Partnership for Aflatoxin Control in Africa | Partenariat pour lutter contre l'aflatoxine en Afrique | Parceria para o Controle da Aflatoxina em África | الشراكة من أجل مكافحة الافلاتوكسين في أفريقيا

Africa Aflatoxin Information Management System (AfricaAIMS) Draft *Methodology*

Introduction

Aflatoxins are naturally occurring fungal metabolites produced by strains of *Aspergillus flavus* and *A. parasiticus,* which are acutely and chronically toxic, immunosuppressive, mutagenic and carcinogenic compounds that affect diverse foods and feeds. Due to these health risks, aflatoxins have therefore proven to be a major barrier in linking African farmers to markets as they prevent commodities from meeting international, regional and local regulations and standards governing agricultural trade and food safety.

Cognizant of these problems, in March 2011 at the 7th CAADP Partnership Platform, the African Union Commission was urged to oversee the establishment of a Continental SPS Working Group to mainstream sanitary/phytosanitary matters in the CAADP framework and establish an Africa-led Partnership for Aflatoxin Control. It was through this call that the Partnership for Aflatoxin Control in Africa (PACA) was established. PACA is therefore an innovative consortium aimed at coordinating and supporting aflatoxin mitigation and management across the health, agriculture and trade sectors in Africa. PACA's overall aim 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.

The PACA Strategy 2013-2022 identifies one of PACA's leading roles to be a knowledge broker and information clearing house. Therefore, through the PACA initiative, the African Union Commission will establish an electronic data management platform which will serve as a "one stop shop" information harbor for use in:

1. Promoting public awareness, advocacy and communication on aflatoxin prevalence and risk;
2. Provision of evidence for the formulation of good legislation and policies;
3. Advocacy to attract or promote investment;
4. Promoting regional and intra-regional trade;
5. Meeting international obligations on food standards to enhance global trade;
6. Generation of evidence to inform interventions;
7. The provision of early warning systems for aflatoxin outbreaks; and,
8. Monitoring and evaluating the impact of interventions in countries.

Background: ARIS II and PACA's Planned System

Features of ARIS II

The Africa Aflatoxin Information Management System (AfricaAIMS) will be initially hosted on Version II of the Animal Resource Information System (ARIS II) at AU-IBAR. It will, thus, be useful to highlight how ARIS II operates. ARIS II is a decentralized information management approach which enables AU Member States at a national and sub-national level, RECs and AUC to be self-sufficient in standardized and swift information flow. ARIS II is built on a modular basis whereby specific and detailed modules are built within ARIS II to meet the different needs of each module. The information that feeds the different modules on ARIS II is drawn from structures that have been established at country and regional levels, and inclusive of international organizations. Information is fed at each level (the farm level, district level, national, regional etc.) either electronically for online users or by hand for off-line users. For each level of the information collection system, there are access points and check points for information validation and clearance.

ARIS II has the following features which make it attractive:

- Allows data analysis and mapping of information to a certain extent;
- Allows step wise roll out – at Administrative and Module operational level;
- Interoperability:-
  - Capability for data import and export in excel, csv formats etc.;
  - Discussion on-going with operators of other information systems (OIE-WAHIS[1]; FAO-TADinfo[2]; SADC-LIMS[3] and other National databases) to allow automatic sharing of data
  - Common reference data – such as administrative divisions; disease names; animal species etc.;
  - Additionally, ARIS II uses Standards and common protocols set by international organizations such as:
    - OIE standards for reference data etc.
    - ISO codes for abbreviations of country names and currencies etc.
    - GIS conventions for the levels of administrative setup and geo-referencing

Aflatoxin Module on the ARIS II

Since ARIS II is built on a modular basis, an AfricaAIMS Module on aflatoxin will be developed through the AU-IBAR ARIS II website http://www.au-aris.org. As with all information systems, the critical ingredient is data. The collection of data for the aflatoxin module on ARIS II will be the responsibility of AU Member States who are at different levels of infrastructure

[1] Office International des Epizooties - World Animal Health Information System (WAHIS)
[2] The Food and Agriculture Organization (of the United Nations) - Transboundary Animal Disease Information System (TADinfo)
[3] The Southern African Development Community - Livestock Information Management System (LIMS)

development, human and institutional capacities, etc. It is therefore critical to design a robust methodology for data collection which will ensure:

- Efficiency and effectiveness in data collection,
- Ease of use and ability to suit the realities on the ground,
- Cost-effectiveness and sustainability, and
- Provision of real time data for updating risk maps on aflatoxins.

Since aflatoxin is a multifaceted challenge involving health, trade and agriculture, it is essential that the AfricaAIMS provides data from all these three sectors.
The aflatoxin information management system on ARIS II is one of the major activities of PACA Secretariat planned for 2014. If done well, the AfricaAIMS initiative will be one of PACA's biggest contributions in the quest to effectively mitigate the aflatoxin problem inAfrica.

Methodology Development Workshop

The PACA secretariat convened an AfricaAIMS methodology workshop which aimed to bring experts from the various sectors and with expertise in data collection in country. The workshop aimed at developing a methodology which will enable the successful implementation of the AfricaAIMS in countries. The workshop was convened on 21-22 November 2013, at the margins on the West Africa Workshop on Aflatoxin Control, held in Accra, Ghana.

In attendance were: Amare Ayalew (PACA-AUC), Wezi Chunga (PACA-AUC), Martin Kimanya (The Nelson Mandela African Institute of Science and Technology), Moses Osiru (ICRISAT), Archileo N. Kaaya (Makerere University- PACA Uganda Chapter),Maria Bisamaza (PACA Uganda Chapter), Aubrey Chinseu (NASFAM), Erick Haraman (Malawi Ministry of Agriculture and Food Security- MOAFS), Jennifer Pratt Miles (Meridian Institute), Benoit Gnonlonfin(BeCA-ILRI).

Meeting Objectives:

1. Develop a robust and holistic approach to collecting relevant and credible data from countries to feed into the ARIS II aflatoxin module.
2. Build understanding of existing infrastructure, human and institutional capacities within countries to enable data collection (e.g. Extension services, laboratories, etc.).
3. Enhance understanding of existing data sets and data collection programs in Africa.

Group discussions:

Two groups were envisaged to facilitate discussions: the "aflatoxin experts" group would design methods from sampling through testing as well as identify relevant data for inclusion in the module, while the "data experts" were to develop a system for submission of data to the ARIS II. However, in view of the small number of participants, it was agreed to work in a single group. To facilitate discussions, a template of questions was developed and below is a summary of discussions within the group.

PART I. DATA COLLECTION

1. Relevant data to be collected for the aflatoxin module on ARIS II

- ***Health***
  - Liver cancer
  - Aflatoxin levels in humans / bio-marker data
  - Extent of consumption of aflatoxin prone crops
  - *Rate of childhood stunting*
  - *Others (HIV, HBV, Nodding Disease, etc.)*
- ***Trade***
  - Aflatoxin standards in countries
  - Volume of export and imports
  - Export rejections
  - *Existence of free trade areas/ border control*
- ***Agriculture***
  - Production levels
  - Aflatoxin contamination along the value chain (prevalence and levels)
  - *Seed moisture content*
  - *Drying, storage, processing and packaging*
  - *Aflatoxin control interventions*

2. Review of Sources of data both existing and new data in countries

2 a) Existing Data

Health

a. Liver cancer

National Cancer registry, IARC, hospitals

b. Aflatoxin levels in humans / bio-marker

Research, Hospitals, CDC

c. Extent of consumption of aflatoxin prone crops

National Statistics Offices, FAOSTAT, Research, World Bank--LSMS

d. Rate of childhood stunting

National demographic surveys, WFP, UNICEF, WHO

e. Others (HIV, HBV, Nodding Disease, etc.)

National Health Reports, UNICEF, WHO

Trade:

a. Aflatoxin standards in countries

Regulatory bodies, bureaus of standards, WTO, CODEX, industries (for voluntary standards)

b. Volume of export and imports

National Statistics Offices, FAOSTAT, Ministries of Trade records, export boards

c. Export rejections

European Food Safety Authority (EFSA), national regulatory bodies, WTO Rapid Alert Systems

d. Existence of free trade areas/ border control

EFSA, ETC., RECs, National Regulatory Bodies, Ministries of Trade

Agriculture

a. Production levels

FAOSTAT, Ministries of agriculture,

b. Aflatoxin contamination along the value chain (prevalence and levels)

Research, Farmers Organizations, Private Companies, WFP- Purchase for Progress (P4P)

c. Seed moisture content

Private companies, farmers' organizations, Bureau of Standards, regulatory bodies

d. Drying, storage, processing and packaging

Research, farmers organizations, private companies, Ministries of agriculture, WFP, FAO, WHO

e. Aflatoxin control interventions

Research, Ministries of Agriculture, Farmers organizations, private companies

2b) New data: review on how data will be collected:

a. Sampling plans

Human body fluids and crops, build on existing protocols and develop sampling methods for target areas

b. Aflatoxin testing methods that are appropriate, cost-effective and reliable

Suitable ELISA method of choice with test results confirmed using Vicam, HPLC/ UPLC

c. Which value chains

Groundnuts, Maize, poultry, fish feeds

d. Which segments of the value chain?

1. Immediately after harvesting/drying
2. At the market level

e. At what frequency?

1. ***Food:*** groundnuts and maize – Twice
2. ***Animal Feed:*** at the market level (aflatoxin and moisture content) and others

3. **Proposed method of collection for non-aflatoxin data identified in group discussion**
    - Secondary sources as enumerated above

4. **Who will collect the samples for aflatoxin data?**

Farmers organizations, processors associations, agriculture and health extensions services, regulatory bodies, research institutions, private sector, NGOs, - depending on the infrastructure at country level.

5. **Who will analyze the samples for aflatoxin content?**

Competent private laboratories, research institutions, farmers' organization national laboratories

6. **Who will be responsible at country level?**

Have a country process to identify their lead institution and **country focal person**
Examples: e.g. Tanzania Food and Drugs Administration (Ministry of Health), Tanzania; Malawi Program for Aflatoxin Control - MAPAC (Ministry of Trade), Malawi; Aflatoxin Management Committee (Ministry of Trade), Uganda.
Others: Research bodies, farmers' organization etc. will be instrumental in the actual sampling and data collection.

7. **Capacity required at country and regional level for data collection/submission: human capacity, infrastructure**
    1. ***Human Capacity***
        a. Train for ability to test for aflatoxin
        b. Train for sampling
        c. Train for testing as needed
        d. Train for basic IT command and ARIS II
    2. ***Infrastructure***
        a. Ability to test for aflatoxin
        b. ELISA plate readers, HPLC/UPLC, Vicam, etc.
        c. Reagents and supplies
        d. Sampling tools
        e. Electronic moisture meters
    3. ***Clear ToR***
    4. ***Monitoring system***

PART II. DATA SUBMISSION

1. ***Flow of samples:*** Sampler submits samples to field officers/area management center/farmers' organizations/district ministry offices

2. ***Define hierarchy for data submission:***
   Agro-Ecological Regions → Country level → PACA Online System
   (submit data to CFP: off-line) (CFP: online and off-line)

   CFP = country focal person

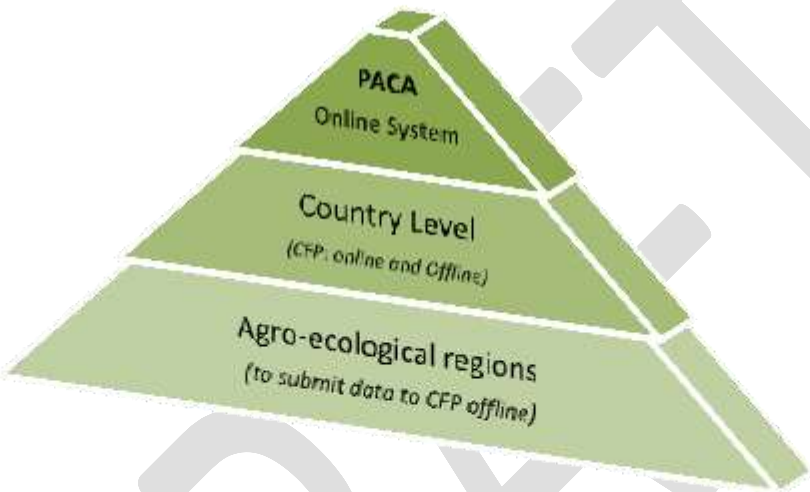


Figure 1: Hierarchy of Data Inputting

3. ***Level of access to "ARIS II"***

Country level → AfricaAims Online System (ARIS II aflatoxin module)
(Country focal point)

PART III. SITUATION ANALYSIS FOR THE AFRICA AFLATOXIN INFORMATION MANAGEMENT SYSTEM

1. Advantages and Disadvantages of AfricaAIMS (ARIS II- Aflatoxin Module)

Advantages:

- Data will become available for planning purposes
- Evidence readily available to inform policy
- Will inform interventions
- Support research collaborations and technology adoption
- Information will be "homegrown" (bottom-up approach)
- Evidence for advocacy and for prioritization of resource allocation

- Evaluation of efficacy of interventions
- Facilitate trade through transparency on aflatoxin prevalence – from countries/seasons with low aflatoxin levels
- Availability of data for setting and enforcing food standards
- Attract resources to support countries
- Promote country capacity—training/ infrastructure and technical backstopping
- Increase country buy-in and political will for aflatoxin control
- Promote awareness on aflatoxin issues
- Early warning systems and risk maps
- Trigger country efforts in investing in management of aflatoxin issues
- Promoting PACA

Disadvantages:

- Potential adverse effect on export and formal internal trade (risk of banning produce from national regions with high aflatoxin levels)
- Cost of running the ARIS system – mainly aflatoxin testing costs, data collection etc.

2. Risks and assumptions

Risks:

- Failure to keep the ARIS II information up to date and operational
- Potential for misleading information (due to data inaccuracies)
- *Could encourage increased food imports over local products*
- Risk of panic unless handled systematically

Assumptions:

- Countries will adopt identified protocols and implement them in the same manner
- Country and REC buy-in

PART IV. COUNTRY AND REC BUY-IN STRATEGIES

Advocacy and awareness raising- what

- Advocacy and awareness raising – highlighting well known and less familiar adverse effects such as the potential for *stunting generation*
- Articulating the role of AfricaAIMS and the need for regular data collection in implementing effective interventions
- Articulating the cost of inaction and highlighting the opportunities of addressing the aflatoxin issues (including the health care burden, etc.)

Advocacy and awareness raising- who should be primary audiences

- Relevant parliamentary committees (eg. agriculture, trade and health) on the importance of the AfricaAIMS
- Relevant Ministries at national level and relevant stakeholders

Mode of engagement

Step 1: AUC to engage RECs on the importance of the aflatoxin issue (letter from COMREA to the head of RECs)

Step 2: RECs and PACA to identify pilot countries (PACA to come up with a selection guideline for identifying pilot countries)

Step 3: Align with instruments and systems that are addressing aflatoxins in countries where applicable and work with entities identified to take lead at county level

Step 4: Validate methodology

Step 5: Build country capacity

PART V. PACA GUIDELINES FOR IN-COUNTRY AFLATOXIN DATA COLLECTION: SAMPLING AND AFLATOXIN ANALYSIS

1. Introduction

Africa Aflatoxin Information Management System (AfricaAIMS) is a web-based tool that will gather aflatoxin information that will guide decision making, policy and regulations for local, regional and international trade. Furthermore, it will provide health related information as well as surveillance data on aflatoxin and eventually other mycotoxin in the subsequent years of the program. This section refines the proposed methodology as developed at the workshop in Accra, Ghana. The objectives of this section are to:

2. Objectives

- To review agro ecological zones (AEZ) of selected pilot countries.
- To select target AEZ.
- To propose a sampling method.
- To propose an analytical method of aflatoxin analysis in target crops (value chain).

3. Outcomes

- The AEZs in each pilot country are selected and known.
- The sampling plan is developed.
- The analytical method of aflatoxin is known and budget is proposed.

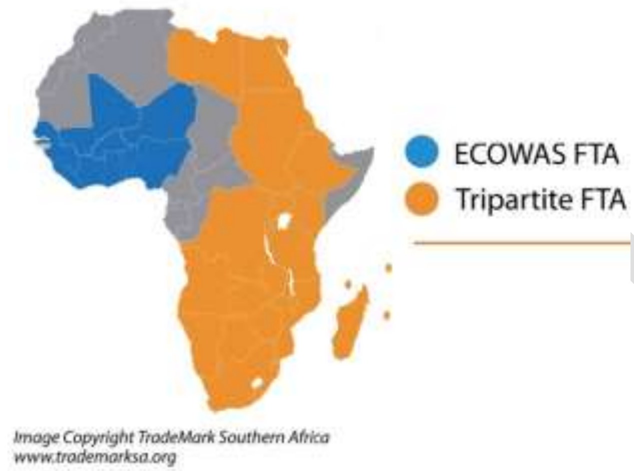
4. Measurable indicators

- Five VICAM equipment, accessories and consumables are purchased and installed in pilot countries.
- At least 3 technicians are trained on the use of the equipment and 7 others from the following categories are trained on sampling techniques: extension services (2), farmer organization (2), processors (2) and country focal point (1) from Ministry of Agriculture.
- Standard operating procedure for aflatoxin analysis is validated, harmonized and available.
- Country generates aflatoxin data for submission to ARISII database.

5. Methodology

5.1 Sampling location: Selected pilot countries

Five African countries will be involved in this pilot study. These countries will be selected in ECOWAS and tripartite region (Figure 1).



5.2 Selected value chains

Data collection will focus on key value chains, such as maize, groundnut, that are staples and also important trade commodities for local, regional, and international markets. Animal feed (poultry, fish) will also be considered. Perhaps, countries will decide adding animal feeds depending on their priority.

Figure 1.Map showing the ECOWAS and Tripartite countries

5.3 Sampling protocol

5.3.1 Sample Size

Bulk sample size of 1000g comprising of 5-10 incremental portions will be taken from each type of commodity using a sampling probe or scoop. The incremental portions will be mixed in a large bowl and the 1000g sample will be withdrawn. The incremental samples are to be taken at randomly selected points in a batch/lot; a diagonal line pattern will be followed across an open batch (e.g. heaps of grain, grain stored in bulk in traditional crib/bin with thatched roofing, or in room or granary). For maize and groundnut stored in bags: where there are less than 10 bags, incremental portions will be taken from each bag, and where the number of bags is >10, incremental portions will be taken from well distributed $\sqrt{N}$ bags (where N = the number of bags).

Very large batches of maize or groundnut grain (which mainly apply to warehouses of grain marketing corporations, relief aid reserves, etc.) will be sampled using more incremental samples, leading to a sample of ±2.5 kg. This will then be thoroughly mixed and divided to produce a 1.5 kg sample.

Overall, about 750 samples (200-1500g/sample) of the above commodities will be collected in different agroecological zones in each country (Table 1). Samples will be collected just after harvesting or during drying and packed in paper bags, shipped to the reference laboratory and stored at 4^{o}C until analyzed.

Sampling will be conducted twice a year. During sampling the moisture content of the collected samples will be measured using portable moisture meter. Alternatively, moisture content of the samples will be measured in the laboratory using constant oven method (AOAC, 1995).

During analysis (moisture content and aflatoxin) each sample will be analyzed in duplicates.

Table 1. Samples size and origin

Countries	Commodity			
	Maize	groundnut	feeds	Total*
Country 1	250	250	250	750
Country 2	250	250	250	750
Country 3	250	250	250	750
Country 4	250	250	250	750
Country 5	250	250	250	750

* The total number of samples will be determined based on country specificity.

5.3.2 Sample collection

a. **Sampling Sites and choice of participants -** Within each AEZ 10 farmers and traders will be selected together with local extension agents or other local agents.
b. With each farmer or trader 5 samples of each type of commodity will be taken depending on the availability of the commodity. Thus, stratified random sampling will be applied.
c. **Random Sampling -** Samples must be randomly taken from grain destined for human consumption only or mixed feed. Grains intended for processing into foodstuffs or feed can be included. Grains intended for seed production are to be excluded.
d. There should be no purposeful sampling to include very bad grains, as this causes complications in the statistical analysis of the data, e.g. increasing the number of outliers etc.
e. **Pest infestation -** Grain which is heavily infested with insect pests (e.g. weevils, worms, moths) should not be sampled. But collected samples should be

representative and indicative of the reality of the situation at that point in time. These pests will result in serious deterioration, including cross contamination, of samples before and after they reach the reference laboratory.

f. **Record-keeping -** Records must be kept of all sample data, using the different data sheets (e.g. data sheet for farmers and data sheet for traders). A summary of these records is to be submitted to the Country Focal Point. It may be important to determine the GPS coordinates of each sample location that will be adapted to each country.

g. **Storage of samples -** Samples should be properly stored overnight in cardboard boxes. Storage in 'plastic bags' should be avoided and nylon bags or cardboard boxes preferred.

h. **Labelling of samples -** Care should be taken that samples are properly labelled on the outside of the bag (and inside with a piece of paper) with the correct sample number and country code. Additional data could be collected with the data sheets.

i. **Transportation of samples -** The samples should be transported to the reference laboratory as soon as possible and kept free of insect infestation, rodent damage or moisture damage (e.g. rain, humidity) in transit and in the reference laboratory. For instance, samples in transit or in storage should be left in a cool environment, not exposed to excessive temperatures. Do not leave samples in closed boxes in cars. It is recommended to offload samples at each overnight stop and store in a cool, dark, dry environment. Avoid transporting samples too long and find a way to off-load samples on the way.

5.4 Aflatoxin analysis

5.4.1 Background and choice of method

A number of diagnostic methods for aflatoxin analysis are available (Table 2). Available methods of analysis range from the in-field rapid diagnostic strips such as Agristrips used in rapid test kits, competitive enzyme linked immunosorbent assays (ELISA) with colorimetric detection, to spectroscopic methods. Aflatoxins possess significant UV absorption and fluorescence properties, and chromatographic methods (either HPLC or TLC) with UV or fluorescence detection are widely utilised. Such methods require sample extraction and extract clean-up by solid-phase extraction (SPE) or immunoaffinity chromatography (IAC) followed by chromatographic separation and detection of aflatoxins. Total aflatoxins can also be measured by direct fluorescence measurements of these purified extracts (e.g. VICAM). VICAM technology (Annex 1) offers the advantage of analyzing samples in a short time (10-15 minutes/sample) and the cost per sample is reasonable. Thus, it is quick and easy to operate.

TLC takes more time than the 10-15 min of VICAM, and can be accurately quantified if combined with densitometer (expensive), but not through visual comparison. In addition, TLC is more laborious. The technician has to spot, develop and visualize in a viewing Ultra-Violet cabinet, and can only quantify with a densitometer.

HPLC/UPLC, LC-MS technologies offers the advantage of 'dilute and shoot' techniques where simple sample extracts are analysed with or without clean-up, with the added advantage of multi-mycotoxin analysis whereby a range of mycotoxins can be analyzed in the same sample analysis run. However, these technologies require high technology package, high cost, and high expertise and are not applicable everywhere in Africa and other developing country contexts. While these current technologies can provide an accurate measurement of aflatoxin levels, PACA advises the use of VICAM technology for the purpose of this data collection. Subsets of samples may be sent to a reference laboratory for confirmation of the aflatoxin data.

Table 2: Diagnostics technologies available commercially

Diagnostic technologies	Technology Cost	Sample cost ($)	Potential use for milled sample	Ease of use (prep time)	Accuracy level
VICAM	$	$$	yes	++	Accurate
ELISA	$	$$	yes	+++	Less accurate
TLC	$	$$	yes	+++	Accurate
Agristrips and other dipsticks	$	$$	yes	+	Less accurate

Note: $ = low/ $$$ = High cost (relative within column); + = low effort/+++ = high effort

5.5 Data analysis

SPSS for Window version 16.0 (SPSS, Chicago, IL) will be used for statistical analyses. Analysis of variance (ANOVA) will be performed using Kruskal Wallis rank sum test. Mean total aflatoxin will be separated with Turkey's honest significance difference (HSD) test ($p=0.05$). Nonparametric correlation test will be performed to evaluate interactions between total aflatoxin and altitude (AEZ) of sampling. Pearson correlation test will also be performed to determine relationship among the parameters.

5.6 Data submission to PACA through ARISII

Country focal point will submit data and other related information to PACA through AfricaAIMS.

The above described in-country aflatoxin data collection is the first to be conducted and will serve the basis for AfricaAIMS database. This will be implemented at country level and will be a mechanism for monitoring of aflatoxin level in commodities. It will be scaled up to other countries in subsequent years.

Provisional budget

Item	Unit cost (USD)	Number (countries)	Total cost (USD)
VICAM* technology procurement	25,000	5	125,000
Other supplies and operations	75,000	5	375,000
TOTAL			**500,000**

*one or two other VICAM equipment may be added per country in the subsequent year.

References

Association of Official Analytical Chemists (AOAC), 1995. In: Cunniff, P.A. (Ed.), Official Methods of Analysis of AOAC International, 16th edn. AOAC International, Arlington, Virginia, USA. 1899 pp.

Vicam Science Technology, 1999. AflaTestTM Instructions Manual. VICAM, Watertown. 39 pp.

PART VI. Timeline of activities

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Finalize and share workshop report													
Confirm initial hosting of PACA online data management on the ARIS II, AU-IBAR website													
PACA Secretariat to meet with AU-IBAR to finalize and formalize the hosting of the aflatoxin module on AU-IBAR website as well as develop a detailed mock module													
Develop criteria for selecting pilot countries to launch ARIS II in 2014 and successive years (in close collaboration with RECs													
Inception workshop for pilot countries to finalize methodology and launch the implementation process of AfricaAIMS													
Finalization of aflatoxin module													
In country training of focal persons on the													

AfricaAIMS in 5 African countries (pilot countries for 2014)													
First data input from countries on the AfricaAIMs													

Part VII. ANNEX

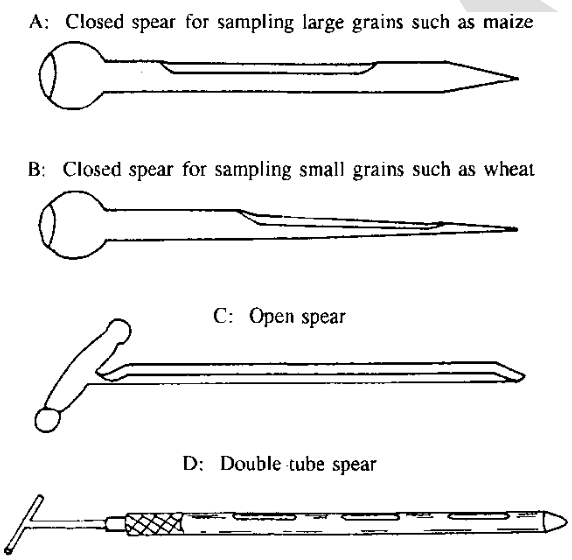
Annex 1: List of supplies and reagents for VICAM, aflatoxin analysis and sampling materials

Catalogue number	Description
G8002	AflaTest Basic Equipment Package 220 V
12022	AflaTest Columns (50 per box)
G2007	0.22 mm Nylon Membrane Syringe Filters (50 per pack)
G4033	Micro-pipettor, 1 mL
G8000	Series-4EX Fluorometer™
20050	Graduated Cylinder, 50 mL
20100	Digital Scale with AC Adapter
20200	Commercial Blender with Stainless Steel Container
20250	Graduated Cylinder, 250 mL
20300	Glass Blender Jar
20501	500 mL Bottle Dispenser for Methanol (0-3 mL range)
20600	50 mL Bottle Dispenser for Developer (0-3 mL range)
20652	Disposable Plastic Pipets, 1 mL (50 per pack)
20656	Micro-pipette Tips for 1mLMicro-pipettor (100)
20700	Wash Bottle, 500 mL
21010	Cuvette Rack
21020	Multiple Position Pump Stand
23040	Vortex Mixer
31240	VICAM Fluted Filter Paper, 24 cm (100)
31955	Microfiber Filters, 1.5 µm, 11 cm (100)
31967	Kim Wipes
32010	AflaTest Developer (50 mL)
33020	Mycotoxin Calibration Standards
33501	Tween 20 (50 mL)
34000	Disposable Cuvettes (250 per pack)
35016	Methanol, HPLC Grade (4 x 4 L)
36010	Disposable Plastic Beakers (25 per pack)
36020	Filter Funnel, 65 mm (10 per pack)
36022	Filter Funnel, 105 mm (4 per pack)
	Thermal printer paper rolls
	Vacuum pump
	Methanol
	Ethanol
	10 mL Syringe (without rubber Syringes)

PP falcon tubes conical 14 ml
PP falcon tubes conical tubes 50 ml
Gloves (small)
Gloves (medium)
Gloves (large)
3M N95 8511 respirators
Shaker (preferably refrigerated) for aflatoxin extraction

Sampling items

- Brown paper bags
- Probes
- GPS
- Potable moisture meter



Example of sampling probes. For the purpose of this study A and D will be recommended.

Example of GPS

Example of moisture meter