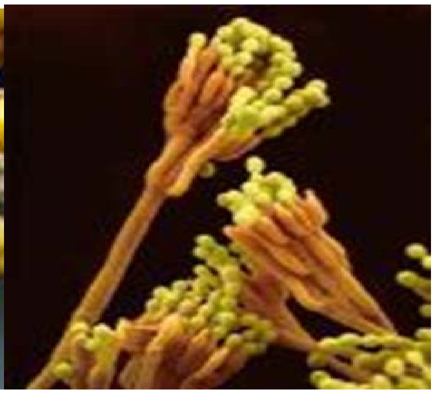
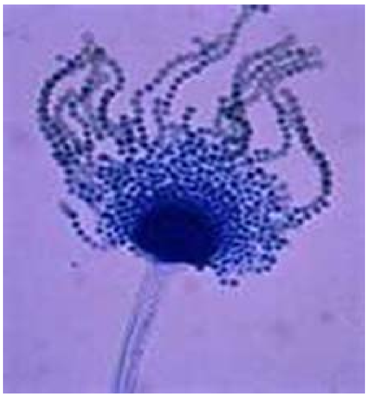
REPORT OF A WORKSHOP ON "PREVENTION AND CONTROL OF AFLATOXIN CONTAMINATION ALONG THE MAIZE VALUE CHAIN"

Organized by FAO and the University of Nairobi

NAIROBI, KENYA, from 28TH TO 30TH SEPTEMBER 2011.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Aflatoxins are secondary metabolites formed by the fungi *Aspergillus flavus* and *parasiticus* during growth under favorable conditions (particularly those related to moisture and temperature). Aflatoxins are known carcinogens causing adenocarcinomas of the liver, which is exacerbated by concurrent Hepatitis B infection. They are also known to be antinutritional, mutagegenic, teratogenic and immuno suppressants. The major toxins are grouped as Aflatoxin B1, B2, G1 and G2 and of these Aflatoxin B1 is the most toxic. Aflatoxin M1 is a breakdown product of Aflatoxin B1 and is excreted in the urine and milk of exposed humans and animals.

Aflatoxin contamination of maize consumed and/or marketed in Kenya is a recurrent problem. In 1961, about 16,000 turkeys died due to consumption of aflatoxin contaminated groundnut feeds. Other outbreaks affecting animals and humans have occurred since, with the 2004 and 2005 outbreaks having the highest morbidity (406 affected) and mortality (157 dead) among the human population. In 2010, 2.3 million bags of maize grown in the Eastern and Coastal regions of Kenya were declared by the Ministry of Public Health and Sanitation as being unfit for human consumption due to high levels of aflatoxin contamination. Previous outbreaks have also shown that high levels of contaminations were commonly found in highly food insecure areas. Therefore the two issues (food safety and food security) are correlated in more than one dimension.

Solutions to mitigate the impact or prevent the contamination exist; but they need to be evaluated with a holistic approach and be tested for their acceptance by stakeholders and agreed upon to get buy-in, and in some cases, tested to provide science based evidence of their effectiveness in controlling aflatoxin. This workshop therefore brought together the key stakeholders of the maize value chain to:

a) Discuss the chain approach
b) Agree on common shared actions needed at various segments and policy support mechanisms for controlling aflatoxin.

The workshop adopted the process of plenary paper presentations that informed the participants on the situation in regard to aflatoxin and breakout sessions along the maize value chain segments to discuss how the segment could mitigate the aflatoxin accumulation.

The recommendations agreed upon from the breakout sessions on how to mitigate aflatoxin were derived after discussion with all the various stake holders in the chain. These included:

i) Need to create aflatoxin awareness with all stakeholders, including the general community. The messages should be appropriate to the targeted audience and contain practical prevention advice;

ii) Need to develop a formal maize strategy which addresses the aflatoxin (and other relevant mycotoxin) food safety factors, including prevention and control at all steps of the value chain;

ii) An authoritative coordination mechanism is urgently needed. The National Food Safety Coordinating Committee exists, but needs strengthening and a legal mandate;

iii) Seed developers and the responsible regulatory agency should encourage breeding programmes that promotes germplasm which decrease the susceptibility of the crop to factors which lead to fungal infestation;

iv) A Code of Practice for prevention of aflatoxin contamination should be developed for pre and post harvest stages of the maize value chain;

v) Capacity development should be provided to farmers and their professional associations to enable self development and self regulation on managing aflatoxin problems, including the adoption of practical Good Agricultural Practices (GAPs);

vi) Options need to be explored to enable effective community aflatoxin management, for example, community drying and storage facilities.

vii) Environmental sentinel surveillance systems should be established that will provide timely prediction of the escalating risk of aflatoxin contamination, so that timely management practices can be activated;

viii) Adequate database systems need to be established for aflatoxin management in Kenya which include integrated information to describe the status of the problem (animal and human cases, laboratory results and applicable environmental data);

ix) Systems for compliance need to be developed to ensure only aflatoxin safe food is marketed. An effective system will be one that combines supportive activities for compliance (training and support), with adequate compliance monitoring and sanctions when necessary;

x) There needs to be further exploration on the safe use of contaminated maize;

xi) It should be recognized that good food traceability systems will enable mycotoxin problems to be quickly identified and appropriate mitigation steps taken.

ACRONYMS

ACDI/VOCA	Agricultural Cooperative Development Initiative
BECA	Biosciences in Eastern and Central Africa
CAARECA	Capacity and action for aflatoxin reduction in Eastern Africa
CIDA	Canadian International Development Agency
CIYMMT	International Maize and Wheat Improvement Center
DDSR	Disaster Safety Response
DFSQC	District Food Safety Quality Committee
EACS	East African Community Standards
EAGC	Eastern African Grain Council
EAC	East African Community
ELISA	Enzyme Linked Immunosorbent Assay
ERS	Economic Recovery Strategy
FAO	Food and Agricultural Organization of United Nations
GDP	Gross Domestic Product
GIZ/GTZ	German International Cooperation
GOK	Government of Kenya
Ha	Hectare
FFFs	Farmer field schools
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
KARI	Kenya Agricultural Research Organization
KEBS	Kenya Bureau of Standard
KEPHIS	Kenya Plant Health Inspectorate Services
KSC	Kenya Seed Company
KS-EAS	Kenya Standard-East African Standard
MoA	Ministry of Agriculture
MOHS	Ministry of Health and Sanitation
NALEP	National Agricultural Extension Programme
NCPB	National Cereals and Produce Board
NGO's	Non-Governmental Organizations
NMK	Njaa Marufuku Kenya
NPHL	National Public Health Laboratories
PRSP	Poverty Reduction Strategy Paper
SRA	Strategy for Revitalizing Agriculture
UON	University of Nairobi
US$	United States Dollars
USAID	United States Agency for International Development
WFP	World Food programme
WHO	World Health Organization
WRS	Warehouse Receipt System

1.0 INTRODUCTION AND AIM OF THE WORKSHOP

Aflatoxins are secondary metabolites formed by the fungi *Aspergillus flavus* and *parasiticus* during growth under favorable conditions (particularly those related to moisture and temperature). Aflatoxins are known carcinogens causing adenocarcinomas of the liver, which is exacerbated by concurrent Hepatitis B infection. They are also known to be anti-nutritional, mutagenic, teratogenic and immunosuppressants. The major toxics are grouped as Aflatoxin B1, B2, G1 and G2 and of these Aflatoxin B1 is the most toxic. Aflatoxin M1 is a breakdown product of Aflatoxin B1 and is excreted in the urine and milk of exposed humans and animals

Aflatoxin contamination of maize consumed and or marketed in Kenyan is a recurrent problem. In 1961, about 16,000 turkeys died due to consumption of aflatoxin contaminated groundnut feeds. Other outbreaks affecting animals and humans have occurred since, with the 2004 and 2005 outbreaks having the highest morbidity (406 affected) and mortality (157 dead) among human population. In 2010, 2.3 million bags of maize grown in the Eastern and Coastal regions of Kenya were declared by the Ministry of Public Health and Sanitation as being unfit for human consumption due to high levels of aflatoxin contamination. Maize is the staple food of many Kenyans (98kg/capita/year). In this context, when maize is contaminated with aflatoxins and declared unfit for human consumption, this is not only a food safety issue, but it raises food security concerns for the country. Previous out breaks have also shown that high levels of contaminations were commonly found in highly food insecure areas. Therefore the two issues (food safety and food security) are correlated in more than one dimension.

In Kenya, until now, control of aflatoxin contamination of maize has relied mainly on testing maize at marketing outlets and withdrawing the contaminated lots. In 2010 the Government tried to mop out the contaminated maze by purchasing the maize from farmers at reduced prizes, a move that was not very successful and came at a high cost. As mycotoxins are ubiquitous contaminants the internationally recommended approach is based on contamination prevention, rather than letting it happen and then trying to remove the contaminated maize from the market. It is now commonly agreed that this requires an all-encompassing chain approach, combining contamination reduction strategies at each step of the chain and implemented coherently by the different stakeholders.

In fact, in Kenya, the specific maize value chain is complex and involves many stakeholders, including the seed developing and marketing companies, research institutions, farmers, traders assemblers, wholesalers, retailers, and dis-assemblers, posho millers and large scale millers) and consumers. At certain times of maize shortages the maize importing companies also become key players in the value chain. From the public sector side the Ministries of Agriculture, Health, Trade and others are also involved due to their role in supporting production, marketing along with their and control and monitoring functions.

When a sector has many players like the maize value chain, a fragmented approach to the control of aflatoxin is not effective because gains made in certain sectors can be lost if other segments do not participate in applying the mitigation measures appropriate to their segments. A coordinated approach to the value chain, based on shared awareness of the issues, with each sector equipped with the appropriate mitigation measures would reap grater benefits for all.

Solutions to mitigate the impact or prevent the contamination do exist, but they need to be evaluated with a holistic approach (e.g. some may have a "perverse" effect on the long run, like a policy to buy contaminated maize could have a dissuasive effect to producers applying GAPs specifically aiming at reducing contamination; or some very technical solutions at one step could have consequences on other segments of the chain). Therefore, solutions need to be tested for stakeholder acceptance, for example, would farmers agree to change method or use new equipment?

In addition, as the aflatoxin contamination is largely known in the public arena and has a clear political dimension, there are already a number of important projects and initiatives supported by donors and technical and financial partners currently occurring in Kenya, complemented by Kenyan research. The issue here is an adequate sharing of new information and research data generated with the wider stakeholder community so that concrete benefits can be gained, either at individual or common level.

Therefore, technical solutions at each segment of the value chain need to be debated and agreed upon by stakeholders to get buy-in, and in some cases tested to provide science based evidence of their effectiveness in controlling aflatoxin. This workshop was therefore aiming at bringing together key actors of the maize value chain, to discuss the chain approach, agree on common shared actions need at various segments and policy support mechanisms for controlling aflatoxin.

The key aim of the workshop was to bring a participatory involvement of all stakeholders along the maize value chain to debate, suggest and agree on appropriate targeted mitigations at every segment of the value chain that would result in reduction of aflatoxin contamination of maize in Kenya.

2.0 SUMMARY OF PRESENTATIONS

2.1 Situation analysis report: aflatoxin control to improve food safety along the maize value chain - Prof. Erastus Kang'ethe, University of Nairobi

Maize is a significant food source in Kenya and more than 75% of the local production is provided by small farmers. Unfortunately there is not enough production to satisfy and maize has to be imported. The maize prices have also been increasing in recent years. Projections show that this shortfall will only increase in the future.

The government has a range of initiatives designed to increase maize production levels, but there is not the same amount of effort being given to manage production and trading conditions or establish large storage facilities.

Mycotoxins have been an identified food safety problem since 1984. To date pesticides have not been considered a maize food safety problem but it is possible that this topic has not been well investigated.

A number of seed companies operate in Kenya and they have produced a range of different seed types suitable for the diverse ecological zones in the country. Seed selection is currently done on the basis of potential productivity. To mitigate aflatoxin seed developing companies would also need to consider pest resistance, disease and drought tolerance, husk cover and flintiness of the grain.

The FAO/UoK investigations find that farmers are not aware of the food safety issues associated with mycotoxins. They are also not aware of the harvest, drying and storage techniques necessary to prevent mycotoxin growth.

There are a number of different players involved in the post harvest marketing chain – small independent operations, posho millers, assemblers and dis-assemblers, wholesalers and retailers as well as the consumers. There is a need for capacity development and training for all of those involved in the post harvest chain.

Storage of product is also a problem, particularly for the small farmers and the householders. A warehouse marketing system is one way of controlling storage conditions and product stored in such facilities would be required to be monitored for quality and food safety factors.

There are maize grading standards (EA2:2005 and KEAS 2:2005) which set aflatoxin limits but these standards are only implemented in the formal marketing channels. Most maize in Kenya is sold through informal marketing systems.

The lead government agency is the Ministry of Agriculture, but there are other government agencies with an interest in food safety/quality issues, for example, the Ministry of Health. At present the Kenyan government has is no specific maze policy.

There are a number of aflatoxin research projects going on in Kenya, but it is important that such work look at ways of preventing aflatoxin contamination rather than just remediation of contaminated product. Consideration also needs to be given on what can be safely done with contaminated maize e.g. contaminated grain fed to cows has resulted in elevated levels in the milk supply.

There are currently a large number of Kenyan laboratories (more than 50) who are capable of undertaking aflatoxin analysis, but often they have no control over how and where the sampling is done. Another major problem is that there is no overarching organization responsible for collating the results and watching for the Kenyan aflatoxin trends.

In summary there are a number of areas that need addressing to control the aflatoxin food safety issues associated with maize. These include government initiatives, effective surveillance systems, collaboration between the many stakeholders, research (particularly related to preventative measures), adequate storage facilities and capacity development and training of the stakeholders.

2.2 Overview on main Toxigenic Fungi and Mycotoxins in maize value chain *- Prof. Sheila Okoth, University Of Nairobi*

Mycotoxins are secondary metabolites of fungi produced on a substrate on which the fungus grows. The toxins are mainly low molecular weight proteins and have generally no known use to the fungi that produce them. Mycotoxin levels can be high under proper environmental conditions such as temperature, moisture, oxygen. Amongst the mycotoxins known today, there are about different 300 and 400 mycotoxins. The most important mycotoxins in maize value chain are aflatoxins, ochratoxin A, fumonisins, trichothecenes, zearalenone and penicillium toxins in feeds. Adverse effects on human and animal health of some of the mycotoxins have been proven.

The Aspergillus toxins in maize include aflatoxin B1, B2 (*A. flavus*); aflatoxin B1, B2, G1, G2(*A. parasiticus*) and aflatoxin B1, B2, G1, G2 *(A. niger*). The Penicillium toxins in maize occur mainly during storage and when harvest is delayed producing penicillic acid and ochratoxin (also *Aspergillus ochraceous*). The fusarium species is capable of producing two or more toxins and the major toxins in maize are fumonisins, trichothecenes and zearalenone. Trichothecenes are responsible for wide range of toxicity in animals, including feed refusal, weight loss and vomiting.

The fungi can produce mycotoxins while maize is in the field, during processing, transportation and storage. The optimal temperatures and water activity (aw) for the growth of *A. flavus* and *A. parasiticus* is 35–37°C (range 6–54°C) and 0.95 Aa_w (range 0.78–1.0) respectively. Aflatoxin production is between 28–33°C and 0.90–0.95A_w (0.83–0.97) respectively. The optimal temperatures and water activity (aw) for the growth of *Fusarium verticilloides* growth is 2 – 35 ^oC and 0.80 Aw respectively while for the fumonisins production the minimum temperature range is10 - 12^oC and 0.80 water activity. The optimal temperatures and water activity (aw) for the growth of *Penicillium verrucosum* is -5 (range 0 – 35 ^oC) respectively while for the Ochratoxin A production, it is 0 – 31 ^oC and 0.80 respectively.

Some of the procedures for mycotoxin reduction in maize with reference to fungi include reduction of insect infestation; application of fertilizer to reduce plant stress; irrigation to reduce drought stress; planting of resistant varieties; adoption of varieties with hard testa and closed drooping cobs; awareness of planting dates to avoid expected drought periods; and crop rotation. Early and accurate identification leads to prevention and control of toxin contamination.

2.3 Prevalence of aflatoxin along the maize value chain in Kenya - Mr George Mahuku & Henry Sila Nzioki, KARI

Acute aflatoxicosis outbreaks in Kenya were first documented in 1981. Recent outbreaks have occurred in Makueni and Kitui (2004-2006) where 447 cases and 181 deaths were reported resulting to a case fatality of 40%. The factors affecting aflatoxin contamination of maize include biological factors (susceptible crop, compatible toxigenic fungi), environmental factors (temperature, moisture availability, mechanical injury, and insect / bird damage), harvesting (crop maturity, temperature, moisture, and handling), storage (structure, conditions, moisture, and temperature), handling and processing. KARI has been collaborating with a project funded by Bill and Melinda Gates Foundation (Aflacontrol project) with collaborative efforts of ACD/VOCA, CIMMYT and IFPRI. The main aim of projects undertaken by KARI are to understand the incidence and prevalence of aflatoxin along the maize value chain in selected study areas, and to identify critical points where intervention technologies are mostly likely to be more effective. The study areas include South Western (transect from Kisii to Homa Bay – high to low elevations), Upper Eastern (transect from Embu to Mbeere - high to low lands), and Lower Eastern (transect that includes Machakos and Makueni districts).

The samples for analysis were collected pre-harvest (crop standing in field), in handling and processing for storage, from farmer stores (every month) and in local markets and vendors (every month). The incidence of aflatoxin in farmer stores in 2009 was higher (% samples >10 ppb) in Upper eastern especially in the 2nd month of postharvest when compared to the other study regions. In 2010, the incidence of aflatoxin in the farmer fields and stores was the same (<10 µg/kg and >10 µg/kg) for all the study regions. However, the market samples had higher levels >10 µg/kg of aflatoxin in Upper and Lower Eastern than South Western region which had more samples with <10 µg/kg.

The project so far concludes that the occurrence of aflatoxins in maize is a complex series of interaction between Genetic x Environment x Pathogen x Farmers practices. This complexity poses difficulties in achieving control. The awareness among stakeholders is low. There is need for training in good pre-harvest, harvest and post-harvest handling. A sustainable aflatoxin management will therefore require an integrated approach which combines resistance and management; promote preharvest resistance and detoxification of contaminated maize.

2.4 Rapid screening and food monitoring of aflatoxin in maize, Eastern Kenya - Abigael Awuor CDC-Nairobi

A pilot project, with the objective of improving public health, was designed and trialled to evaluate an effective food monitoring system for aflatoxins. This project was undertaken in randomly selected villages and households in Makueni, Kitui, Kibwezi and Mutomo Districts, with a total of 421 households surveyed between April and May, 2006 (outbreak year) and 2007 (non-outbreak year).

Samples of maize were collected after harvesting and first screened using a visual inspection at the household level. Then the maize was tested using a rapid screening tool (Romer Agra Strip®). In addition, confirmatory testing was done in Nairobi with immunoaffinity fluorometry and Gold standards applied.

Results were reported to the households and replacements initiated in the case of a high aflatoxin content. Samples (> 5 bags) were sent to the National Public Health Laboratory (NPHL) for confirmatory testing. The results were also reported to the District Food Safety Quality Committee for surveillance.

The rapid screening performance indicated that it had 90% sensitivity and 96% specificity as compared to the visual inspection which had 29% sensitivity and 81% specificity.

A cost effectiveness study was carried with the objective of determining if using a portable and rapid field screening tool is cost effective when compared to the current method of visual inspections. The cost of this strategy for 76 cases per thousand is $ 69.99. The second strategy (AGRASTRIP I) involved use of rapid screening followed by replacement and laboratory confirmation of contaminated maize. This strategy would cost $ 13.34 for 14 cases per thousand. The third strategy (AGRSTRIP II), this involved a rapid screening followed by replacement, laboratory confirmation of maize found NOT to be contaminated and replacement of false negatives which would cost $ 12.14 for 12 cases per thousand. The AGRASTIP I and II were therefore, more effective and cheaper to use. The costs included those incurred by the Government in administering screening, medical expenses of households, decreased production, and cost of CDC and DDSR District Disaster Security Response.

This study has shown that the implementation of the system is feasible according to the results obtained from the 240 households and 242 maize samples collected in the study regions. The system has a 77% sensitivity which is higher than the 27% sensitivity reported for visual inspections due to delayed reading of the test results.

The challenges of implementing this system included the cost or funding (each test kit is US $ 5) and building a monitoring and surveillance system. The recommendations from CDC were to introduce a data management refresher course, give additional training to the Ministry of Public health and Sanitation staff, incorporate maize screening into the official staff duties in the aflatoxin prone belt and integrating new community strategies for sustainability with a proper maize replacement coordination system.

2.5 Surveys to Screening: Maize mycotoxin surveys and the capacity and action for aflatoxin reduction in Eastern Africa Project - Jagger Harvey, BecA Hub at ILRI

A survey was conducted in Eastern and Western Kenya which collected samples from posho mill users in 2009-2010. The samples were analysed for aflatoxin to determine the scope of mycotoxin contamination in Kenyan smallholder maize farmer. The objective was also to find out whether Western Kenya was the source of aflatoxin contaminated grains that cause aflatoxicosis in Eastern Kenya. Mycotoxin measurements at BecA Hub were done using a Helica MycoMonitor, Total Aflatoxin Assay, a solid phase direct competitive enzyme immunoassay with a detection limit of 1 part per billion (ppb) and Vicam aflatest (fluorometer/monoclonal antibody based affinity chromatography; 0.1300 ppb aflatoxin measurement). The results of the study indicated that aflatoxins and fumonisins are present above accepted limits in both Eastern and Western Kenya. Other analyses are underway including AEZ influence, varietal effects and storage conditions.

The Capacity and Action for Aflatoxin Reduction in Eastern Africa project is funded by AusAID as part of the BecA-CSIRO partnership (Flagship project). The project is led by BecA Hub at ILRI and includes a range of partners from Kenya, Tanzania, Australia and USA. CAAREA objectives include establishing mycotoxin diagnostics platform at BecA-ILRI, characterizing *Aspergillus flavus* from around Kenya and Tanzania (maize and soil), sourcing inoculums, resolving key population biology/patho-system questions, test modelling as potential predictive tools and contextualizing findings across Kenya, Tanzania and the region, identifying maize germplasm resistant to aflatoxin accumulation in specific environments (field trials and postharvest experiments), including GxE(xM); and providing information to guide their future breeding efforts to Kenyan and Tanzanian national breeders.

Among the mycotoxin diagnostics platform at BecA, the technologies include UHPLC, ELISA, Immunocapture-fluorometry and other technologies under development are FT-NIR and electronic nose.

The objectives of the *Aspergillus flavus* survey are to characterize population dynamics in soils and maize and determine relation to maize contamination by aflatoxins across AEZs/regions. CAAREA's current work on fungal isolation and characterization involves isolation of *Aspergillus flavus* for inoculation of maize at Kiboko, isolation from Kiboko maize samples, morphological and molecular identification, toxigenicity check (in vitro and on maize flour), determination of predominant isolate, SSR genotyping, and determination of strains, S and L strains. Other activities include field trial design and preparations, training panel for NIR, and BecA Hub laboratory modification.

The supporters of this project included NEPAD/AU, Canadian International Development Agency (CIDA), Syngenta Foundation for Sustainable Agriculture, AusAID/CSIRO, Google Foundation, Rockefeller Foundation, Gatsby Charitable Foundation, Doyle Foundation, and The Kenyan Government.

2.6 Prevention and control of aflatoxin contamination of the maize value chain in Kenya: Introducing working groups discussions - Catherine Bessy, FAO Rome

The purpose of this presentation was to summarize the main findings presented so far in the workshop, and in particular highlighted in the value chain report prepared by FAO and UoN and link them to the work expected form the different stakeholders groups.

It was therefore recalled that:

- Aflatoxin contamination of maize is a crucial food safety and food security issue in Kenya. Extrapolations for risk assessment studies have estimated that about 5 to 28% of liver cancers worldwide are due to aflatoxin contamination of food.

- In case of maize contamination, decontamination is the only option available for use of the contaminated maize, but the derived products are of limited use (and not for human consumption). Other alternative uses of contaminated maize such as in animal feed and biofuel are yet to be developed and framed in Kenya. Consequently, prevention is a major way forward.

- As in any chain, the maize value chain, when viewed from a food safety point, is weak as its weakest link. There is need for strong a multifaceted and coordinated approach if all segments need to move forward towards prevention.

Practical steps to be implemented by the value chain stakeholders include:

- Implementation of GAPs from planting to harvesting to ensure a robust and healthy crop to avoid its infestation by fungus. This involves for example, selection of appropriate variety, timing of planting, crop rotations, cleaning of soil, management of plant nutrition, weeds, irrigation and harvesting at appropriate time (when maturity fully reached). However, it is not always easy to put these recommendations into practice (e.g. timing of rains/time of harvesting, access to proper varieties (yield/resistance to fungal infestation). This requires a multifactorial decision making process from farmers (including costs considerations), which are all required information to make informed decisions.

- The prevention of aflatoxin contamination of maize should consider measures from harvest storage such as (but not limited to) control of moisture content, prevention of condensation prevention of attacks of the grain by insects. Therefore the importance of drying technique (and capacity for moisture content measurements); availability of mobile dryers, appropriate shelling technologies which can reduce damage to the grain (and related access to equipment); and sorting practices.

- During storage, the prevention measures should consider management of humidity and insect infestation; household storage is frequently a serious issue (including the type of material of equipment used: polypropylene/sisal bags, metal silos). Assets could be the availability of common storage facilities and warehousing receipt system adaption for small holders.

The prevention strategies should also take into consideration other value chain stakeholder such as traders (assemblers, wholesalers, disassemblers, retailers), and processors (small scale Posho millers, medium/big milling companies, and domestic processing). They would be mainly concerned with implementation of good storage management practices and quality control policy.

The use of traditional preparation methods (wet processing) has shown in some research experiments to also have a great impact on decreasing the contamination of aflatoxins.

But there are also stakeholders with "indirect effects" on the value chain (who do not handle the product directly). These include: inputs and seeds suppliers, service suppliers (analytical laboratories), and institutional players like NCPB, extension and research services, policy makers (import policies, food security policies) and food safety regulatory agencies.. The testing methods are important but need to be properly used since it is a tool not a solution. There is need to identify which analytical techniques are suitable for which use. The official sampling protocols for mycotoxins seem to be difficult to implement with the field staff. In addition, the alternative use of the rejected maize should be appropriately addressed to avoid food security concerns.

Coordination between the different stakeholders in the maize value chain is needed at various levels such as:

- Private/public sector
- Regulatory agencies (agriculture-health-trade)
- Strengthening of NFSCC, regulators and support services (extension).

There is also need to strengthen and systematise the GAPs since the base information already exists. These good practices need to be very carefully adapted to the context, then when tested, feasible and efficient, need to be translated into national guidelines. The notion of food safety management system needs to be introduced since some steps are crucial and need specific monitoring. In addition, the national authorities need to combine regulatory approaches (ex standard setting and control programmes) with non-regulatory approaches (training programmes) and with appropriate incentives.

The establishment of food safety measures needs a legal basis, otherwise no enforcement is possible. The rules have to be followed by operators and procedures to assess compliance and penalties for non-compliance have to be put into place. The decisional process for determining food safety measures should consider existing value chain practices, feasibility and cost of application, weight versus other options. Food safety measures cannot be implemented without full buy-in from operators in the maize value chain. Codes of Practice for the reduction of contamination should be applied throughout the production and processing stages while the risk management options for mycotoxin control should address the maximum levels and accompanying sampling plans applied to end product.

In conclusion, it was mentioned that a lot is already known and can be done to prevent and control aflatoxin contamination in maize. But there is need for specific adaptation to the local context which requires each link in the chain to be aware of its responsibilities, know what it shall do and fully accepts it, ensures mutual support of value chain actors and agreement on the same. The workshop was therefore designed with a view to ensure appropriate co-operation amongst the stakeholders within the different segments and on what needs to be done to move forward.

3.0 WORK OUT SESSIONS AND DISCUSSIONS

The participants were divided according to the segment of the value chain they represented, namely:

i) Seed companies
ii) KEPHIS
iii) Research and Development (KARI, CIMMYT, IITA)
iv) Distributors and Stockists.
v) Farmers

It should be noted that although other sectors were invited to the workshop, the workshop was lacking wide representation from the food and feed millers, grain handlers' and retailers' and consumer organizations.

Those groups formed were given guidelines questions relevant to the segment to discuss, then they reported back to the plenary session and answered further questions from the other groups. (See Annex for a summary of these activities.

4.0 RECOMMENDATIONS OF THE WORKSHOP ON "PREVENTION AND CONTROL OF AFLATOXIN CONTAMINATION OF THE MAIZE VALUE CHAIN"

4.1 Recommendations targeting general awareness rising of the different value chain members

Recommendation A: Creating global awareness of the aflatoxin issue in the maize value is strongly needed. Awareness messages should have a specific content adapted to the different categories of stakeholders, from the farmers to the consumers. The messages should be formulated in a way that they do not create a global panic but, while informing the stakeholders about the importance for their health the message conveys practical advice for action. The vehicles and processes should be appropriate for the audience targeted.

Lead - Public-Private Partnership and consumer organizations.

4.2 Recommendations targeting policy interventions

Recommendation B: A maize strategy should be prepared, addressing aflatoxin prevention and control at all steps of the value chain, taking into consideration that other mycotoxins are likely to be potential contaminants of maize, this strategy could address mycotoxins management in maize rather than limiting itself to aflatoxins.

Lead- MoA and MoPH&S

Recommendation C: An authoritative coordination mechanism is urgently needed. In this regard it has been noted that the National Food Safety Coordinating Committee exists but needs strengthening, including a legal existence.

Lead organization – MoA, MoPH&S

Recommendation D: A powerful incentive for compliance of the private sector operators is needed through a real market for safe food. This is likely to be achieved through awareness raising programmes (see recommendation A). This should be accompanied by rigourous and risk based regulatory activities checking for compliance and sanctions for non-compliance. But it must also be clear that these regulatory activities should be articulated with supporting activities to enable compliance (training, information, and support to professional associations).

Lead - MoA, MoPH&S and Private-Public-Partnerships

Recommendation E: Seed developers and the responsible regulatory agency should encourage breeding programmes that promotes germplasm which decrease the susceptibility of the crop to factors which lead to fungal infestation.

Lead organization – STAK and KEPHIS

Recommendation F: The development and strengthening of Farmer and Professional Associations (targeting all categories of the value chain operators) should be strongly encouraged to offer the members a coordinated voice, be focal points in training programmes for their members and allow self regulation.

Lead organizations - MoA, MoCD

Recommendation G: Farmer associations and Government need to find mechanisms to ensure farmers have access to equipment and supplies necessary to prevent fungal infestation (e.g. tarpaulins, suitable bags, driers) at a reasonable cost. These mechanisms may be very different depending on the equipment considered, but should take into consideration the possibilities of small business development at local level (e.g. local production of simple equipment for shelling, silos; provision of drying services) and encourage, when appropriate, community approaches (e.g. community storage banks).

Lead organizations – MoA and professional Associations

Recommendation H: Global information on aflatoxin data (when appropriate, from sample testing and research programmes) should be shared in order to inform on interventions and policy

Lead organization – NFSCC

4.3 Recommendations targeting specific regulatory interventions

Recommendation I: A code of practice for prevention of aflatoxin contamination should be developed for pre and post harvest stages of the maize value chain.

Lead organization – MoA and MoPH&S and Private-Public-Partnerships

Recommendation J: Monitoring and surveillance programmes should be set up, aiming at gathering data allowing to better target prevention measures. It is recommended that consideration not only be given to the measurement of aflatoxins levels, but also proxy indicators of potential aflatoxin contamination. The latter could include but not be limited to, moisture content, rainfall patterns, temperature.

Lead: NFSCC

Recommendation K: The regulations concerning aflatoxin contamination of maize and maize products should be updated, and where they do not exist be developed in consultation with all value chain partners taking into account recent data on aflatoxin. The same approach applies to other mycotoxins potentially contamination the maize value chain.

Lead organizations- MoA, MoLD, MoPH&S, NFSCC

Recommendation L: Contaminated maize should be disposed of, using appropriate methods and as per regulations. There could be a need for revising the current regulations.

Lead MoA, MoPH&S

4.4 Recommendations targeting improved technical capacities of the value chain members

Recommendation M: Farmer capacity development needs to be practical in order to adopt and adapt Good Agricultural Practices (GAPs). A number of vehicles to do this exist. These include use of farmer organizations, NGOs, other professional organizations, extension services within ministries and farmer field schools.

Lead organization- MoA and Farmers Organizations

Recommendation N: Effort should be made for the seed developer's information to reaches farmers efficiently, providing them with information on specific GAPs on the selected varieties for the various ecological zones

Lead organization – STAK

Recommendation O: Training on the principles of the Code of Practice and their application should be participatory, timely, and practical and target all farmers and operators of value chain.

Lead organization – MoA, MoPH&S, STAK

Recommendation P: Information should be made available for professional services offered in relation with aflatoxin management (e.g analytical testing, pest control programmes, supply of appropriate technical and sanitation equipment, field testing equipment).

Lead organization – NFSCC

Recommendation Q: A traceability system in the maize value chain should be urgently developed, allowing also a better use of monitoring data for prevention purposes and targeted support to those actors of the value chain that would have most difficulties to comply with the code of practice.

Lead organization – MoA and Professional Associations

ANNEX 1. OPENING SESSION REMARKS

1.1 Welcoming Remarks by Prof. Agnes W. Mwang'ombe- Principal CAVS

The Principal stressed the fact that the college of Agriculture and Veterinary Sciences (CAVS) deals with crops and animals which are all affected by Aflatoxin. The most known effects are the contamination of maize and subsequent affects on humans. However, the little talked about is the effects on livestock which include reduced food conversion efficiency, reduced milk production by about 33%.,and low reproduction efficiency due to irregular estrus cycles . She noted that aflatoxin being non tariff barriers it can be used by our trading partners to deny Kenyan milk to lucrative markets. She stressed therefore the need to bring the aflatoxin menance under control.

1.2 Remarks by FAO Country Representative – Dan Rubangira

A) Introducing points: why is maize contamination by Aflatoxin such an issue for FAO in Kenya?

- Maize is one of the most important commodity in the diet of Kenyan population today (98kg/capita/year)
- Aflatoxins are metabolites elaborated by moulds, namely *Aspergillus flavus* and *parasiticus* during growth under favorable conditions (including moisture and temperature). Aflatoxins are known carcinogens causing adenocarcinomas of the liver, which is excerbated by concurrent Hepatitis B infection. They are also known to be antinutritional, mutagegenic, teratogenic and immnunosuppressants.
- Aflatoxin contamination of maize consumed and or marketed in Kenya is a recurrent problem. Outbreaks affecting animals and humans have been recorded since the 1960es, with the 2004 and 2005 outbreaks having the highest morbidity (406 affected) and mortality (157 dead) among human population.
- More recently, in 2010, 2.3 million bags of maize grown in the Eastern and Coast regions of Kenya were declared by the Ministry of Public Health and Sanitation as being unfit for human consumption due to high levels of aflatoxin contamination.
- Maize being the staple food of many Kenyans, when contaminated with aflatoxins and declared unfit for human consumption, this is not only a food safety issue, but it raises food security concerns for the country. Previous outbreaks have also shown that high levels of contaminations were commonly found in highly food insecure areas. Therefore the two issues (food safety and food security) are strongly correlated.

B) Expanding the issue: Why is food safety such a concern worldwide at the heart of FAO's mandate?

- Food Safety remains a public health priority worldwide (developed and developing countries). WHO stats show foodborne diseases are still a leading cause of deaths and illnesses .
- FS impacts not just on public health
    - Growing importance of food safety/ quality requirement for international food trade. Increasingly stringent FS and Q requirements for accessing international markets pose substantial challenges to developing countries
    - Acceptance that safe and quality food is a basic human right, has now been translated into an important requirement for governments, food producers and processors to

follow good practice and be responsible for ensuring a safe food supply to the population

C) FAO leadership role and credibility to convene this workshop: What is FAO doing in food safety? What can we share with Kenya on the issue of aflatoxins contamination of the maize value chain?

- FAO provides independent scientific advice on food safety and nutrition which serves as the basis for international food standards (Codex)
- Develops institutional and individual capacities for food control and food safety management in many countries, including the management of food safety emergencies
- Supports processes for the development of food safety policy frameworks
- Facilitates global access to information and encourages and supports the development of food safety/ quality networks.

This is translated in a number of food safety activities and programmes, including:

- Development of policy support tools to guide planning and investment in national food control systems
- Technical advice for the development and improvement of integrated and modern food control systems
- Support to field projects addressing food safety and quality issues that have been prioritised by member countries
- Enhance effective participation in the work of the Codex Alimentarius Commission
- Development of technical tools and guides related to various technical and managerial aspects of food control

A number of projects have been recently implemented in member countries, helping them to identify strategies to reduce contamination by mycotoxins in different value chains: Ochratoxin A in the coffee, aflatoxins in pistachios, improvement of the shea nut and cashew nut value chain, to cite only the most recent ones.

- Despite all efforts made by national and international partners, a number of problems still persist in key value chains for developing countries

- What's FAO way forward?

    - Raise awareness among policy makers and decision-makers on Food Safety and Quality issues
    - Help countries in establishing an enabling legal and regulatory framework that ensure effective coordination among different players : should we adopt maximum limits for contaminants, or codes of practice aiming at reducing contamination; what types of monitoring and control measures can be applied; what strategy for testing?
    - Support concerned stakeholders at national and local levels in the application of good practices along the chain to ensure compliance with national and international food safety requirements

D) Conclusion: workshop scope and aims.

- A number of technical and financial partners national and international are currently active in Kenya, working on different aspects pertaining to aflatoxin contamination of maize: monitoring the contaminations, understanding the root causes, testing solutions to prevent or reduce contaminations by the fungus or the toxins etc...
- A number of stakeholders have a role to play in a complex value chain: in the input provisions (seeds for example), in the primary agricultural production (farmers and associations), in the following steps of the chain, namely purchase, storage, transformation and transportation, service providers (testing laboratories for example) up to consumption. But also the state authorities (policy and decision makers, technical government agencies, research institutes) with a role to play at each step of this chain, (control, surveillance, technical guidance, setting up maximum limits). And finally, the international technical and financial partners that can help investigating further on solutions or root causes.
- However, the flow of information is not always as fluid as necessary – we all tend to work into silos.
- Sustainable and efficient strategies need preliminary concertation: what is scientifically sound and technically feasible, where do the different responsibilities lie among stakeholders; what changes are they ready to adopt etc.
- This workshop is precisely about this: sharing available information, discussing roles and responsibilities about future course of action, building a common, responsible and sustainable agreement on the way forward.

1.3 Opening Remarks- Prof. G.A.O. Magoha Vice Chancellor University of Nairobi

The Vice Chancellor was represented by Prof. Jacob Kaimenyi Deputy Vice Chancellor Academic Affairs. In the Vice Chancellors speech, he stressed the importance of the workshop to come out with practical solutions to a problem that is threatening the food security of the country.

While the country is aware of the effects of acute aflatoxicosis, chronic exposure is not usually addressed despite aflatoxin is a known carcinogenic agent that causes liver adenocarcinomas, teratogenic and mutagenic agent, causes stunting in children because of its anti-nutritional properties, and an immunosuppressant which increases a person's susceptibility to diseases.

The Vice Chancellor called for close collaboration between the research community, government ministries and extension service providers in order to pass the messages to farmers and other value chain stakeholders on the strategies to control aflatoxin. He lauded the FAO efforts to bring together value chain actors to discuss and agree on appropriate strategies for the control of aflatoxin in the maize value chain.

In his off cuff remarks, the Deputy Vice Chancellor challenged the participants on whether the mitigation measures are well known by the farmers and what needs to be done to increase this awareness. Does the data available indicate which are the prone areas to aflatoxin and why are these thus vulnerable? The data from various surveys, laboratory testing and projects, how is it shared? When the workshop comes out with recommendations, who will these recommendations target? Who will ensure implementation of the recommendations and how will we know whether we have had any effect if the recommendations are implemented?

ANNEX 2: BREAKOUT SESSION GUIDES; GROUP QUESTIONS, FEEDBACK DISCUSSION AND PLENARY REACTIONS/QUESTIONS

A) Seed Companies

<u>Group Questions</u>

i) Identify the specific stakeholders within this segment of the value chain

ii) For each stakeholder, list their main activities (in relation to the maize value chain)

iii) For each activity indicate how it contributes to mitigating and or enhancing pre and post harvest infection and accumulation of aflatoxin

iv) Indicate for each what mitigations can be used to control aflatoxin build up.

v) For the dent and flint maize types, identify the characteristics you consider to contribute to post harvest aflatoxin accumulation and contamination

vi) For each characteristic identified above, indicate what measures need to be taken to reduce the risk of aflatoxin contamination and/or accumulation.eg if you feel that bear tips contribute to aflatoxin accumulation, what measures are needed in the varieties we breed.

vii) For the seed registration criterion, what changes are need in the standards to reduce the risk of aflatoxin accumulation and or contamination as a result of the seed variety (ies)

viii) What recommendations would you put forward to contribute to the prevention or control of aflatoxin along this segment of the value chain?

ix) Who should be held responsible to lead in the management and implementation of the recommendation(s) above by the stakeholders in this segment of the value chain.7

Responses from Seed Group stakeholders to the Group Questions

a) Seed companies

The main activities carried out by the seed companies include varietal development, basic seed production, processing, storage and distribution (transport and product information). The group identified the following as enhancing aflatoxin accumulation; increased susceptibility of dent types, bare tips, upright cobs, slow dry down varieties, selling varieties that are not ecologically suited, disease and insect susceptible varieties, lodging (falling) and drought stressed plants.

In addition, the group recognized that aflatoxin contamination could also arise from poor agronomic practices, diseased cobs, high moisture seed, inappropriate equipment and fungicide, rodents and insects, moist or high humidity conditions, high temperature, poor ventilation, and poor information to stockists and farmers.

The seed companies have a responsibility to follow the basic seed production, processing, storage and distribution steps (rouging, stress avoidance, thorough cob selection and sorting, drying to 12.5% moisture, avoiding kernel mechanical damage, application of systemic fungicides, regular rodent control and fumigation, proper storage conditions, use of pallets, clean vehicles that are protected against weather element) and supply farmers with the information on the right varieties for right ecology.

The recommended mitigation for the seed companies include breeding with a focus on:

- flint varieties
- good husk cover
- drooping cobs
- good standability
- fast-dry down
- disease and insect resistant
- drought tolerant varieties for the right ecological zones.
-

b) Seed grower and Transporters

Since their activities are to deal with developed varieties, it is important that they observe proper agronomic and transportation practices.

c)KEPHIS

The main activities of KEPHIS are registration, variety evaluation, certification and after sales sampling. The certification involves grower selection, crop registration, field inspection, cob selection, germination sampling for purity and post control observations. If KEPHIS abrogates this responsibility weak seed companies with untrained staff could be dealing with seed development which could lead to unsuitable varieties.

KEPHIS could help mitigate aflatoxin problem in the seed development by vetting companies to ensure only those with capacities are doing seed development, bulking and selling. Should release criteria to support low aflatoxin vulnerability (husk cover, standability, drooping, disease/insect resistance, preference for flint); ensure field hygiene and GAPs are followed by seed growers and developers; ensure quality seed at stockists; and monitoring and evaluation for growers and Inspection agency.

d)R&D (KARI, CIMMYT, IITA)

The main activities for the R&D are variety development and breeders seed maintenance. The role of these institutions in aflatoxin consists of the licensing of inappropriate varieties. The recommendations for mitigation include ensuring the right varieties for right ecology and educate farmers on good agricultural practices.

e) Distributors and stockists

The suggested mitigation steps are regular rodent control and fumigation, proper storage conditions, use of pallets, careful handling especially at loading and provision of information on right varieties for the right ecology.

B) Farmers and Farmer associations

Group Questions

i) Identify the specific stakeholders within this segment of the maize value chain

ii) For each stakeholder, list the main activities (in relation to the maize value chain)

iii) For each activity say how it contributes to mitigating and or enhancing aflatoxin accumulation and/or contamination

iv) For those activities that contribute positively to aflatoxin accumulation and or contamination, indicate what prevention or mitigation measures are needed to reduce the risk

v) What are the role(s) of the many farmer associations ,NGO etc in the fight against aflatoxin accumulation and or contamination

vi) What recommendation(s) would you suggest to contribute to the prevention or control of aflatoxin along this segment of the value chain

vii) Some of the recommendations may require farmer investments in simple technologies and time, what willingness exist among the smallholder farmer to invest in these?

viii) Is there willingness from the farmer perspective to organize in line with community cereal banks aimed at market access?

ix) Who should be held responsible to lead in the management and implementation of the recommendation(s) above by the stakeholders in this segment of the value chain?

<u>Responses from Farmers and Farmers' Association stakeholders to the Group Questions</u>

3.1 Farmers

The specific stakeholders within the segment are farmers and farmer's organisations. Other stakeholders include seed companies, financial institutions, agro dealers, machinery constructors, traders, millers, brokers and extension providers. The farmer's activities include the choice of correct varieties, farming, storage of seed, and storage of grain and providing feedback information. Mitigations for the farmers include the selection of appropriate varieties, good agronomic practice including crop rotation and appropriate storage.

The main activities of the farmers are land preparation, crop management, shelling/drying, transportation, marketing, storage and disposal of spoilt maize. Farmers can reduce aflatoxin contamination with the following steps:

a) improve timing in planting
b) ploughing in residues
c) management of weeds (whose growth causes moisture stress)
d) properly scheduled harvest time
e) avoid hitting in bags (which breaks kernels);
f) avoid chemical use (NOVA) for drying;
g) avoid drying on ground; timely drying;
h) avoid applying insecticides when maize is still hot
i) refrain from poor and unhygienic transportation
j) improving storage in market
j) avoid use of contaminated gunny bags.

The farmers' contribution to mitigating aflatoxin contamination also involves scouting to control pests, timely farm operations, hand shelling and sorting before shelling.

3.2. Farmer organizations

The main activities of these organizations are to bring farmers together, to provide services and access to inputs and market and influence policy change through advocacy and lobbying.

Their contribution to the mitigation of aflatoxin contamination of maize includes awareness creation and education of farmers, establishing self-regulatory rules for the group, providing for group storage facilities, bulking centres and regulating marketing, providing quality inspectors for the members, forming partnerships with researchers and seed companies.

C) Laboratories

Group Questions

i) Identify the stakeholders along this segment of the value chain

ii) List for each stakeholder their main activities (in relation to the maize value chain)

iii) How do the activities above contribute to control of aflatoxin

iv) What do you perceive as the role (s)of public and private laboratories in the control of aflatoxin accumulation and or contamination

v) How best can we share data on aflatoxin from our laboratories without conflicting with client confidentiality clauses.

vi) What recommendation would you suggest to be adapted for the control of aflatoxin

vii) Who should be held responsible to lead in the management and implementation of the recommendation(s) above by the stakeholders in this segment of the value chain?

Responses from Laboratory Group to Group Questions

The laboratories are in relationships with a wide range of stakeholders: hotels/tourists industry, schools and institutions (Hospitals, public health inspectors, NCPB), suppliers, millers, large scale farmers, retailers, maize grains importers and exporters, relief agencies (Red Cross, UNICEF), laboratories (CDC, local and overseas laboratories, universities), research institutions (universities, KARI, etc.), food and feed manufacturers (client of the millers), individuals consumers, and veterinary doctors and breeders (animal health companies).

The recommendations to mitigate aflatoxin include, better collaboration between public and private laboratories in mycotoxin (aflatoxin) projects; frequent use of laboratories by the regulators; availability of the list of accredited laboratories and their competences; frequent provision for testing for aflatoxin;

creation of a Kenyan proficiency testing scheme on aflatoxin; encourage self regulation and control of public and private food quality control laboratories; and conduct intensive research activities. In addition, establish a Kenyan food safety authority (KFSA).

The laboratories have challenges with client confidentiality and therefore supplying information to a central epidemiological database. It is identified that there is also no central list of laboratories were are certified by a Competent Authority to undertake all mycotoxin analysis. Such a list is required by the laboratory clients so that they can make an informed choice on which laboratory will be the most suitable for their specific needs.

D) Policy makers- National authorities

Group Questions

i) Identify the various policies and legislations that have a positive contribution towards reduction of aflatoxin accumulation and or contamination

ii) For each policy and legislation identified above, list those clauses/sections that relevant to aflatoxin control and or contamination

iii) What have been the constraints to the implementation of these clauses/sections in order to control aflatoxin accumulation and or contamination

iv) How can these clauses/sections be harnessed to control aflatoxin contamination?

v) If there are gaps in the policy and regulatory framework, what policy/legislations would you suggest to help control or mitigate the aflatoxin accumulation and or contamination?

vi) What blend of regulatory and non regulatory approaches would you recommend?

vii) What recommendations would you propose to the control of aflatoxin from the policy arena.

viii) Who should be held responsible to lead in the management and implementation of the recommendation(s) above by the stakeholders in this segment of the value chain?

Reponses from Policy Group to Group Questions

The following legislation has been set up in Kenya and have role in addressing aflatoxin: Food, Drugs and Chemical Substances Act, CAP 254; Agriculture Act, CAP 318; Agricultural Produce (Export) Act, CAP 319; Agricultural Produce Marketing Act, CAP 320; Crop Production and Livestock Act, CAP 321; Dairy Industry Act, CAP 336; Animal Diseases Act, CAP, 364; Fertilizer and Animal Foodstuffs Act, CAP 345; Meat Control Act, CAP 356; Public Health Act, CAP 242; and Standards Act, CAP 419. The national and EAC standards consists of KS-EAS2: 2005, Maize (grading); KS 168: Dry Maize Milled Products; KS 30: Kenya standard specification for pasteurized liquid milk; KS 10: Kenya standard specification for raw whole milk; KS 61: Specification for poultry; KS 62: Specification for dairy meal; KS 138: Specification for Pig feeds; and KS 674: Specification for Dog feeds.

The policies available include the Food Security and Nutrition Policy; Kenya Health Policy Framework; Agriculture Sector Development Strategy; and the Seed Policy. Despite the existence of the laws and policies, there are constraints in their implementation which include but not limited to:

- out dated laws which aren't benchmarked on contemporary requirements;
- overlapping and conflicting mandates;
- absence of a single authority to manage food safety
- lack of a legal basis for NFSCC enforcement of food safety.

In order for the policy to be alive, research is needed to inform policy in order to continually give appropriate regulations that are science based. The government should establish a programme for awareness creation not only to the farmers but also among the policy team, develop information packages relevant to certain segments of the value chain, mainstream food safety curricula in the various institutions and involve a Farmer/Commodity/Producer Organizations in dissemination of information and provide professional service.

The following suggestions were recommended for the mitigation of aflatoxin contamination of maize: There is need to pick the clauses in the various Acts and entrench these in a Code of Practice and or maize policy/strategy. The relevancy of these regulations should be checked against other international standards. The

Code of Practice should include information on monitoring and surveillance and inform on appropriate subsequent corrective actions, withdrawal/recall from the market and decontamination/ alternative use/disposal.

E) Food and Feed millers, Bulk handlers and Transporters

*There were insufficient members of this group to form a working group.

Group Questions

i) Identify the various stakeholders along this segment of the maize value chain.

ii) For each stakeholder list their activities (in relation to the maize value chain) and indicate how these contribute to aflatoxin accumulation and or contamination.

iii) For these activities ii) above indicate what actions are needed to control aflatoxin accumulation and or contamination.

iv) What recommendation (s) would you suggest to control aflatoxin accumulation and or contamination along this segment of the value chain?

vii) Who should be held responsible to lead in the management and implementation of the recommendation(s) above by the stakeholders in this segment of the value chain?

F) Consumer organizations and retailers

*There were insufficient members of this group to form a working group.

Group Questions

i) Identify stakeholders along this segment of the value chain

ii) For each stakeholder list their activities that would reduce and or enhance aflatoxin accumulation and or contamination

iii) What is the perceived role of the consumer organizations and the retailers in the advocacy and consumer awareness and demand for safer foods to reduce exposure to aflatoxin

iv) What recommendations would you propose in order to reduce exposure and demand for safe food in this segment of the value chain

v) Who should be held responsible to lead in the management and implementation of the recommendation(s) above by the stakeholders in this segment of the value chain?

ANNEX 3: LIST OF PARTICIPANTS

Participant name		Organization/affiliation
1	Francis Ndambuki	Kenya seed company
2	Kinyua M'Mbijjiwe	Monsanto Kenya Ltd.
3	Pius Ochola	Pannar Seed Company Ltd.
4	J. A.W Ochieng	KARI
5	Simon Kibet	KEPHIS
6	Dr. Evans Ikinyi	Seed Traders Association of Kenya
7	Dominic Mureithi Mathenge	Polucon Laboratory Ltd.
8	Joseph Chai	Intertek Testing Services Ltd
9	Kennedy Odhiambo	SGS, Kenya Ltd
10	Dr.G.K. Gathumbi	Bora Biotech. Ltd
11	Nancy Njiine	National Public Health laboratories
12	Isaac Mugenya	Kenya Bureau of Standards
13	Immaculate Odwori	Kenya Buraeu of Standards
14	Dale West	Unga Ltd
15	Martin Kinoti	Nutrimix Ltd
16	Manyara	Lesiolo Grain Handlers Ltd.
17	AgripinaNgui	National Cereals & Produce Board
18	Paloma Fernandes	Cereal Millers Association
19	Gerrald Makau Masila	Eastern African Grain Council
20	Lucy Mwangi	Kenya National Federation of Agricultural Producers
21	Gabriel K. Tarus	Large scale farmer
22	Gustus James Mutio	Farmer Kitui
23	Elija Mosoti	Farmer Gaitu
24	Dr.Ombacho Kepha	Chief Public Health Officer
25	Dr. Purity Nguhiu	Ministry of Livestock Development
26	P.N Nyaga	Ministry of Agriculture
27	Robert Kilonzo	Secretariat, National Food safety coordinating committee
28	Francis Karin	Tegemeo Institute
29	Edwin Wanjawa	Consumer Federation of Kenya
30	Dr. Washington Otieno	USAID
31	Ms. Zippy Mbati	WFP, Kenya Office
32	Dr. W. Otieno	UNIDO
33	Dr. Andrew Karanja	World Bank Country Representative
34	Caroline Maua	World Vision
35	Catherine Bessy	FAO, Rome
36	Dorothy Jean McCoubrey	FAO, Harare
37	Prof. Sheila Okoth	University of Nairobi
38	Prof. E.K. Kangethe	University of Nairobi
39	Dr. Catherine Kunyanga	University of Nairobi
40	Marimba	University of Nairobi
41	Edith Ndaru	University of Nairobi
42	Abigael Obura	CDC
43	Dr. Nzioki H. S	KARI

44	Dr. Harvey Jagger	BECA-ILRI
45	Bernard Mtonga	FAOSFE, Addis Ababa, Ethiopia