STRENGTHENING AFLATOXIN CONTROL IN SENEGAL: POLICY RECOMMENDATIONS

BASED ON FINDINGS OF THE COUNTRY-LED SITUATION ANALYSIS AND ACTION PLANNING (C-SAAP) CONDUCTED FROM 2015 TO 2017 BY THE PARTNERSHIP FOR AFLATOXIN CONTROL IN AFRICA (PACA)

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الشراكة من أجل مكافحة الافلاتوكسين في أفريقيا

1. WHAT ARE AFLATOXI NS?

Aflatoxins are highly toxic metabolites that affect the safety of food and feed in tropical and subtropical regions of the world, including Senegal. They are mainly produced by *Aspergillus flavus* and *Aspergillus parasiticus* fungi that reside in soil. There are four types of aflatoxins that are important in health and agriculture: aflatoxin B_1, B_2, G_1 and G_2. Aflatoxin B_1 is the most common of the four types.

2. WHAT ARE THE HEALTH EFFECTS OF AFLATOXINS?

The health effects of aflatoxins can be categorized into two general forms: acute and chronic aflatoxicosis. Acute aflatoxicosis results from ingestion of food containing moderate to high levels of aflatoxins and is characterized by a rapid and obvious onset of toxic responses, including hemorrhaging, acute liver damage, edema (swelling), digestive difficulties, and possibly death, usually within a week of exposure. Chronic aflatoxicosis is experienced when individuals ingest low levels of aflatoxins in food over a long time-period. This is associated with immune suppression, low birth weight, impaired child growth and liver cancer. The biggest and best known health effect of aflatoxin is liver cancer. It is estimated that globally about 782,200 new cases of liver cancer occur yearly, and that 83% (648,200) of them occur in less developed countries, including Africa[1]. According to Liu and Wu[2], as high as 28.2% of the annual global liver cancer cases may be attributable to aflatoxin exposure and 40% of these cases occur in Africa, making liver cancer the top cause of cancer mortality in the continent. Aflatoxin B1 is recognized by the International Agency for Research on Cancer of the World Health Organization (WHO) as one of the most toxic and carcinogenic substances found in nature.

3. WHAT ARE THE TRADE IMPACTS OF AFLATOXIN CONTAMINATION?

The Food and Agriculture Organization of the United Nations estimates that 25% of the food produced worldwide is contaminated with aflatoxins. Due to the increasing recognition of the impact of aflatoxins on human health, food regulatory authorities have set and enforced maximum limits (MLs) for aflatoxins in traded food. Stringent limits of 2ppb for aflatoxin B_1 and 4ppb for total aflatoxins in foods are enforced in the European Union (EU). In countries that fail to meet aflatoxin standards, foreign income from aflatoxin prone foods falls as exporters cannot access strategically important international markets. Africa is reported to lose more than US$ 670 million per year in export earnings due to the presence of aflatoxins in farm produce. If a country does not have or enforce aflatoxin regulations, contaminated foods which do not meet export standards will be sold in the domestic market or used for household consumption, increasing the health risks associated with aflatoxin exposure in local communities.

4. WHAT TYPES OF FOOD ARE PRONE TO AFLATOXIN CONTAMINATION?

Aspergillus spp. can colonize and contaminate a wide variety of food commodities with aflatoxins, including groundnut, maize and rice, which are staple foods in Senegal.

5. WHAT ARE THE GLOBAL REGIONS MOST AFFECTED BY THE AFLATOXIN CONTAMINATION PROBLEM?

Fungal growth and the formation of aflatoxins in food is influenced by climatic conditions. Regions and countries, such as Senegal, located between 40°N and 40°S, have a climate that favors growth of the aflatoxin producing *Aspergillus* spp. and are thus chronically affected by aflatoxin contamination of food and feed.

6. AT WHAT STAGE ALONG THE FOOD CHAIN DOES AFLATOXIN CONTAMINATION OCCUR?

The risk of aflatoxin contamination begins during pre-harvest and can be worsened by inappropriate harvesting, handling, storage, processing, and transport practices. Drought, high temperature, low soil fertility, pest infestation and other stresses that affect plant growth and vigor increase the likelihood of fungal infection as well as the levels of aflatoxins produced by the *Aspergillus* fungi. Aflatoxin contamination can thus be prevented by application of good agricultural practices in crop cultivation and good management practices in post-harvest food handling.

7. TO WHAT EXTENT ARE SENEGALESE FOODS CONTAMINATED WITH AFLATOXINS?

In Senegal, about 36% of groundnut production contained aflatoxins at levels that exceed the EU ML of 4 ppb and about 14%, the US limit of 20 ppb, for total aflatoxins. However, the proportions of groundnut samples exceeding MLs varied between the different agro-ecological zones. The highest proportions of groundnut samples containing aflatoxins at levels exceeding the EU ML of 4 ppb and the US ML of 20 ppb were recorded for the Sudan-Sahel zone at 46.67% and 15.56%, respectively (Table 1).

Many reports attribute the high risk of aflatoxin contamination in Senegal to reliance on rain-fed agriculture - when drought occurs, the stress to rain-fed crops such as groundnut make them more susceptible to infection from aflatoxin-producing *Aspergillus* fungi.

In maize, about 27% of the samples from the Sudan-Sahel Zone exceeded both the US ML of 20 ppb and the EU ML of 4 ppb. There were no data for aflatoxin contamination in locally produced or imported rice, accessible at the time of the situation analysis.

1 Ferlay, J., Soerjomataram, I., Dikshit, R., Eser ,S., Mathers, C., Rebelo, M., Parkin, D., Forman, D. and Bray, F. 2015. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. *International Journal of Cancer* 136(5): E359-E386. Doi:10.1002/ijc.29210

2 Liu, Y. and Wu, F. 2010. Global burden of aflatoxin-induced hepatocellular carcinoma: a risk assessment. *Environmental Health Perspectives* 118(6): 818-824

TABLE 1: PROPORTIONS OF GROUNDNUT SAMPLES FROM THREE AGRO-ECOLOGICAL REGIONS OF SENEGAL EXCEEDING THE MAXIMUM LIMITS OF 4 PPB AND 20 PPB[3]

Maximum limit	Sahel (Regions of Saint –Louis, Matam, Louga, Thiès)	Sudan (Regions of Ziguinchor, Sédhiou, kolda, Kédougou)	Sudan-Sahel (Regions of Tambacounda, Kaolack, Kaffrine, Fatick)
4ppb	17.02%	33.33%	46.67%
20ppb	2.13%	14.81%	15.56%

8. TO WHAT EXTENT ARE GROUNDNUT, RICE AND MAIZE IMPORTANT FOR FOOD SECURITY IN SENEGAL?

In Senegal, the main agricultural commodities susceptible to aflatoxins contamination are groundnut, rice, maize, cashew nuts, milk and cottonseed. Of these crops, groundnut, rice and maize are the most important, in terms of their high production and import volumes or their contribution to food or feed supply. Senegal is one of the lead producers of groundnut in the world. In recent years, the production increased from 331,000 tons in 2007-2008 through 710,000 tons in 2008-2009 to 1,000,000 tons in 2009 - 2010 in 2016 -2017, production increased to 991,427 tons and during the 2017 – 2018 season, production reached the record volume of 1,405,223 tons[4]. Annual consumption of rice as food is up to 1.2 million tons. However, maize production of 114,000 tons was reported for Senegal in 2013. This rose from 346,030 tons in 2016-2017 to 410,364 tons in 2017-2018.

9. WHAT IS THE EXTENT OF AFLATOXIN EXPOSURE AMONG THE PEOPLE OF SENEGAL?

The best approach of measuring exposure to aflatoxins is the use of biomarkers. The most reliable marker of aflatoxin exposure is aflatoxin albumin-adduct. Using such a biomarker, Watson et al. (2015)[5] determined the average level of aflatoxin exposure in Senegalese population. The researchers found that, in Senegal, the aflatoxin biomarker levels range from 3 – 5,882 ng/ kg body weight (bw)/day (with a geometric mean of 415.8 ng/kg bw/day). The exposure levels were high in areas where per capita consumption of aflatoxin contaminated food is high, such as Tambacounda, Kedougou, Kaffrine and Kaolack.

10.WHAT IS THE RISK OF DEVELOPING AFLATOXIN-INDUCED LIVER CANCER IN SENEGAL?

The risk of developing liver cancer (when individuals are exposed to aflatoxins) is 30 times higher in people exposed to hepatitis B Virus (HBV) compared to those who are not. In Senegal, about 11.06% of the population is HBV positive[6]. In view of the estimated aflatoxin exposure determined by Watson *et al*. (2015) and the

3 PACA. 2017. *Country-led Aflatoxin and Food Safety Situational Analysis and Action Planning for Senegal: Final Report*, Partnership for Aflatoxin Control in Africa, African Union Commission

4 United States Department of Agriculture (USDA) Foreign Agricultural Service (FAS). 2010. Nigeria Grain and Feed Annual Report, Global Agriculture Information Network (GAIN)

5 Watson, S., Diedhiou, P.M., Atehnkeng, J., Dem A., Bandy, R., Srey, C., Routledge, M.N. and Gong, Y.Y. 2015. Seasonal and geographical differences in aflatoxin exposures in Senegal. World Mycotoxin Journal, 8(4): 525 – 531, DOI 10.3920/WMJ2014.1824.

6 Schweitzer, A., Horn, J., Mikolajczyk, R.T., Krause, G., and Ott, J.J. 2015. Estimations of worldwide prevalence of chronic hepatitis B virus infection: a systematic review of data published between 1965 and 2013. *The Lancet* 386(10003): 1546-1555

prevalence of hepatitis B virus infection (11.06%), an estimated 4,118 new cases of aflatoxin-induced liver cancer occur each year among Senegal's population of nearly 15,850,567[7].

11. WHAT IS THE NUMBER OF HEALTHY LIFE YEARS LOST DUE TO AFLATOXIN-INDUCED LIVER CANCER IN SENEGAL?

With assumption that each liver cancer case results to death within a year, it was estimated that the 4,118 aflatoxin-induced liver cancer cases, would lead to **a loss of 98,300 healthy life years, annually.** The healthy life years lost were estimated using the disability adjusted life years (DALYs) approach.

12. WHAT IS THE ECONOMIC IMPACT OF AFLATOXIN-INDUCED LIVER CANCER IN THE SENEGAL?

Senegal loses up to $161 million, annually, as a result of aflatoxin-induced liver cancer. This economic impact was calculated using the transferred value per statistical life (VSL) method.

13. WHAT IS THE IMPACT OF AFLATOXINS ON SENEGAL'S PARTICIPATION IN THE INTERNATIONAL TRADE OF GROUNDNUTS?

The impact on trade was estimated based on the cost of decontaminating groundnut cake (with ammoniation) to comply with the importing countries ML. On annual basis Senegal exports about 60,000 tons of groundnut cake. Thus, detoxifying this quantity of groundnut cake through ammoniation was estimated to cost $3.6 million, annually. The human cost linked to the workers' safety and accidents recorded for the decontamination were not considered in this estimation

14. WHAT ARE THE PACA SUPPORTED INITIATIVES TO CONTROL AFLATOXINS IN SENEGAL?

PACA supported the country-led situation analysis and action planning (C-SAAP) for control of aflatoxins along the groundnut, rice and maize value chains in Senegal. The policy recommendations in this document are based on the outcomes of the C-SAAP. Additionally, in partnership with key institutions in Senegal, PACA is generating and sharing data under the framework of the Africa Aflatoxin Information Management System (AfricaAIMS) initiative. AfricaAIMS generates data on aflatoxin contamination in groundnut, rice and maize, as well as on other aflatoxin related issues in the health and trade sectors. The initiative's key objective is to provide locally relevant, home grown and reliable evidence to facilitate informed decisions on policies, food safety regulations and standards, mitigation interventions (e.g. educational and technological), resource allocation, and advocacy and awareness raising activities by the Senegal government and other stakeholders. Local capacity building, through the provision of equipment and training of personnel, is central to AfricaAIMS.

PACA also provided catalytic support to develop a resource mobilization

7 United Nations, Department of Economic and Social Affairs, Population Division. 2017. *World Population Prospects*: The 2017 Revision

strategy and convene business meetings to enhance ownership and financing of the national aflatoxin control plan. PACA's catalytic support extends to convening aflatoxin working groups to spearhead planning and implementation of aflatoxin mitigation actions at the country level. In order to ensure that these efforts are well coordinated, PACA has hired a country officer who is housed by the Directorate of Plant Protection under the Ministry of Agriculture. PACA shall provide ongoing support to track progress in the implementation of the national aflatoxin control plan.

15.WHAT ARE THE ROLES OF KEY INSTITUTIONS INVOLVED IN DELIVERY OF FOOD SAFETY CONTROL SERVICES IN SENEGAL?

In Senegal, food safety control authorities are spread across the ministries responsible for trade, agriculture and health, with little coordination between them. The lack of clearly defined responsibilities and mandates for the relevant authorities and their control departments undermines efforts to control food safety risks. The roles of the key institutions are briefly presented below:

a. **Sénégal Bureau of Standards (Association Sénégalaise de Normalisation - ASN)**
Food standards in Senegal are set by ASN, under the ministry responsible for industry. ASN was established by Decree 78-228 of March 14, 1978, and has since set standards related to aflatoxin control, namely NS 03-053 governing the packaging and labeling of groundnut paste intended for human consumption; NS 03-054 prescribing the method for determining the level of aflatoxins B1, B2, G1 and G2 in groundnut paste; and NS 03-062 prescribing specifications for groundnut crude oil intended for human consumption after refining. However, the Bureau has not yet set MLs for aflatoxin in food crops.

b. **Division of Consumption and Consumer Safety (DCSC)**
The DCSC operates under the ministry responsible for health and is mandated to coordinate food and feed safety services in the country. The DCSC derives its powers from Law 66-48 of May 27, 1966 which governs the control of food products and fraud prevention; Decree 68-507 of May 7, 1968, which outlines import control conditions; and Decree 68-508 of the same date, which establishes the conditions for investigating and documenting violations. However, these laws are outdated. When the C-SAAP was being undertaken a bill to amend them was being formulated by relevant departments.

c. **Directorate General of Health**
Under the ministry responsible for health, food safety services are administered by the Directorate General of Health's National Committee of the Codex Alimentarius in accordance with Law 83-71 of July 5, 1983, establishing the Health Code, which empowers health officers in Senegal to monitor and inspect foods for safety.

d. **Plant Protection Directorate (DPV)**
Plant health protection services are offered under the Plant Protection Directorate, which derives its powers from Decree 60-121 of March 10, 1960, instituting requirements for phytosanitary control. The directorate operates under the ministry responsible for agriculture and is mandated to provide phytosanitary certification services for plants and plant-based products.

e. **Veterinary Services Directorate (DSV)**
Animal health protection services are offered under the Veterinary Services Directorate of the ministry responsible for livestock. Regulation of aflatoxins in animal feed is a responsibility of this ministry, but the directorate has not yet established limits for aflatoxin levels in animal feed.

f. **Domestic Trade Directorate**
The Domestic Trade Directorate, under the ministry responsible for trade, was created to facilitate trade and performs its functions according to Decree 70-94 of January 27, 1970, which established a product control Committee. However, the committee was still not operational at the time the C-SAAP was carried out.

g. **Food Technology Institute**
The Food Technology Institute provides analytical services for food safety control in Senegal. This is the only laboratory in the country with the capacity to analyze aflatoxins in food. However, most of the samples analyzed for aflatoxin contamination come mainly from the producers of chocolate, groundnut paste and animal feed, rather than official food control agents.

16.WHAT IS THE LEVEL OF AWARENESS AND KNOWLEDGE OF AFLATOXINS AMONG SENEGALESE?

Awareness on the issue of aflatoxins is high in the community working with groundnut industries involved in export of groundnut and groundnut products. In this community, over 90% of the people are aware of the aflatoxin problem. Due to the growing awareness, the groundnut export industry, sort groundnut to ensure compliance with importing country requirements. Unfortunately, the sorted out (low quality) groundnut is kept for domestic market increasing the risk of aflatoxin exposure to local consumers.

17.EVIDENCE-BASED POLICY RECOMMENDATIONS FOR THE MITIGATION OF THE AFLATOXIN PROBLEM IN THE SENEGAL

Based on the gaps identified by the C-SAAP in Senegal, a set of recommendations were developed and validated by stakeholders. The recommendations were designed to cover the whole food value chain, from farm to table and are outlined in Table 3.

TABLE 3: STRATEGIC RECOMMENDATIONS FOR MITIGATION OF THE AFLATOXIN PROBLEM IN SENEGAL[8]

Advocacy and awareness raising
1. Raise decision-makers' awareness of the aflatoxin problem
2. Involve health and food safety stakeholders, as well as the general public, in aflatoxin control programs
3. Participate in PACA-related regional activities to mobilize the different parties involved at the sub-regional and regional level
4. Implement a national platform aimed at supporting aflatoxin control at national and regional levels
Farm level operations and related interventions
5. Train technical support staff and producer associations in good agricultural practices
6. Support and develop control strategies, such as biological control, as well as the development of decision support tools
7. Develop, where possible, aflatoxin resistant varieties for groundnut and maize
8. Assess the potential of using local clay matrices, such as attapulgite, to detoxify groundnut cake and other components used as animal feed
Transportation and processor interventions
9. Develop a system to collect, analyze and share data and information
10. Determine alternative uses for aflatoxin contaminated food
11. Monitor the prevalence of aflatoxins in groundnut, rice, maize, milk, eggs and meat
12. Establish a food safety regulatory system with clear roles and responsibilities for all the actors along the food chain
Policy Improvements
13. Adopt a protocol for bio-monitoring of aflatoxin exposure
14. Formulate aflatoxin standards for food and feeds
15. Maintain a comprehensive National Aflatoxin Control and Monitoring Plan
16. Harmonize the aflatoxin action plan with other initiatives underway, especially the National Emergency Response Plan for Food Safety
Institutional capacity building
8. Conduct surveys on the consumption of aflatoxin prone food products
9. Characterize and document production practices (in the plant and animal sector) for use in monitoring health outcomes
10. Strengthen inter-sectoral collaboration to ensure safety of food and feed
11. Train official control officers, specifically in their decentralized branches, on techniques to implement aflatoxin control procedures
12. Set up a Technical Working Group responsible for aflatoxin risk assessments

8 Based on the findings of the C-SAAP: PACA. 2017. *Country-led Aflatoxin and Food Safety Situational Analysis and Action Planning for Senegal: Final Report*, Partnership for Aflatoxin Control in Africa, African Union Commission

PACA Partnership for Aflatoxin Control in Africa

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