control of exports and imports in the countries. National food control labs have collected data over many years and from different commodities, which could be very useful in evaluating aflatoxin risk data, but it is not made available to the public domain. These national institutions could make their data publically available through systems such as the Global Environment Monitoring System - Food Contamination Monitoring and Assessment Program (commonly known as GEMS/Food[8]), which would add significantly to the overall picture of potential aflatoxin exposure of West

[8]http://www.who.int/foodsafety/chem/instructions_GEMSFood_january_2012.pdf?ua=1

African populations. Even though these labs analyze almost exclusively products that are destined for export and levels on foods for home consumption are often not assessed, this data could give us a baseline scenario in countries where there is no published data.

Aflatoxin in humans in ECOWAS countries

There have been quite some studies in The Gambia assessing human exposure to aflatoxins in biological fluids and associated human health impact. Fewer studies were executed in Benin, Togo, Burkina Faso, Côte d'Ivoire, Nigeria, Guinea, Sierra Leone and Ghana, while no studies have been done in the other countries.

Table 2. Presence of aflatoxin in human subjects in ECOWAS countries as documented by the literature

	Country
Blood (Af-albumin)	Benin, Burkina Faso, Côte d'Ivoire, The Gambia, Ghana, Guinea, Nigeria, Senegal, Sierra Leone, Togo
Cord Blood	The Gambia, Guinea
Breast Milk	The Gambia, Guinea, Nigeria, Sierra Leone
Urine	Guinea, Nigeria, Sierra Leone

Regulatory environment for food safety and aflatoxin management in the ECOWAS region& past actions for improving regulatory systems

The main objectives of the national food control system are:

1) protection of public health against food-borne diseases;
2) protection of consumers against falsified, unfit or mislabeled food products;
3) promotion of trade through quality assurance and adherence to national and international legislative and regulatory requirements.

Responsibilities for food control are often shared between several ministries. Although these have very different roles and responsibilities, their regulatory activities sometimes overlap and their control duties are often dispersed, in some cases leading to no action. Considerable disparity exists in competence and resource allocation between these structures within and between countries. Take, for example, the case of Nigeria[9]. In Nigeria, multiple agencies handle various aspects of SPS measures. These agencies include the following:

The **Federal Ministry of Commerce and Industry**is the focal point for WTO in Nigeria.

The **Federal Produce Inspection Service** (FPIS) inspects and ensures that all agricultural produce destined for exports or local processing meets prescribed international quality standards. The Federal Produce Inspection Service (FPIS) conducts two-tier mechanism of

[9]Overview Of The Implementation Of Sanitary And Phytosanitary (SPS) Standards And Constraints In Nigeria, Ibrahim Naibbi, National Coordinator For Nigeria

produce inspection. Primary grading and an evacuation check test is carried out by trained officers of **State Produce Inspection Service** (SPIS) who issue Evacuation Certificates. The FPIS on the other hand, conducts arrival check tests taking into consideration inspection of weight of the consignment, moisture content, inspection of packaging, sampling and disinfestations of produce warehouses. It further conducts inspection and quality controls at major seaports in Lagos, Port-Harcourt, Warri and Calabar. Based on a 3% sample, it assesses the quality (Q), weight (W), fumigation (F) and packaging (P) of raw or cured agricultural produce and issues QWFP Certificate. It utilizes the laboratories of NAFDAC for quality assurance.

Standards Organization of Nigeria (SON) is the custodian of all National and International Standards on Food Safety in Nigeria. It coordinates the elaboration, review, adoption and adaptation of food safety standards through the active involvement of relevant stakeholders and publishes the standards for implementation after necessary stakeholder sensitization. SON has the capacity for and does training in ISO 22000 Food Safety Standards, HACCP and Good Agricultural Practice (GAP) in Nigeria.

The **Nigeria Agricultural Quarantine Service** (NAQS) implements SPS standards in Nigeria through:

(a) import inspection: Maintains over 46 entry/exit points at International airports, seaports, land borders, general post offices and courier hub centers for port inspection, treatment (if necessary) and detention.
(b) export inspection and certification: Handles request for phytosanitary inspection for the presence of pathogen and pests on agricultural commodities for export and determines whether they meet SPS conditions of the importing countries. Issues Phytosanitary Certificates vouching that the consignment is free from injurious pests.

National Agency for Food and Drug Administration and Control (NAFDAC), controls and regulates imports and exports of packaged, processed and semi-processed foods through documentation, inspection, registration, sampling, laboratory testing and enforcement of compliance to good Hygiene Practice (GHP) and Good Manufacturing Practice (GMP) at food production factories. Furthermore it:

a) regulates and controls the importation and exportation of pesticide formulations and chemicals;
b) undertakes the registration of pesticide formulations and grants marketing authorization to importers and manufacturers;
c) serves as the Chair of Codex in Nigeria and runs the Secretariat of the General Purposes Technical Committee of the National Codex Committee.

In summary, the *legislative and institutional framework* in almost all countries is outdated, and is characterized by overlaps and ambiguity in institutional responsibilities in particular in regard of inspection and laboratory tasks. Often several ministries supervise the same activities (for

example, the table below which illustrates the overlapping responsibilities in two regulatory systems, one from an Anglophone and one from a Francophone country[10]).

Table 3. Regulatory system in an Anglophone and a Francophone country

Country	Legislation	Ministries, Departments and Agencies involved in enforcement and monitoring
Ghana	Food and Drugs Law (P.N.D.C.L. 305B1992)	Food and Drugs Board, Ministry of Health
	Standards Decree (N.R.C.D. 1731973)	Ghana Standards Board Ministry of Trade and Industry
	General Labeling Rules, 1992 (L.I. No. 1541, 1992)	Food and Drugs Board
	Ghana Standards Board Certification Mark Rule, LI 662,1970	Ghana Standards Board
	Pest and Plant Disease Act 307, 1965 (L.I. No. 1541, 1992)	Plant Protection and Regulatory Services Ministry of Agriculture
	Pesticides Act 528, 1997.	Ministries of Health, Food & Agriculture & Trade
Niger	Decree 98-108, 1998 on Food Imports/exports	Ministry of Agricultural Development
	Decree nº 76/MDR/CAB on the promotion and organization of agricultural exportation projects implemented by decree nº 77/MDR/CAB and decree nº 78/MDR/CAB	Ministry of Agricultural Development
	Order nº 35/MDR/CAB,2001 on the establishment of a Committee on food safety implements decree n. 2000-147 ruling the rural development ministry assignments	Ministry of Agricultural Development
	Order nº 09/CAB/PM/2001 establishing a committee for food safety policies	Ministry of Agricultural Development
	Laws on fraud control 1905	Ministry of Public Health
	Gen Order 131, 1941 on the preparation of meat	Ministry of Trade & Industry
	Order 3278, 1942 on imports/exportation of animals, Meat and other animal products	National Public Health Lab

In some countries like Ghana and Benin, new food safety institutions like the Ghana Food and Drugs Authority and ABSSA (Agence Béninoise de Sécurité Sanitaire des Aliments) have been established without integrating the old structures or declaring them obsolete. This in turn, results in inefficiency in the use of resources, ambiguity concerning the responsibilities and loss of government resources, increased overhead costs and loss of national and international competitiveness for the private sector. Moreover, it does not follow the principles of international good practice of separating (a) Standard setting and advisory roles from standard enforcement roles; and (b) Risk assessment from risk management functions.

Even in advanced countries the standards for aflatoxin differ from one country to the other and for different commodities. In some regions there are efforts to establish regional standards, such

[10]National Food Safety Systems in Africa- A situation analysis (Paper prepared by FAO Regional Office for Africa, Accra, Ghana, 2005.) *www.fao.org/docrep/meeting/010/a0215e/A0215E07.htm*

as the regional trade organization MERCOSUR (Table 4) has such aflatoxin standards, all of them based on tolerable health risk.

Table 4. Maximum allowable aflatoxin level

Table 2: Maximum Allowable Aflatoxin Levels by Africa, the EU, MERCOSUR, the United States, and the Codex Alimentarius

Product	Standard (µg/kg)	Product	Standard (µg/kg)
United States		European Union	
Raw peanuts (industry standard)	15	Groundnuts, nuts, dried fruit, and processed products thereof, intended for direct human consumption or as an ingredient in foodstuffs	4 (2)
Human food, maize, and other grains intended for immature animals (including poultry) and for dairy animals or when its destination is not known	20	Groundnuts to be subjected to sorting, or other physical treatment, before human consumption or use as an ingredient in foodstuffs	15 (8)
For animal feed, other than maize or cottonseed meal	20	Nuts and dried fruit to be subjected to sorting, or other physical treatment, before human consumption or use as an ingredient in foodstuffs	10 (5)
For maize and other gains intended for breeding beef cattle, swine, or mature poultry	100	Cereals and processed products thereof, intended for direct human consumption or as an ingredient in foodstuffs	1 (2)
For maize and other grains intended for finishing swine of 100 pounds or greater	200	Feed materials and complete feedstuffs with the exception of:	(50)
For maize and other grains intended for finishing beef cattle and for cottonseed meal intended for cattle, swine, or poultry	300	• feed materials from peanuts, copra, palm-kernel, cottonseed, maize and products processed thereof	(20)
Africa (average)		• complete feedstuffs for dairy cattle	
Groundnuts	44 (14)	• complete feedstuffs for pigs and poultry (except young animals)	(5)
MERCOSUR		• other complete feedstuffs	(20)
Foodstuffs	20		(10)
Codex Alimentarius			
Peanuts intended for further processing	15		

Note: Standards reported are for total aflatoxin B1+B2+G1+G2. Figures in parentheses are separate standards for aflatoxin B1. EU standards are after harmonization in 2002.
Sources: Dohlman 2003, Otsuki et al. 2001, and FAO 2004.

The West Africa region has not yet made regional efforts to regulate aflatoxin. But, under the 'Better training for safer food initiative' (also funded by the EU), a Regional Workshop "Towards a Pan-African food safety system, the example of aflatoxins" was implemented in June 2015 with the specific objective of reinforcing the understanding of participants on the "AU Food Safety Referential" and its application guidelines on the EU legislation with a particular focus on the area of aflatoxins[11].

International Regulatory Environment for Mycotoxins

The Codex Alimentarius Commission (CAC), a joint body managed by FAO and WHO, is the global standard-setting body established to protect human, animal and plant life. The Codex Committee on Contaminants in Foods (CCCF) sets standards for contaminants in food based on scientific evidence and risk analysis. Global aflatoxin limits are specified by Codex Alimentarius (CAC) in CODEX STAN 193-1995[12]. Furthermore sampling protocols, standards for mycotoxin testing using different equipments and a codes of practice for preventing mycotoxins in cereals (CAC/RCP 51-2003), peanuts (CAC/RCP 55 -2004), feedstuffs (CAC/RCP 45-1997),and tree nuts (CAC/RCP 6-1972). These codes include comprehensive pre-harvest, post-harvest, storage, and sorting recommendations to prevent and control mycotoxins. They are based on Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP), and often employ the Hazard Analysis and Critical Control Point (HACCP) approach. Many scientists assert that the surest way to prevent economic and health losses from aflatoxins is to shore up implementation of GAP and GMP via these code of practices, based practices such as soil testing and selection irrigation where possible, spacing, weeding, pest control, timely harvesting, removal of moldy/shriveled grains and peanuts, proper drying, dry storage etc.. Codex empowers countries to ask for justification of standards that exceed those set by the CAC.The European Union has the strictest limits on aflatoxin levels in food, which along with other issues of quality control may have contributed to significant trade losses to African countries that do not have the means or resources to test or control for the toxin[13].Yet many countries lack standards and enforcement mechanisms that can detect and prevent aflatoxins from entering the food chain.

Efforts for Aflatoxin control[14] in ECOWAS member states

There are several methods to control aflatoxin, which are detailed below, this is an introductory list without aiming to give a complete overview.

[11]http://www.foodinfo-europe.com/component/jeajaxeventcalendar/?view=alleventlist_more&event_id=412&Itemid=101
[12]http://www.fao.org/fileadmin/user_upload/livestockgov/documents/1_CXS_193e.pdf
[13]http://abtassociates.com/AbtAssociates/files/fa/facafce3-af77-4c5a-a3d5-a27198d619f1.pdf
[14]http://aflatoxinpartnership.org/?q=activities-in-africa

Agronomic intervention

There are several methods that have been implemented to reduce aflatoxin in foods in the ECOWAS region such as the implementation of: 'Good Management Practices' for reducing mycotoxins (Nestlé) Ghana, Nigeria, Benin, Togo; Biocontrol (IITA) Nigeria, Gambia, Senegal, Burkina Faso;

Postharvest & Processing intervention

Use of good storage practices and PICS bags (Ghana, Nigeria, Togo, Benin, Burkina Faso, Mali, Niger, Senegal); Good postharvest practices in maize (Guinea); Good postharvest practices for groundnut – Burkina Faso; Use of special sorting tables to reduce aflatoxin in groundnut (Senegal); Testing the effectiveness of the 'universal nut sheller' and ultraviolet light (black light) screening technology in reducing the aflatoxin content in contaminated peanuts/groundnuts (Mali); Reduction of postharvest losses of food crops (grains and pulses) by addressing major constraining factors of technology dissemination and adoption, knowledge and information sharing, rural advisory services and policies related to Post-Harvest Management (Benin)

Interventions targeting reduced health impacts

Effect of Hepatitis B vaccination on reduced hepato-cellular carcinoma risk–on-going evaluation in Gambia; Use of food diversification to reduce mycotoxin risk - ongoing tests in Ghana; use of clay to reduce mycotoxin risk – Ghana; Testing lipid nutrient supplements (LNS) with a lower energy dose per high level of micronutrients to prevent child stunting and support normal motor development (Burkina, Ghana); Developing enterosorbent intervention therapies for populations at risk for aflatoxin-related diseases (Ghana).

More details can be found on the PACA website and with the institutions undertaking the studies and projects.

RESULTS

In the following section the results from the questionnaire are presented.

Regulations and policies

There are 8 (53.33%) of the 15 countries that have food safety legislation in place, while Burkina Faso and Sierra Leone have no food safety policy; the latter is in the process of developing a policy. Cote d'Ivoire and Senegal have a policy dating from the 60's and 70's, which surely by now could be updated. Guinea-Bissau and Guinea did not reply.

Only 20% of the countries (Benin, Nigeria and Ghana) have a specific standard for aflatoxin. While all the other countries use Codex limits or the limits that are prescribed by their trading partners such as the case of groundnut exports from Senegal to China. Sierra Leone is the only country with no aflatoxin regulation in place, while again Guinea-Bissau and Guinea did not reply

Survey results

The results of the survey are presented country by country, since many of the institutions and regulations are very country specific. Within the country sections, survey results are presented in three sections: 1. Policy, Standards and Regulations, 2. Institutional Authorities and 3.Testing and Laboratories. More information on aflatoxin testing methods can be found in Annex 3. A table specifying aflatoxin policies, competent authorities, aflatoxin regulation and country specific standard operating procedure by each country follows (Table 8).

Benin

Standards and Regulations:

The National food control law was voted by the National Assembly (Loi 09-1984), but may need updating.

Table 5. Aflatoxin limits for commodities in Benin passed in 2007

Food/Commodity	Maximum level in ppb		
	B_1	Sum of B_1,B_2,G_1+G_2	M_1
2.1.1 Groundnuts to be subjected to sorting or other physical treatment, before human consumption or use as an ingredient in foodstuffs	8	15	
2.1.2 Nuts to be subjected to a sorting treatment or other physical treatment, before human consumption or use as an ingredient in foodstuffs	5	10	
2.1.3 Peanuts, nuts and products derived from the processing , for human consumption or use as an ingredient in foodstuffs	2	4	
2.1.4 Dried fruit to be subjected to a sorting treatment or other physical treatment, before human consumption or use as an ingredient in foodstuffs	5	10	
2.1.5 Dried fruit and products derived from processing , for direct human consumption or use as an ingredient in foodstuffs	2	4	

Food/Commodity	Maximum level in ppb		
	B_1	Sum of B_1,B_2,G_1+G_2	M_1
2.1.6 All cereals and all products derived from cereals, including processed cereal products , with the exception of foodstuffs listed in 2.1.7 , 2.1.10 , 2.1.12	2	4	
2.1.7 Maize to be subjected to a sorting treatment or other physical treatment, before human consumption or use as an ingredient in foodstuffs	5	10	
2.1.8 Raw, heat treated milk and milk for the manufacture of dairy products			0.05
2.1.9 Following species of spices : Capsicum spp (dried fruits thereof , whole or ground , including chilies, chili powder, cayenne and paprika) Piper spp (dried fruits , including white and black pepper) *Myristica fragrans* (nutmeg) *Zingiber officinate* (ginger) *Curcuma tonga* (Indian saffron of)		10	
2.1.10 Cereals and food -based foods for infants and toddlers	0.10		
2.1.11 Infant formula and follow-on formula , including milk for infants and toddlers ages			0.025
2.1.12 Dietary foods for special medical purposes specifically for infants	0.10		0.025

According to some of the respondents, this legislation has been mirrored from the EU regulation without any consideration of the consumption patterns in Benin and the quite substantial data on aflatoxins in various commodities in the country (compare Table 1).

Institutional Authorities

The Secrétariat Technique de Contrôle des Denrées Alimentairesis responsible for coordinating actions to reduce aflatoxin in foods but, according to the respondents, this coordination is not effective. With the creation of the Agence Béninoise de Sécurité Sanitaire des Aliments (ABSSA) it was thought that this agency would now take over the coordination, but this has not been the case, with multiple agencies intervening in the food safety field and none of them being effective.

One of the problems is that ABSSA – the national food safety agency – has only recently come into existence (2013), but the previous agencies that were doing food control (DPQC[15] and DANA[16]) have not been abolished. DANA is the designated CODEX focal point (by law), but does not have any competences and on-going activities. Only a new 'arrete' would be able to change this law.

The Ministry of Agriculture provides leadership for aflatoxin control in Benin with several agencies as specified below, without having been mandated by a law.

Direction des Pêches,
Direction de l'Alimentation et de la Nutrition Appliquée,
Direction de la Production Animale,

[15]Direction de la Promotion de la Qualité et du Conditionnement des Produits Agricoles
[16] Direction de l'alimentation et de la nutrition appliquee

Direction de l'Agriculture,
Agence Béninoise de la Sécurité Sanitaire des Aliments,
Centre d'Action Régional pour le Développement Agricole,
Institut National de la Recherche Agricole au Bénin,
Associations des producteurs agricoles

No specific budget has been allocated to aflatoxin control activities, except for punctual projects with outside funding intervening in aflatoxin control.

Testing and Laboratories

According to respondents, 25 different laboratories have some competence in aflatoxin monitoring activities. According to one of the respondents, only five labs are functional and able to perform aflatoxin analysis effectively. They are:

1. Laboratoire Central de Contrôle de la Sécurité Sanitaire des Aliments (LABSSA)
2. Laboratoire de l'IRGIB (Université Privé)
3. Laboratoire des sciences du sol, des eaux et d'environnement (LSSEE)[17]
4. LAPHA – le laboratoire de physico chimie des aliments / Faculté des Sciences Agronomiques (Université Publique) - Université Abomey-Calavi
5. Laboratoire de l'Agence Béninoise de Sécurité Sanitaire des Aliments (ex. DPQC)

None of these labs are accredited for any analyses, best competence can be found in the first two labs. If the LABSSA lab needs results from an accredited laboratory, they send the samples to the Ghana Standard Authority for analysis. By the end of the year the Central Laboratory (LABSSA) should be accredited for microbiological analyses and chemical analyses by 2016. The Central Laboratory also participates in ring-testing[18] that sometimes includes aflatoxin as part of the ring-testing protocol.

Methods used for toxin analysis in Benin include:

1. Thin layer Chromatography and UV-Cabinet (semi-quantitative method)
2. HPLC; HP-TLC (methods are explained in Annex 3)
3. ELISA and other kits

Human capacity in the above mentioned labs include a total of the following trained staff:

Ph.D._____5

M.Sc._____10

B.Sc._____7

[17] – **probably not functional**

[18]A ring test (also called as proficiency test) is an inter-laboratory test that allows to evaluate the performance of testing laboratories, and is based on analysis of similar homogeneous samples. The aim is to enable laboratories to assess and improve their feed analysis performance.

Others: DTS Diplôme de technicien supérieur: 2; DIT Diplôme d'ingénierie en technique:1, DEAT Diplôme d'études agricoles tropicales: 1

This list does not include personnel at the IRGIB lab and technical school, which is one of the main providers of competent staff for laboratories in Benin.

Burkina Faso

Standards and Regulations:

Burkina Faso follows the Codex Aflatoxin limits without having passed a specific national legislation on aflatoxin. Codex specifies aflatoxin limits for:

Maize – 20ppb

Groundnut – 15ppb

Milk – 0,5ppb (M_1)

Baby foods are regulated at AflatoxinB_1: ≤ 2 ppb and Aflatoxin total : ≤ 4 ppb.

Institutional Authorities:

Several agencies and laboratories are involved in the control of aflatoxin, including:

Agence burkinabè de normalisation, de la métrologie et de la qualité (ABNORM)-

Laboratoire national de santé publique (LNSP)

Direction générale de la protection des végétaux (DGPV),

Overall the respondents do not think that there are problems of coordination between these agencies, while no central body exists that provides leadership within the context of aflatoxin regulation and control. Burkina Faso has not developed a national regulation on aflatoxin, and has not allocated a budget for these activities in the country.

Testing and Laboratories:

There are several laboratories that have the competence to be detecting aflatoxin in Burkina, they are:

1) Laboratoire National de Santé Publique (LNSP)
2) Département de Technologie Alimentaire (DTA)
3) Centre de Recherches en Sciences Biologique, Alimentaire et Nutritionnelle (CRSBAN)

The first lab is the only one having functional equipment, using HPLC. The labs participate in inter-laboratory testing scheme run by 'Bureau interprofessionnel d'études analytiques' (BIPEA), France. DTA is accredited for Microbiology, while LNSP is in the process of getting accreditation for toxicology. The number of staff in these labs is specified in the following Table 6.

Table 6. Number of Staff in main labs and qualification in Burkina

	DTA	LNSP
Ph.D.	1	-
M.Sc.	2	3
B.Sc.	2	2
Ph.D.-candidates	11	-
Technicians	12	5

Cape Verde

Standards and Regulations:

The Decree Nº32 / 2010 - E specifies the organization and functioning of the National Food Control System. Aflatoxin limits for commodities in Cape Verde follow the Codex Alimentarius, with the limit in maize at20ppb, groundnut 15ppb and milk 0.5ppb.

Institutional Authorities:

Cape Verde created the Agência de Regulação dos Produtos Farmacêuticos e Alimentares (ARFA) in September 2005 to coordinate the various aspects of food safety. ARFA was created by Decree no. 43/2005 of June 27. This food and drugs agency has a provisional mandate to oversee standards and metrology. Another agency with a similar mandate is the Ministry of Environment, Agriculture and Fisheries (MEAF). This has resulted in some overlap and conflict among staff of the two organizations. ARFA does not have a specific mandate for aflatoxin control and management, but is concerned about food safety in general. However no specific strategy has been developed and no budget allocated.

Testing and Laboratories:

Cape Verde has two laboratories:1) L'Inlab[19] (physical, chemical and microbiological parameters) and 2) LOPP (Laboratório Oficial de Produtos de Pesca, Fishery products), but according to the respondent the second lab is not totally functional. The first lab is accredited, while the second is not. From time to time, these labs subcontract analyses with labs in Portugal, Brazil and Institut Pasteur in Senegal.

It does not seem that Cape Verde has the human and infrastructure capacity to do aflatoxin analysis. The 2006 report on SPS Capacity in Cape Verde[20]includes a long list of recommendations on how to upgrade the food safety capacity of Cape Verde.

One of the reasons for the lack of SPS regulation and affiliated institutions in Cape Verde could be the late accession to the WTO (World Trade Organization). Cape Verde became the WTO's 153rd member on 23 July 2008.

[19] http://www.inpharma.cv/index.php?mod=module&page=13&mod_id=4
[20] SPS Capacity in Cape Verde, WATH Technical Report No. 13 2006

Cote d'Ivoire

Standards and Regulations:

The Government of Côte d'Ivoire has defined Article 10 of the act 2013 – 866 from the 23 December 2013 on the creation of the Ivorien Committee on Normalization (CIN). Even though Ivory Coast has developed over 200 standards, they have not yet developed a standard on aflatoxin.[21] However, several norms have been developed for methods for the determination of aflatoxins with different equipment. Like most francophone countries, Cote d'Ivoire uses the Codex limits or the European Union, and application of other standards depending on the end customer.

Institutional Authorities:

The new food safety plan, which has not been approved yet in Cote d'Ivoire, has foreseen that the coordination of the activities under this plan is with the CIN.

Testing and Laboratories:

Several public and private labs carry out quality control in Cote d'Ivoire including: Laboratoire National d'Appui au Développement Agricole (LANADA), Laboratoire National de Santé Public (LNSP), Institut Pasteur de Côte d'Ivoire, Laboratoire Bioconex, Laboratoire ENVAL[22], Laboratoire National d'Essai de Qualité de Métrologie et d'Analyses (LANEMA), Institut National d'Hygiène. The state-run lab is LANADA which is under the supervision of the National Food Safety Agency (Direction de la sécurité sanitaire des aliments) that depends on the Ministry of Agriculture.

The following laboratories have functional equipment: LNSP; ENVAL and LANADA.

The latter laboratory LANADA is rather well equipped with 4 HPLC's and running routinely up to 6000 mycotoxin analyses per year mostly Ochratoxin A (OTA) on coffee and cocoa[23]. Also, the human capacity in the LANADA lab is very good:

Maître de Recherche2 ;
Attachés de Recherche7 ;
Vétérinaires Inspecteurs, Biologistes6 ;
Ingénieurs Agronomes, Agroalimentaire, Qualité 8 ;
Ingénieur Informaticien1 ;
Ingénieurs des Techniques Agricoles11 ;
Techniciens de laboratoire 46 ;
Contractuels 51.

[21] http://www.codinorm.ci/doc/Catalogue_Normes_Ivoiriennes_2015.pdf
[22] http://www.enval.ci/
[23]http://www.icco.org/sites/sps/documents/Final%20SPS%20Africa%20Workshop%20Abidjan/12%20%20LANADA%20ET%20SECURITE%20SANITAIRES%20DES%20ALIMENTS%20EN%20CI%202013.pdf

The Gambia

Standards and Regulations:

The Food Safety and Quality Act (8th August 2011) regulates food quality. In The Gambia, certain respondents state that aflatoxins are regulated according to the Codex limits, while some of them refer to the not yet signed limits by The Gambia Standards Bureau (TGSB), for

1) Peanuts & peanut paste(10p b)

2) Cashew (10ppb).

Institutional Authorities:

Respondents stated that the Food Safety and Quality Authority established in 2013, is the sole Competent Authority for food and feed and that there are no overlaps or gaps, and they are the enforcers of the legislation. The FSQA consists of four Departments – the Scientific Affairs, Food Control, Regulatory Affairs, and Administration and Finance. The number of approved staff for appointment for the Scientific Affairs and Food Control Directorates is 22, six (6) staff for the Directorate of Scientific Affairs and sixteen (16) staff for the Directorate of Food Control[24].

Testing and Laboratories:

Only one laboratory in The Gambia can determine aflatoxin – it is based at the National Agricultural Research Institute (NARI) using TLC and VICAM, and is beginning the process for ISO 17025 accreditation. There are only one MSc and two BSc's at the NARI laboratory.

Ghana

Standards and Regulations:

In Ghana, the following standards for aflatoxin exist:

Maize 15µg/kg (GS 211:2013),

De-germed maize meal 20µg/kg (GS 729:2003),

Tom brown[25] 10µg/kg (GS 883:2008)

Raw Peanut 20µg/kg (GS 313:2001),

Peanut Butter and Crunches 4µg/kg (GS 49:2005)

Processed and unprocessed foods 15µg/kg (GS 211 PT.1:2003)

Ghana is one of the few countries in the ECOWAS region that has translated standards into standard operating procedures, i.e., the Ghana Standard GS 66:1990 sets General Principles and Code of Hygienic Practices for food handling.

Institutional Authorities:

Several agencies are responsible for aflatoxin control:

[24] http://www.standardsfacility.org/sites/default/files/STDF_PPG_462_Application_Feb-14.pdf

[25] roasted-maize porridge sometimes fortified with legumes (cowpea or groundnut)

1. Food& Drugs Authority (Health) (Enforcement)
2. Plant Protection & Regulatory Services (PPRS) (Agriculture) (SPS)
3. Ghana Standard Authority (GSA) (Trade) (Standardisation)

Institutional mandates are defined in the National Food Safety Policy.

Testing and Laboratories:

Several laboratories in Ghana are performing aflatoxin analysis, including:

(1) Food Research Institute (FRI) laboratory (Public)
(2) Ghana Standard Authority (GSA) laboratory (Public)
(3) Food and Drug Authority Laboratory (Public)
(4) SGS (Private)

The first two labs have functional equipment for aflatoxin analysis, using HPLC. The FRI lab has adopted the EU sampling plan and the lab is ISO 17025 certified. GSA is ISO 16050 certified. Furthermore FRI has accreditation by South African National Accreditation System (SANAS). The GSA lab is accredited by Deutsche Akkreditierungsstelle (DAKKS) from Germany. Even though it seems to be that these labs have good infrastructure and high powered equipment (U/HPLC), the number of staff that were specified was very low in number and also in qualification, with one person currently undergoing PhD training, 2 M.Sc. holders, and 3 B.Sc. as specified for the GSA lab.

Guinea

Contacts did not submit data.

Guinea-Bissau

Contacts did not submit data.

Liberia

Standards and Regulations:

Respondents indicated that the relevant existing legislation is entitled 'National Environment and Occupational Health Policy and Food Safety guideline,' which was approved in 2010. National aflatoxin regulation is specified in the National Fortification Guideline and public Law 1976 that was approved in 2013.

Institutional Authorities:

The Ministry of Commerce and Industry and Ministry of Agriculture are in charge of enforcing the above limits. Ministry of Health is responsible for monitoring the safety of food within Liberia. Ministry of Commerce and Industry is responsible for monitoring quality of

commodities that are traded so that they do not exceed maximum aflatoxin limits. Ministry of Justice is responsible for prosecution of violators.

The main constraint of the Liberian food safety system is the inadequate number of trained staff, lack of equipment and overlap between the different agencies that should monitor food safety. Even the leadership and coordination of efforts is divided between two agencies (i.e., the Ministry of Health and Ministry of Commerce & Industry. The respondent specified that a national strategy for aflatoxin control exists without giving further details. No budget has been set aside to undertake the related activities in the country.

Testing and Laboratories:

Only one laboratory – the 'chemical laboratory' – was listed as having the equipment to test for aflatoxin, but they do not partake in international proficiency testing programs for aflatoxin nor are they accredited. Annually, the laboratory conducts less than 20 aflatoxin tests using TLC. The lab has only B.Sc. level staff.

Mali

Standards and Regulations:

There is a National Policy on Sanitary Safety of Food which was passed in November 2002. Like many francophone countries, Mali uses Codex limits for aflatoxin.

Institutional Authorities:

The mandates for aflatoxin risk management services for aflatoxin control are clearly defined.

1) Research activities: Institut d'Economie Rurale (IER);

2) Control activities: National Agriculture Directorate of Fisheries, National Directorate of Veterinary Services, National Directorate for Animal Production and Industry, National Directorate of Trade and Competition, National Customs Directorate).

The coordination of all the activities is through the National Agency for Food Sanitary Safety (Agence Nationale de la Sécurité Sanitaire des Aliments, ANSSA). Even though the different responsibilities are clearly defined, the respondents still mentioned a lack of control and monitoring activities; and insufficient funding for control activities and monitoring.

More importantly, the mandates for the management of aflatoxin-related risks are spread across the various departments involved, so that eventually no-one is responsible. Mali has developed a control plan for aflatoxin, which includes monitoring and surveillance and further execution of research activity and a specific budget has been allocated to these activities amounting to 80million Fcfa, even though Mali is one of the poorest countries in the region and with many internal problems.

Testing and Laboratories:

Several laboratories are involved in the control of food safety, which goes beyond aflatoxin control:

1 Laboratoire National de la Santé ;

2 Laboratoire Centrale Vétérinaire ;

3 Laboratoire de Technologie Alimentaire ;

4 Laboratoire de Nutrition Animale ;

5 L'ICRISAT

6 Laboratoires de l'Université

7 Laboratoire de la Direction Nationale de l'Agriculture

Only the laboratories at Institut d'Economie Rural, ICRISAT and the Laboratoire de Biotechnologie de l'Université, have functional equipment for aflatoxin testing using HPLC and Elisa testkits. None of the labs are accredited yet. Some respondents stated that the labs have 2 Ph.D., 5 M.Sc. and 4 B.Sc., but it is not clear in which laboratory this staff is located.

Niger

Standards and Regulations:

There is no National Policy on Sanitary Safety of Food and no specific aflatoxin regulation. Like many francophone countries, Niger uses Codex limits for aflatoxin (please compare Table 3 with some more information on the food safety system in Niger as documented by the literature).

Institutional Authorities:

Niger still has a nascent food safety system, with no food safety policy and related directive. There is no specific aflatoxin legislation. Only the plant protection service (Direction Générale de la Protection des Végétaux) has a mandate to physically inspect foods that enter the Niger and those that are exported. The Ministry of Agriculture coordinates these inspection activities. The respondent mentioned a lack of control and monitoring activities; and insufficient funding and infrastructure for control activities and monitoring.

In accordance with the Law No. 2008-08 from April 30, 2008, the National Agency for Verification of Conformity to Standards (Agence Nationale de Vérification de Conformité aux Normes, AVCN) has been established. The Agency is responsible for the coordination of all activities regarding technical standards and regulations, but for now they have no role in the control of aflatoxin.

Testing and Laboratories:

The only national reference laboratory is LANSPEX (Laboratoire National de Référence), which has a GC MS/MS and a U/HPLC, but lacks standards for testing. There are only 2 M.Sc. level staff in the lab. The lab is in the process of accreditation.

Nigeria

Standards and Regulations:

Nigeria has the National Policy on Food Safety and its Implementation Strategy which was approved in 2014.

The stated aflatoxin limits as developed by the Standards Organization of Nigeria (SON) are:

Ready to eat	4µg/kg
Further processing	10µg/kg
Fruits and Fruit Products	4µg/kg total aflatoxin
Baby and Infant Foods	4µg/kg (AFM_1-0.05 µg/kg)
Tea, Coffee and Cocoa Products	4µg/kg total aflatoxin
Ruminant animal feeds	20µg/kg total aflatoxin

The maximum limits (MLs) for total aflatoxin for others commodities namely malt drink, composite flour, wheat semolina, shea butter, shea nut kernels, sesame seed and wheat flour is 4ppb.

Table 7. Mycotoxin legislation in Nigeria

Code[26]	Number	Fumonisin	Aflatoxin
Standard for Maize Grit	NIS 718:2010	Fumonisin B_1, B_2 (ppb) (max): 3	Aflatoxin B_1 (ppb) (max): 2
Standard for *Kulikuli* (Groundnut Cake)	NIS 594:2008		Total Aflatoxin (max): 4 ppb Aflatoxin B_1 (max): <2 ppb
Standard for Groundnut Seed	NIS 491:2006		Yes. 20 ug/kg (max) in-shell and for kernels grades 1, 2, and 3.
Standard for Maize Grain	NIS 253:2003		Being reviewed. 4 ppb for total Aflatoxin and 2ppb for Aflatoxin B_1
Standard for Soya Beans Flour	NIS 342:1997		Aflatoxin mg/kg (max): 0.001 aflatoxin level (under review)
Standard for Maize Oil	NIS 391:2000		Not mentioned
Standard for Groundnut Oil	NIS 388:2000		Not mentioned
Sorghum Grains	NIS 328: 2003		10 ppb
Millet Grains	NIS 467: 2003		10 ppb

[26] http://abtassociates.com/AbtAssociates/files/f5/f5cbf254-54b6-4893-8a9a-0511c754e569.pptx

Institutional Authorities:

The control organization in Nigeria are the Nigeria Agricultural Quarantine Services (NAQS) for raw agricultural commodities and National Agency for Food and Drugs Administration and Control (NAFDAC) for processed goods and ready to eat food. No agency has a clear cut lead agency role in aflatoxin control. The government of Nigeria has not allocated a specific budget to aflatoxin control activities; this is included in the general budget for food safety.

Furthermore, no clear mandate has been given for monitoring of prevalence in the field, stores and in food products to help in setting national regulations. In fact, two agencies are dividing the work: one for processed products and the other for raw products. However, some respondents feel that leadership is being provided by NAFDAC which is part of the Ministry of Health. Nigeria has gone so far as to set up a 'Technical Committee on the Control of Mycotoxins', under the Federal Ministry of Agriculture and Rural Development. Also a very active mycotoxin research society has been set up The Nigeria Mycotoxin Awareness and Study Network (NMASN), which had a name change in 2011 to Mycotoxicology Society of Nigeria (MSN) with annual meetings. This year marks the 10th edition (http://www.ngmycotoxin.org/). The society has run awareness raising campaigns in Nigeria.***Testing and Laboratories:***

The following laboratories have functioning equipment for aflatoxin analysis:

1. NAFDAC Laboratory
2. IITA Laboratory
3. Nigerian Stored Products Research Institute (Ibadan Sub-Station)
4. Standard organization of Nigeria (this needs to be verified)
5. NAQS

Using TLC and HPLC (Annex 3). The NAFDAC laboratory has been participating in proficiency testing since 2005 and is accredited by A2LA[27] since 2013. NAFDAC also has decentralized laboratories in Maiduguri, Port Harcourt and Kaduna that are able to analyze mycotoxins. Several other laboratories have been established at universities and research institutes that are doing aflatoxin analysis for research purposes.

Human capacity in some of the labs, includes the following staff:

	FUT, Minna	Uni Abeokuta	NAFDAC
Ph.D.	1		
M.Sc.	1	1	5
B.Sc.		1	10
Other (HND)	1	2	5

[27] https://www.a2la.org/

This does not reflect all the human capacity for aflatoxin management and detection in Nigeria, since the country has the most active research community on aflatoxin in West Africa.

Senegal

Standards and Regulations:

The national food policy law dates from the 60's and 70's, so an update should be useful. Senegal has not set a maximum accepted tolerable limit for aflatoxin in any crop, but they are using the Codex limit and when exporting crops like peanuts they have to comply with the EU standard or the Chinese standard (10ppb) depending on end-market.

Institutional Authorities:

Contacts did not submit information.

Testing and Laboratories:

There are several laboratories that work in food safety and can test for aflatoxin in Senegal:

1. Directorate of Internal Trade Lab (Chemical and microbiological)
2. Directorate of Plant Protection (DPV) (Phytosanitary controls)
3. Foundation Ceres Locustox (Pesticides residues and heavy metals)
4. Institut de Technologie Alimentaire (ITA) (Chemical and microbiological)
5. Laboratoire d'Analyses et essais (ESP) (Chemical and microbiological).

Most exporters use the laboratory of ITA, which is in the process of being accredited for mycotoxin analysis according to ISO/CEI 17025. This laboratory also participates in ring-testing by FAPAS Circuit and Bipea. In this laboratory, 1 M.Sc. holder, and 1 B.Sc. with some lab technicians are active and most of the analyses are done by VICAM or HPLC. At DPV VICAM is available and mostly used for research purposes.

Sierra Leone

Standards and Regulations:

For now, Sierra Leone does not have food safety legislation, and is in the process of developing food safety legislation under the leadership of the office of the vice-president. The Public Health Act of 1960 gave the Ministry of Health and Sanitation the overall mandate for food control.

Institutional Authorities:

Responsibility to carry out food control across the various food chains falls under various government ministries and departments, including: the Ministry of Fisheries and Marine Resources, Ministry of Trade and Industry, Ministry of Agriculture, Forestry and Food Security, Ministry of Tourism and Cultural Affairs, Ministry of Local Government and Rural Development, and in some cases the Environmental Protection Agency. Section 110 of the same act specifically empowers health officials to examine all foods intended for human consumption

and empowers the ministry to enforce procedures for controlling manufacturing and importation of food items. The Sierra Leone Standards Bureau is the National Statutory body responsible for the management of food safety in Sierra Leone. By law, the Sierra Leone Standards Bureau is a conformity assessment body mandated by the Standards Act No. 2 of 1996 to carryout products assessment through inspection, testing and issuance of certificates of conformity to quality.

Testing and Laboratories:

The laboratory facility for aflatoxin is based at the Sierra Leone Standards Bureau, and they will be fitted with a HPLC and AAS during the month of June 2015. Only one staff at the laboratory has a B.Sc. qualification. This laboratory is not accredited and does not participate in ring-testing.

It was stated that there are also some mycotoxin activities at the Sierra Leone Agricultural Research Institute (SLARI), without fully specifying what is their capacity or their involvement.

Togo

Standards and Regulations:

Contacts did not submit information on aflatoxin standards and regulations. Food policy seems to be governed by an Inter-ministerial Order N° 003 MDPRCPSP/MS/MAEP dated10 April 2009, which was passed by the Ministry of Agriculture, but there is no specific standard for aflatoxin and codex limits used.

Institutional Authorities:

The national agronomic research Institute Togolais de RechercheAgronomique (ITRA) is the focal point of Codex Alimentarius. The two institutions that are involved in aflatoxin control are: 1. Institut Togolais de Recherche Agronomique (ITRA) ; 2. Direction de la Protection des Végétaux(DPV). ITRA conduct occasional research activities on aflatoxin with national competitive research funds. However, to the knowledge of the author of this study there have been no recent published studies on aflatoxin from Togo.

Testing and Laboratories:

Food control in Togo is only systematic when exporters are demanded certificates for foods that are to be exported. Three laboratories have the capacity for aflatoxin control in Togo, namely:

1. Les laboratoires Physicochimiques de l'ITRA
2. Laboratoire de microbiologie alimentaire de l'Institut National d'Hygiène (INH)
3. Laboratoire de l'Ecole Supérieure des Techniques Biologiques et Alimentaires Université de Lomé.

The laboratory of ITRA performs the highest number of toxin analyses per year, but these are less than 20 annually. Even though ITRA's mandate for food control has not been clearly defined, they are able to provide the service of food quality control for exporters. As a result,

Togo does not have a regulatory limit for aflatoxin, and limits that are required by the receiving countries for exports from Togo are applied. The ITRA lab uses an HPLC for aflatoxin analysis, and also TLC. They also participate in ring-testing through BIPEA. According to the laboratory manager, since 2014 there are technical problems in the ITRA laboratory, but prior to this date they regularly did analysis 2009 : <20; 2010 : 20-50; 2011 : 20-50; 2012 :50-100; 2013 : <20. The laboratory has 1 Ph.D. level staff, 2 M.Sc. and 3 B.Sc..

Table 8.Policy and regulatory environment for aflatoxin management in the ECOWAS countries

Country	Policy; Name & date of adoption	Regulation; Name& data of adoption	Responsible Authority for setting standards and enforcing regulations	Leadership for aflatoxin control	Standard operating procedures in place for sampling & testing; food control
Benin 	Yes. National food control law voted by National Assembly Loi 09-1984 (15 March 1984)	Yes, 'arrete' N°0362 MAEP/D-CAB/SGM/DRH/DP/SA on maximal levels of certain contaminants in foods formulated by DPQC[28] dated 2007	1) Ministère de l'Agriculture, de l'Elevage et de la Pêche (Direction des Pêches, Direction de l'Alimentation et de la Nutrition Appliquée (DANA), Direction de la Production Animale, Direction de l'Agriculture, Agence Béninoise de la Sécurité Sanitaire des Aliments, Centre d'Action Régional pour le Développement Agricole, etc.); 2) Ministère de la Santé (Direction Nationale de la Santé Publique, etc.)	Agence Béninoise de la Sécurité Sanitaire (ABSSA) des Aliments/Beninese Agency for Food Safety operational since 2013 DPQC but also DANA that intervenes/there is a lack of coordination (should be resolved with creation of ABSSA)	Yes; No
Burkina Faso 	No The Presidency of the Upper Volta in his time had adopted Ordinance No. 75-025 / PRES / PL / HR / ET of 20 May 1975 on the	No As a member of Codex Alimentarius, the country uses the rules of codex	The competent authorities responsible for official controls are responsible for enforcing these standards, they are: ◎ inspectors of the Directorate of Plant Protection and Packaging for plant products	1. Institut National de l'Environnement et de Recherches Agricoles (INERA) 2. Direction de la	Yes, Yes By Agence Burkinabè de Normalisation (ABNORM) adopted standards and

	packaging of the control and the quality of food and Fraud. In 2012 the Ministry of Commerce has established the Higher Council for Quality applicable to all food and non-food.		and products of plant origin together with the laboratories performing the necessary analyzes ; ◎ veterinary inspectors for animal products and animal together with the laboratories conducting the necessary analyzes.	Protection des Végétaux et du Conditionnement (DPVC) 3. Le Laboratoire National de Santé Publique 4. Agence burkinabè de normalisation, de la métrologie et de la qualité	the Codex Alimentarius guidelines into national standards , including the governing aflatoxins in foods
Cape Verde 	Yes Decree - Legislative No. 3 /2009 - Principles and General Standards on monitoring food safety; Decree No. 25 /2009 - General standards for food hygiene ; Decree nº24 / 2009 - standards on the labeling of food products; Decree Nº32 / 2010 - E objectives and principles on the organization and functioning of the National Food Control System (SNCA) ; Decree-Law No 7/2010 - E objectives and principles on the organization and functioning. Integrated Early Warning System	No – Codex used	1)Ministry of Agriculture 2) Ministry of health	Regulatory agency and supervision of pharmaceutical and Food Products (RAWA) in consultation with other competent authorities of the food chain in the country, responsible for the sectors of agriculture , livestock, fisheries, health, industry and commerce, etc. and also other entities such as organizations of economic operators, chamber of commerce, and consumer	Yes – in limited cases, need for further elaboration; No

	on Food (SIARA) c) 2009 and 2010, the basic law No. 3 /2009 is under review of the law from 1992			associations, and universities.	
Cote d'Ivoire 	Yes The Government of Côte d'Ivoire has defined Article 10 of the act 2013 – 866 from 23 December2013 on the creation of the IvorienCommittee on normalization (CIN) / DECREE No. 2014 - 460 of 6 August 2014 concerning allocation , organization and functioning of the national standards body called the Ivorian Committee for Standardization (CIN) c) 23 December 2013 (Creation) and 6 August 2014 (allocation , organization and functioning of the (CIN)	No – use Codex Alimentarius	Ministry of Agriculture Ministry of Commerce Ministry of Industry	According to the official report current provision is the recent Ivorian Committee for Standardization (CIN) -	No ; No
The Gambia 	Yes The Food Safety and Quality Act (8th August 2011)	No – is being developed	Health: Yes, under the coordination of FSQA Agriculture: Yes, under FSQA Fisheries: Yes, under FSQA Environment: Yes, under FSQA Trade: Yes, under FSQA Other please specify: FSQA under the Office of Vice	Food safety and Quality Authority –FSQA	No; No

			President, Ministry of Justice		
Ghana 	Yes By Parliament of the Republic of Ghana and Assented to by President Public Health Act, 2012 (Act 851) from 9th October, 2012 27 April 2015 Food safety Policy adopted[29]	The laws relevant for foodsafety include the Food and Drugs Act, 1992 (P.N.D.C.L. 305B) as amended, the Tourism Act, 2011 (Act 817), the Local Government Act, 1993 (Act 462) and various Local Government (District/Municipal/Metropolitan Assembly).Public Health Act, 2012 (Act 851) has replaced the Food and Drugs Act, 1992 (P.N.D.C.L. 305B) and Food and Drugs Amendment Act, 1996 (Act 532)	FOOD &DRUGS AUTHORITY (FDA)	1.FOOD & DRUGS AUTHORITY (Health) (Enforcement) 2.Plant Protection & Regulatory Services (PPRS) (Agriculture)SPS 3.GHANA STANDARD AUTHORITY (GSA) (Trade), Standardisation	Yes; Yes also standard operating procedures Ghana Standard GS 66:1990 sets General Principles and Code of Hygienic Practices for food handling
Guinea 					
Guinea-Bissau 					
Liberia 	Yes National Environment and Occupational Health Policy and Food Safety guideline passed by the Government of Liberia in 2010	Yes National building up Guideline and public Law 1976 passed in 2013	Ministry of Commerce and Agriculture Ministry	Ministry of Health and Ministry of Commerce & Industry	Yes; No
Mali 	Yes a) the Government of the Republic of Mali following the work of	No The law on phytosanitary control is the general framework for phytosanitary risk management Mainly regulation by CODEX Alimentarius and	1. Agriculture (Institut d'Economie Rural, Direction Nationale de l'Agriculture, Direction Nationale de la	Agence Nationale de la Sécurité Sanitaire des Aliments	Yes ; No

[29]http://www.fdaghana.gov.gh/images/stories/pdfs/News%20&%20Events/National%20Food%20Safety%20Policy%20Adopted.pdf

	an interdepartmental committee on food safety created through a decree of the Prime Minister b) National Policy on Sanitary Safety of Food c) November 2002	the European Union on mycotoxins (aflatoxins) is used	Pêche, Direction Nationale des services Vétérinaires, Direction Nationale de Production et d'Industrie Animale) ; 2. Commerce (Direction Nationale du Commerce et de la Concurrence, Direction Nationale des Douanes) ; 3. Santé (Agence Nationale de la Sécurité Sanitaire des Aliments).		
Niger 	No	No – use Codex Alimentarius	1.Direction Générale de la Protection des Végétaux (DGPV) ; 2.Agence Nationale de Vérification de Conformité aux Normes(AVCN) (Ministère de l'Industrie) ; 3.La Police Sanitaire du Ministère de la Santé.	Agence Nationale de Vérification de Conformité aux Normes(AVCN) (Ministère de l'Industrie) ;	No; No
Nigeria 	Yes a) Federal Ministry of Health Abuja Nigeria with other Stakeholders b)National Policy on Food Safety and its Implementation Strategy c)2014	Yes; standards set by Standard Organization for Nigeria	Nigeria Agricultural Quarantine Services for agricultural commodities and NAFDAC ready to eat food	National Agency for Food and Drug Administration and Control (NAFDAC)	Yes/No. This is one of the existing gaps, no group within the stakeholders ready to spend resources to translate Codex Guidelines, Technical Standards, Regulations, etc into Farmers

					Guide, Food Handlers Handbooks, SOPs, etc.
Senegal 	Yes Decree No. 60-121 of 10 March 1960 establishing phytosanitary control ; The basic law or Act 66-48 of 27 May 1966 70-94 The Decree of January 27, 1970	No Reference to codex; or importing country (eg. China)	Ministry of Agriculture Ministry of Commerce Ministry of Health	1. La Direction de la Protection des Végétaux (DPV) 2. L'Institut de Technologie Alimentaire (ITA)	No ; No
Sierra Leone 	No Food safety is mentioned in parts of theEnvironmental Health Policy (May 2004). A specific law is currently being developed under the office of the Vice President of Sierra Leone	Not yet	Health, Agriculture, TradeThese three ministries should and would be in charge, when the necessary modalities are put in place	In February 1996, the Government of Sierra Leone established the Sierra Leone Standards Bureau by an Actof Parliament No. 2 of 1996. The Act came into force on 16 August 1999 and the Bureau started operationson 24 January 2000	No; No
Togo 	a) Ministry of Trade b) Interministerial Order N° 003 MDPRCPSP/MS/MAEP c)10 April 2009	No Codex	Laboratories of the Directorate of the Togolese Agricultural Research Institute which would be responsible	There is no mandated institution for aflatoxin control	No; No

Analytical capacity in the ECOWAS countries

All of the ECOWAS countries, except for Cape Verde and Sierra Leone, have the analytical capacity to test for aflatoxin, usually using HPLC, but most of them use cheaper and more robust testing methods like Vicam, TLC and Elisa for routine testing. However, PACA did not receive information from Liberia, Guinea and Guinea-Bissau. Togo stated that aflatoxin analysis is not possible in the laboratory of ITRA, which does have an HPLC, without specifying the reason for this.

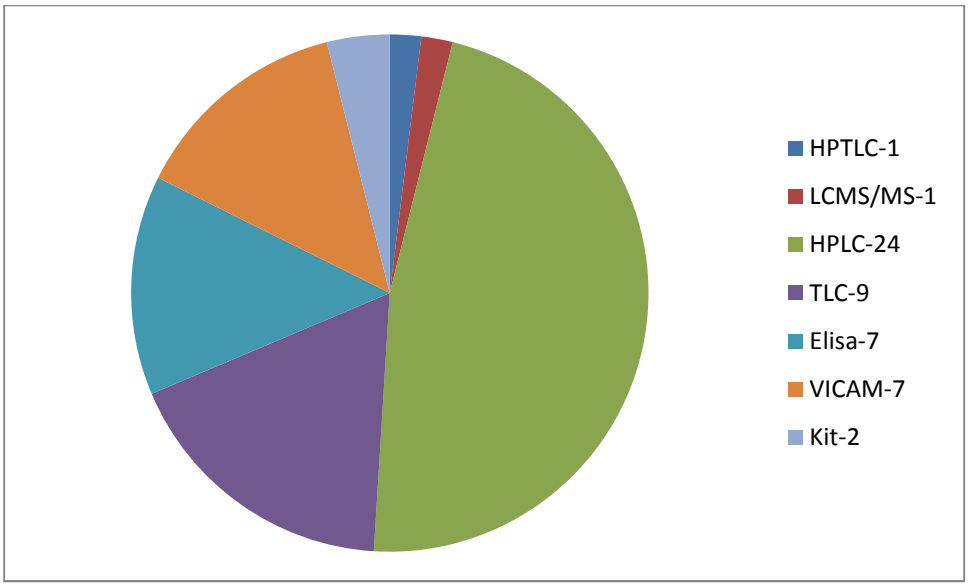


Figure 2. Equipment used for aflatoxin analysis in ECOWAS countries

Staff capacity in the labs is also quite good with most of them having undergone relevant training in recent years through bi-lateral or multi-lateral capacity building projects. Some of them have also undertaken M.Sc. or Ph.D.-training in advanced labs. However, the number of staff as specified by the respondents is quite low, which exposes the labs to the risk of losing staff capacity.

Method and Type of equipment used for aflatoxin analysis

Most of the labs are not yet accredited, except for Ghana and Nigeria. Some labs are in the process of accreditation, for instance in Benin and Senegal. Several countries partake in proficiency testing, including Ghana, Senegal, Nigeria and Mali. However, some respondents felt that international ring-testing is too expensive and it would be useful to organize this on a regional basis, maybe led by ECOWAS. Most staff in national laboratories, with an active aflatoxin analysis program, have been trained in sampling. Respondents indicated that countries have no problem procuring the necessary aflatoxin standard for analysis and other chemicals in the countries. However, the author's experience points to the contrary.

Figure 3. Method[30] used for aflatoxin analysis

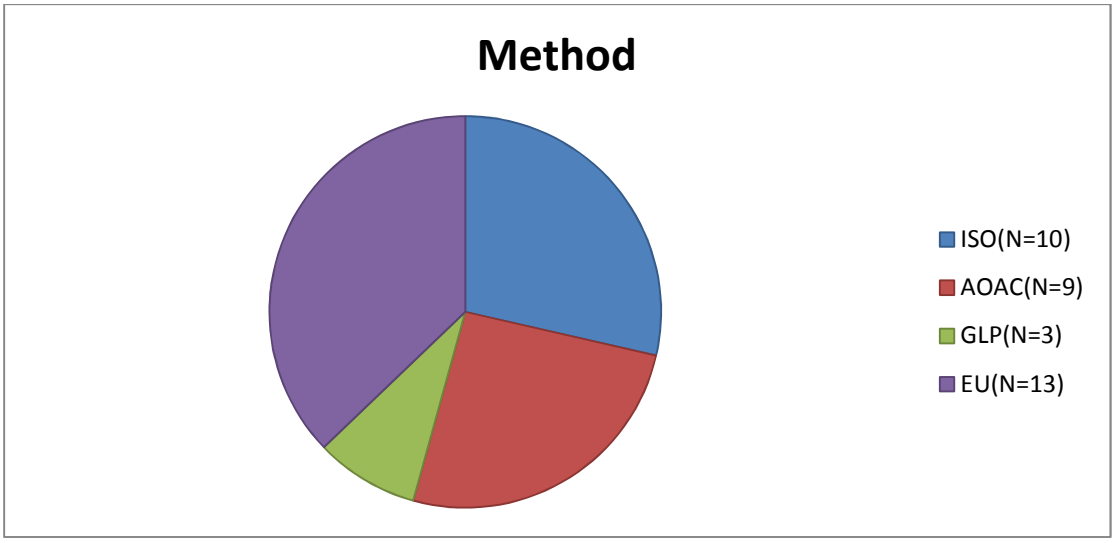


Table 9. Aflatoxin analysis cost and number of samples analyzed annually in ECOWAS countries

Country	Cost aflatoxin analysis	Number samples analyzed annually
Benin	55.000cfa-local; 80,000 GSA[31]	<20 GSA
Burkina Faso	50 000 - 100 000 FCFA	100-500
Cape Verde	n/a	n/a
Cote d'Ivoire	10 000 to 40 000 F CFA	100-500
Gambia	About D1500.	50-100
Ghana	140 Ghana Cedis	100-500
Guinea		
Guinea-Bissau		
Liberia	Not yet determined	Not yet determined
Mali	6000-8000cfa	100-500
Niger	Not specified	Not specified
Nigeria	50,000 (HPLC); 2000 - 5000 Naira	>2000
Senegal	53100 FCFA	2013-188 samples; 2014-216 samples
Sierra Leone	Not yet estimated	<20
Togo	20 000 - 80 000 FCFA	<20

[30] ISO – International Organization for Standardization; AOAC – Association of Analytical Communities; GLP –Good Laboratory Practice; EU – European Union

[31] Ghana Standards Authority

Some countries (e.g., Mali) charge very low fees for aflatoxin analysis, which probably do not cover the cost of expendables and staff costs. In other countries, costs probably mirror cost structures in laboratories in the EU, which might be much higher than the actual cost and could effectively scare away clients. A two tiered cost structure, with one fee for local market and another for exports might be appropriate.

Biopesticide Regulation in the ECOWAS region & Risk Assessment Capacity

The Permanent Inter-state Committee for Drought Control in the Sahel (CILSS) was set up on September 12, 1973 following the major droughts that hit the Sahel area in the 70s. The CILSS organization has thirteen Member States including: 8 coastal countries (Benin, Côte d'Ivoire, Gambia, Guinea Bissau, Mauritania, Senegal and Togo), 4 landlocked countries (Burkina Faso, Mali, Niger, Chad) and 1 Island State (Cape Verde). In Niger there is a committee for the approbation of biopesticides. The CILSS countries have a common legislation for biopesticides, using the Sahelian Common Pesticide Registration. However, respondents indicated that most countries are not aware of this common legislation and biopesticides have to go through the normal pesticide registration process. In Nigeria, NAFDAC has drafted 'Regulation and Guidelines for the registration of biopesticides in Nigeria'.

Many countries have risk assessment experts (Annex 3 includes a list of experts that probably does not include all experts). The UN Food and Agriculture Agency (FAO) conducted several training courses for risk assessment experts in the UEMOA region. For instance,they organized the third course[32] in a series, in 2013 with 27 participants from Benin, Burkina Faso, Cote D'Ivoire, Guinée Bissau, Mali, Niger, Senegal and Togo[33]. Some food safety experts participated in international risk assessment courses, like the course offered by the University of Ghent[34].

Awareness creation in the ECOWAS region

In most countries, NGO's or farmers organizations are organizing awareness creation on aflatoxin and the methods to reduce aflatoxin contamination. Mostly, these campaigns are focused on good quality production. In some countries, Ministry of Agriculture, specific Directorates for Food Security and Nutrition, or organizations for the protection of consumers also run awareness campaigns. Typically, these are ad hoc activities mostly funded as time-bound projects. ECOWAS countries have not made continuous efforts to raise awareness on the risks of aflatoxin exposure and the methods to reduce contamination.

[32]http://www.fao.org/fileadmin/user_upload/agns/news_events/1_Rapport_formation_cotonou.pdf
[33]http://www.fao.org/fileadmin/user_upload/agns/news_events/Liste_participants.pdf
[34]http://www.itpfoodsafety.ugent.be/

Table 10. Institutions that have run aflatoxin awareness campaigns in the ECOWAS countries

Country	Awareness creation & lead institutions[35]
Benin	Rotary Club, national farmers' association, Direction Alimentation et Nutrition Applique (DANA), IITA
Burkina Faso	OMS, FAO, CODEX, IITA
Cote d'Ivoire	Fédération des Maïsiculteurs de Côte d'Ivoire (FEMA-CI) Union des Coopératives de Vivriers de la région des Savanes (UCOVISA)
The Gambia	NARI aflatoxin laboratory Food Safety and Quality Authority (FSQA) in collaboration with radio stations Consumer Protection Agency of the Gambia Action Aid with National Farmers Platform
Ghana	EatSafe Ghana, IITA Ghana Federation of Agricultural Producers
Mali	EuCAR, ADAF Galle, Aga Khan Foundation
Niger	None
Nigeria	Mycotoxicology Society of Nigeria, IITA
Senegal	EndaPronat, SPV/IITA/USDA via TV, radio
Sierra Leone	None
Togo	Rotary club, Inades Formation, ITRA, IITA

In the past Rotary International in collaboration with IITA has run an awareness campaign in Ghana, Benin and Togo to inform stakeholders on the need for producing and consuming good quality maize, with good impact[36]. Traders were key participants in this campaign; they introduced a label of good quality maize in their sale.

Several recent seminars on aflatoxins have been held in the region, including:-

- The FARA seminar in Ghana on June 17 to establish an innovation platform in Ghana on aflatoxin awareness and control,
- A meeting led by IITA in Burkina on aflasafe in May,

[35] Some countries did not report on awareness campaigns

[36]James, B., Adda, C., Cardwell, K.F., Annang, D., Hell, K., Korie, S., Edorh, M., Gbeassor, F., Nagatey, K., and Houenou, G. 2007.Public information campaign on aflatoxin contamination of maize grains in market stores in Benin, Ghana and Togo. Food Additives and Contaminants 24: 1283-1291.

- A regional workshop on "Towards a pan-african food safety system – the example of aflatoxins" was organized from June 15-18 in Ouagadougou, Burkina Faso with funding of the EU.

KEY GAPS AND RECOMMENDATIONS

The identified key gaps are presented in two sections: the first one mainly focusing on actions for Aflatoxin control and management, while in a second section recommendations for improved institutional arrangements for aflatoxin management are elucidated.

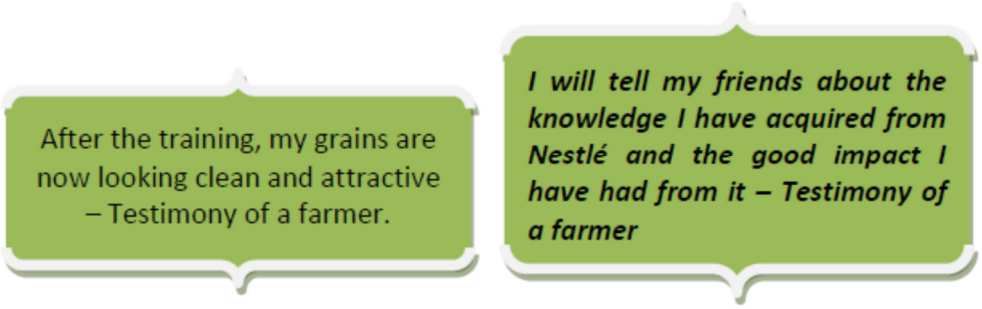
Aflatoxin control and management

Gather positive examples of Aflatoxin control

Within each country, respondents had a wide divergence of opinions and level of information. Several efforts are underway in the region to reduce aflatoxin in cereal and peanut value chains, for instance: the information campaign run by consumer organizations and farmers organizations in Ghana; use of aflatoxin management practices in Nigeria, Gambia and Senegal with concurrent awareness raising campaigns; and the campaign to reduce aflatoxin in maize in Ghana lead by Nestle in collaboration with the Ministry of Food and Agriculture (MOFA) and IITA-Benin using **good management practices**.

Recommendation: gather, share, and scale lessons learned from successful efforts to reduce aflatoxin in West Africa. Such as the successful Nestle campaign as documented below

"There are indications that if the project is sustained, the project area could achieve zero Aflatoxins levels in the medium to the long term. [37]"



Give stakeholders tools for controlling aflatoxins including regional code of practice

Most stakeholders do not have sufficient knowledge on tools for reducing toxin contamination in their foods.

Recommendation: Develop a regional code of practice (standard operating procedure) for the prevention and reduction of mycotoxin contamination for high risk commodities such as maize, groundnut, rice and sorghum in 'mono-modal' and 'bi-modal' rainfall regions[38].

[37] Citations from a report by Nestle CWAR (Central and West African Region) on impact of aflatoxin control on farmers livelihoods
[38] Mono-modal rainfall have one cropping season per year, while bi-modal rainfall regions have two cropping seasons with the first crops harvesting usually falling in the rainy season

Recommendation: Evaluate the cost/benefit and stakeholder opinions on already successful aflatoxin awareness & control campaigns – like the one led by Nestlé and IITA through independent sources including costing of development of technology.

Integrate aflatoxin control activities into projects working on value chain development

There is need for improved coordination with projects working on value chain development so that they can integrate mycotoxin control into their project activities. Furthermore, not all stakeholders in a value chain are associated in aflatoxin control measures making approaches inefficient, since not all the chain actors are associated in control efforts. For example, if only processing actors are controlling aflatoxin then products that reach the factory are already contaminated.

Recommendation: Pre-package aflatoxin awareness and control material and send to all projects on the continent working on value chain development of relevant products. Associate all chain actors in control efforts.

Enhance awareness of stakeholders

Quality control of foods in the ECOWAS region is limited to raw product exports. In rare cases, processed goods that are manufactured for the national market are controlled. Most stakeholders in the value chain are not aware of mycotoxin risk, the methods to reduce risk and international standards such as Hazard Analysis Critical Control Point (HACCP), traceability and Good Agricultural Practices (GAP).Also, many stakeholders see quality control as a policing and repressive institution; many people feel that this is unnecessary interference of the state in their activities.

Recommendation: Create awareness on the role of quality control in safeguarding people's health & well-being.

Make aflatoxin a political priority

In few countries, policy and decision makers are involved in food safety activities and are as such not informed on the role food safety can play in guaranteeing health of their population, and contributing to income generation through production and trade. Decision-makers and people in the countries feel that 'we have eaten these grains for long and have not suffered'. Actions for food safety and quality improvement could be integrated into the SUN (scaling up nutrition) efforts, where national nutrition action plans are developed, which should include actions on the reduction of aflatoxin.

Recommendation: Involve policy and decision makers in decentralized campaigns for awareness creation and aflatoxin control; include aflatoxin control in the national nutrition action plans.

Address other mycotoxin and food safety issues

Aflatoxin is only the 'tip of the iceberg'. Scientists need to collect data on other food safety risks in the ECOWAS region through total diet studies, so that exposure risk of the population can be sufficiently evaluated. Scientists could conduct studies similar to the total diet study that is in progress in Benin, Cameroon, Mali and Nigeria[39].

Recommendation: Collect data on exposure to other mycotoxins and the risk of multi-mycotoxin exposure; and their health impact. Develop research for development programs to address other food safety risks.

Improved institutional arrangements for aflatoxin management

Survey participants raised several constraints to having aflatoxin regulation and control in the ECOWAS nations. The author has formulated a number of recommendations to address these constraints.

Streamline activities at regional level

Two organizations at regional level are trying to coordinate harmonization of regional legislation, i.e., ECOWAS and UEMOA. As some countries are in the process of streamlining regulations, regional organization may consider whether a regional standard is feasible.

Recommendation: Improve coordination between ECOWAS food safety desk and the UEMOA partner institution. Explore a potential regional aflatoxin standard and its potential economic and social benefit.

Improve coordination between different ministries and institutions

In most countries, multiple institutions are in charge of food safety components, which often results in lack of action. While it is positive to have involvement from multiple sectors, fragmentation of responsibilities for aflatoxin management weakens implementation and enforcement efforts. With no institution taking the overall lead, goals are rarely met due to lack of clear direction and vision. Some of the countries have streamlined food safety activities under one agency, such as Benin and Mali. A similar process is in progress in Nigeria.

[39]http://www.standardsfacility.org/PG-303

Recommendation: Identify or create one entity responsible for food safety per country, which coordinates and implements all food safety activities in collaboration with other entities.

Createnational standards and policies

Many West African countries (e.g. Togo, Sierra Leone, Cape Verde), do not have a regulatory framework and national standards, but rather enforce international standards that are not always adapted to the context of the country. Furthermore, the standards are not based on national exposure data, and do not take into account very sensitive groups like babies, the elderly and immune-suppressed people. Lastly, research results are not sufficiently integrated into the policy formulation process.

Recommendation: Look into the development of standards that reflect national consumption patterns and specific consumer groups. Include researchers, and their national line ministry, in standard setting.

Recommendation: Collect more data on exposure of the population to aflatoxin and its health effects in the ECOWAS countries, especially from non-staple crops.

Build decentralized laboratory capacity

Laboratory infrastructure is usually only located in one central laboratory. Even though staff technical capacity increased recently through efforts of multiple agencies, the number of staff in such institutions is quite small.

Decentralized lab-capacity can be supported by many field-based testing kits that are available and easy to operate and maintain under the climatic and the infrastructural (humidity, power, maintenance) circumstances in ECOWAS countries.

Recommendation: Deploy field-based kits (blue-box of WFP) and rapid test kit based equipment to farmer organizations and rural and urban markets.

Strengthen laboratory capacity (human and infrastructure)

Many countries have limited human and infrastructural capacity for aflatoxin analysis. A possible solution might involve establishing a specialized lab in one of the countries for centralized sample analysis. Furthermore, countries have difficulties in the application of internationally accepted procedures due to inadequate public amenities, poor infrastructure, bureaucracy and poor government utilities (e.g. irregular power supply, poor agricultural extension services).

Lack of accreditation of the labs seems to be a problem. However, it is not clear if accreditation will increase the number of samples being analyzed in the labs. As an example, Benin is doing about 20 samples for aflatoxin a year and most of them are run through the accredited lab of the Ghana Standards Agency (GSA).

Recommendation: Establish a well-equipped central regional lab as the service provider, training and reference lab for mycotoxin analysis.

Create national food safety & aflatoxin control plans

Few ECOWAS countries monitor the quality of the food supply in their domestic market, and even more so the foods that are produced, stored and consumed on the farm.

One suggestion is to implement national plans for the control of aflatoxins that build on successful campaigns.

The plan needs to include recommendations how to deal with potential positive detection of lots and what recommendations can be given to farmers, traders and processors with such lots; so that such produce does not enter the human food chain.

Recommendation: Develop national food safety plans. Aflatoxin control plans could be a starting point to show the way ahead for national food safety plans.

Allocate national budgets for food safety activities

Only one country (Mali) indicated that they had allocated an amount from the national budget for food safety activities. Survey respondents from other countries may not have been informed about the allocated amounts or none were put aside.

Recommendation: Develop an example budget for aflatoxin awareness and control activities for an 'example country.' So that countries have guidance about the minimal cost of minimum activities.

Recommendations for other food safety activities with common approach in ECOWAS

ANALYTICAL SERVICES

Respondents stated that participation in ring-testing or proficiency testing is expensive, so that they suggest that regional proficiency testing could be implemented.

COMMON ACTIVITIES

There might be several activities that could be coordinated through the ECOWAS and UEMOA food safety contact points as suggested by the survey respondent, they include 1) development of a common food safety framework for SSA; 2) develop a food security policy and mandatory food security monitoring plan within the context of a common framework for food safety in sub-Saharan Africa; 3) develop a common pesticide and biopesticide registration protocol for the ECOWAS region; 4) The food safety desk of ECOWAS should be reorganized in order to attract sufficient capacity building programs, that will regularly bring together the Food Safety Regulators from the ECOWAS countries.

NEW ACTIVITIES

The survey participants suggested that the ECOWAS should consider starting new activities to find a harmonized approach to other food safety concerns in the regions such as: heavy metals, pesticide residues, other mycotoxins and multi-mycotoxin exposure; PAHs (Polycyclic Aromatic Hydrocarbons); POPs (Persistent Organic Pollutants); arsenic in rice; histamine; antibiotics and veterinary drugs residues; Hepatitis viruses, Salmonella and Cholera, and adulteration, food additives, and hygiene of foods – especially street-food.

CONCLUSIONS

Implementation of Aflatoxin regulation and Aflatoxin control on its own is not sustainable. Therefore, quality control should be integrated into a value chain approach that eventually gives higher benefits to small scale producers who do everything to produce higher quality and safer produce, getting paid higher prices for better quality and effectively cutting out middlemen. Furthermore, these producers/traders/processors need better access to services like inputs (fertilizer, good seeds, and moisture meters), drying and storage facilities, but also quality control advice and services in their localities so that they have the tools for improving quality in their locality. Farmer based organizations (FBO's), non-governmental organizations (NGO's) and extension services need to be informed on what works to control aflatoxin using simple means, which should be specified in a regional code of practice.

The survey of key informants in the 15 ECOWAS countries revealed that only 8 of them have afood safety legislation in place, with 4 countries not submitting any information. There are only 3 countries that have an aflatoxin standard Benin, Nigeria and Ghana, while the other countries use Codex limits, except for Sierra Leone who has no legislation. No information was provided by Guinea-Bissau and Guinea. Laboratory infrastructure in most countries is good including human capacity, but the number of staff is low. Low volume of analysis also prevents them to have the necessary routine.

There are several recommendations specified in the report in two sections with the first one specifying 6 recommendations on aflatoxin control and management; while in the second section 8 recommendations on how to improve institutional arrangements for aflatoxin management.

The report gives a very good overview of the present policy environment and capacity of the ECOWAS region regarding aflatoxin control and regulations. Recommendations are formulated on how to facilitate regional cooperation to better address aflatoxin control and mitigation in the ECOWAS region. The most important element is to implement aflatoxin awareness and control strategies on a regional basis so that programs are more sustainable.

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Annex 1: Questionnaire (in English[40])

PACA-ECOWAS SCOPING STUDY TO ASSESS THE REGULATORY ENVIROMENT AND TECHNICAL CAPACITY FOR AFLATOXIN MITIGATION IN THE ECOWAS MEMBER STATES

QUESTIONNAIRE

N0		
1	**Is there an existing legislation/policies in place to control food safety in the country?**	YES ☐ NO ☐
2	**If yes, a) who has set these policies? b) what is the full name of the policy? c) when was the date of approval of the policy?** **a) WHO set POLICY** **b) NAME of POLICY** **c) DATE of approval**	
3	**Is there a national regulation on aflatoxin?** **a) WHO set REGULATION** **b) NAME of REGULATION** **c) DATE of approval**	YES ☐ NO ☐
4	**What is the existing maximum accepted tolerable limit for aflatoxin in your country in these crops:** **a. Maize _____** **b. Peanuts_____** **c. Oilseed (Please name the oilseed crops in your response)_____** **d. Other commodities (Please name the commodities in your response)_____**	
5	**Have regulations and standards been translated into standard operating procedures?** --- --- ---	
6	**Who is responsible for enforcing the above mentioned limit(s) or standard(s)?** --- --- ---	

[40] The questionnaire was translated to French by a translator

7	**Which /ministries are in charge of aflatoxin control activities?**	**Health** ☐ **Agriculture** ☐ **Fisheries** ☐ **Environment** ☐ **Trade** ☐ **Other please specify**_____ ☐
8	**Which agency(ies) are in charge of aflatoxin control activities** 1. _____ 2. _____ 3. _____	
9	**Are their mandates as pertaining to aflatoxin defined in legislation/policy?** please specify_____	
10	**Are there any gaps or overlaps in the mandates of the different agencies pertaining to aflatoxin control?** --- --- ---	
11	**Which body provides the leadership and coordination for these efforts?** --- ---	
12	**Is there a national strategy for aflatoxin control, if yes please specify**_____	YES ☐ NO ☐
13	**Is there a specific budget allocated for aflatoxin monitoring & control?** Yes _____ Amount_____ None_____ Do not know_____	
14	**When are aflatoxins controlled in your respective countries?**	**At importation** ☐ **At exportation** ☐ **During regional trade** ☐ **During national trade** ☐ **On processed goods** ☐ **please specify which ones** _____

15	**Processed goods are controlled when destined for which market ?**	National ☐ Regional ☐ Export ☐
16	**Which laboratories (public and private, reference and specialized, etc.) at central, regional and local level are involved in food analysis (physical, chemical and microbiological)?** ----------	
17	**Which laboratories have working labs/equipment to test for aflatoxin levels?** **1.** _____ **2.** _____ **3.** _____ **4.** _____	
18	**Are any of these labs part of international proficiency testing programmes for aflatoxin?** ---------- ----------	
19	**Are the labs accredited?** ---------- ----------	
20	**If you know how many samples were analyzed last year for aflatoxin?**	**<20**_____ **20-50**_____ **50-100**_____ **100-500**_____ **>500**_____
21	**How much does one sample analysis for aflatoxin cost?? NOT necessary exact cost, but range** ----------	
22	**Do you know if staff has been trained in sampling OR which sampling protocol is being used?**---------- ----------	
23	**What method(s) are used for aflatoxin testing?**	**ISO** ☐ **AOAC** ☐ **GLP** ☐ **EU** ☐
24	**What Instruments are used for aflatoxin testing?**	**GC MS/MS** ☐ **U/HPLC** ☐ **TLC** ☐ **Elisa** ☐ **VICAM** ☐ **Other**_____

25	**Are you able to purchase your own aflatoxin standards?? Or how do you get supply of standards?** --- ---	
26	**What human capacity for aflatoxin analysis exists in the laboratory?**	**Number of** **Ph.D._____** **M.Sc._____** **B.Sc._____** **Other please specify_____**
27	**Are lab results recognized by other countries? ----------** --- ---	
28	**What is needed to improve the capacity to detect aflatoxin in your country?----------** --- ---	
29	**a) Are there any risk assessment experts (food and feed) in your country?** **b) If yes, please specify** **the names,** **full address,** **institution (s)** **and other relevant contacts?**	YES☐ NO ☐
30	**What regulatory framework exists for the registration of microbial biopesticides?----------** ---	
31	**Which guidelines are used for the distribution and marketing of biopesticides in your country?----------** ---	
32	**Have you run aflatoxin awareness creation/information campaign in your country?**	YES☐ NO ☐
33	**Are there any NGOs that are involved in awareness creation/information campaign?** **If YES, Which ones_____**	YES☐ NO ☐

34	**What are the major gaps in the current national framework of food law, regulations and standards pertaining to aflatoxin?----------**	
35	**Apart from aflatoxin which other food safety concern do you have which should be addressed through a common ECOWAS approach?----------**	
36	**What particular challenges are you facing with respect to aflatoxin control?----------**	

Annex2: List of respondents & their contacts

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Annex 3: Aflatoxin analysis methods (after Wacoo et al. 2014[42])

Method*	Need for a label	Need for prior sample preparation	LOD**	Multiple analysis	Need for skilled operator	Field usage	Reference
TLC densitometer		SPE	1–20 ng/Kg	Yes	Yes	No	[1, 2]
HPTLC		Extraction only	Pictogram	Yes	Yes	No	[3]
HPLC		IAC or SPE		Yes	Yes	No	[4]
LC-MS/MS		Extraction only	0.8 µg/Kg	Yes	Yes	No	[5]
Fluorometer		IAC	5–5000 µg/Kg	Yes	Yes	No	[6]
FTIR			<10 µg/Kg	Yes	Yes	No	[7]
RIA	Radio isotope	Extraction only	1 µg/Kg	Yes	Yes	No	[8]
ELISA	Enzymes	Extraction only		Yes	Yes	No	[9]
Immunodipstick	Colloidal gold	Extraction only	5 µg/Kg	Yes	Yes	Yes	[10]
QCMs		Extraction only	0.01–10 ng/mL	Yes	Yes	No	[11, 12]
SPR		Extraction only	3.0–98 ng/mL	Yes	Yes	No	[13]
OLWS		Extraction only	0.5–10 ng/mL	Yes	Yes	No	[14]
Electrochemical		Extraction only	2 µg/Kg	Yes	Yes	No	[15]
Electrochemical		Extraction only	1 femtomolar	Yes	Yes	No	[16]

*TLC-thin layer chromatography; HPTLC- high-performance thin layer chromatography, HPLC-high-performance liquid chromatography; LC-MS/MS - Liquid chromatography–mass spectrometry; FTIR - Fourier Transform Infrared Spectroscopy; RIA-radioimmunoassay; ELISA - enzyme-linked immune-sorbent assay; QCMs - Piezoelectric Quartz Crystal Microbalances ; SPR-surface plasmon resonance; OLWS -optical waveguide light-mode spectroscopy

** LOD – Limit of detection

[42]Alex P. Wacoo, Deborah Wendiro, Peter C. Vuzi, and Joseph F. Hawumba, "Methods for Detection of Aflatoxins in Agricultural Food Crops," Journal of Applied Chemistry, vol. 2014, Article ID 706291, 15 pages, 2014.http://www.hindawi.com/journals/jac/2014/706291/

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Annex 4: List of People with Risk Assessment Capacity

Country	Risk Assessment Capacity
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