INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Assessment of Aflatoxin Awareness by Players in Groundnut Value Chain: The Case of Dora in Mutare, Zimbabwe

Dube Loreen
Alumni, Department of Agribusiness,
Faculty of Agriculture and Natural Resources, Africa University, Old Mutare, Zimbabwe
Mutetwa Moses
Alumni, Department of Horticulture,
Faculty of Agriculture and Natural Resources, Africa University, Old Mutare, Zimbabwe

Abstract:
Aflatoxin is a toxin mainly produced by the fungi Aspergilus flavus. It is a serious problem in agricultural trade and health issues. However documentation and awareness of its effects is not widely evident. Without any awareness and knowledge of aflatoxin, it would be difficult to mitigate against it and its economic and health impacts. Based on evidence in literature, 'molds' and 'toxin' were used in the present as a surrogates for aflatoxin since chances of its presence are higher compared to the clean healthy looking peanut. The study aimed at assessing awareness and prevalence of aflatoxin along the groundnuts value chain It further assessed the mitigation strategies used by stakeholders. The study was preliminary and thus did not do any laboratory testing. Questionnaires were personally administered to groundnut value chain actors. These included farmers in Wards 5 and 35 of Dora in Mutare, vendors, representatives in processing companies and final consumers. A total of 54 respondents were included in the sample. This was achieved through a multistage sampling approach. The study area was purposively selected due to its dominance in groundnuts production and proximity to Mutare City which offered a ready market. Stratified random sampling was then used to select 28 farmers, 10 vendors, 1 representative from a storage center, 5 AGRITEX officers, 3 retailers and 7 processors. From the study, it was found that there is generally a low level of aflatoxin awareness. It was also found that molds are prevalent in all stages of the value chain. Some actors receive already affected nuts. In some cases the nuts are affected during storage due to the type and duration of storage. Based on these findings, it can be concluded that because of the ignorance businesses and lives are at risk as people consume and use moldy groundnuts. Stakeholders do have strategies of keeping their products mold free .A significant component are also willing to adopt any new mitigation strategies against molds and aflatoxin. From the research findings, raising aflatoxin awareness through campaigns and training programs is recommended. This can be augmented with innovative affordable mitigation strategies against aflatoxins such as affordable storage facilities and anti-aflatoxin cultural methods.

Keywords: *Aflatoxin, fungi Aspergilus flavus, mold, groundnuts, value chain, health*

1. Introduction

Aflatoxins are highly toxic carcinogenic fungal metabolites produced by two main fungi of the same genome, *Aspergillus flavus* and *Aspergillus parasitecus* (Desai *et al.*, 1999). These fungi occur naturally in crops such as groundnuts, maize, and cotton seed amongst others (Amaral-Philips *et al.*, undated). Under favorable and conducive environmental conditions, these fungi proliferate and produce toxins in crops (Aboloma, 2014). The known Aflatoxins include Aflatoxin B1, B2, G1 and G2 of which Aflatoxin B1 (AFB1) is most frequently found in plant substrates, and shows the greatest toxigenic potential (Oliveria *et al.*, 2009). Aflatoxins have impacts on agricultural trade and food security. Its ingestion through food and feed stuff has lethal effects on humans and domestic animals (COMESA, 2014; Ayelew *et al.*, 2013). Some of the particular effects are immune system disruption, growth retardation in children, liver diseases/cancer (aflatocosis), and death. This toxin is found in a number of crops, but serious concern has been raised internationally on their occurrence in groundnuts (*Arachis Hypogea L.*).

Groundnuts are consumed in different forms. They can be boiled or roasted, included as an ingredient in other products as peanut butter or peanut oil, and crushed for animal feed. The crop plays an important role in the nutritional security and diets of rural population. It has high protein content (21-30 %), fat (41-52 %), carbohydrate (11-27 %), minerals such as calcium, potassium,

magnesium and Vitamins E, K and B (Kumar and Popat, 2010). Peanuts are used from a subsistence household level to a commercial level depending on different socio-economic reasons. The presence of aflatoxins in groundnuts does not only pose as a health hazard for consumers but also as an economic risk to the value chain actors who include farmers, traders and processors. The contamination affects the quantity and quality produced and marketed (N'Dede e*t al.*, 2013). It is because of the effects brought about by the presence of aflatoxins that the value chain actors who experience economic losses due to its contamination, and even the general public must be aware of it.

Aflatoxins are most prevalent in areas along latitudes 40^0N and 40^0S (Desai *et al*., 1999) Zimbabwe is amongst the mostly affected countries. Dry weather conditions near maturity, high moisture during harvest which normally takes place in Zimbabwe, are favorable for the spread of the fungi. Inadequate drying, presence of moisture during storage, and poor processing of crops are conditions favorable for the growth and contamination of these fungi and the occurrence and accumulation of aflatoxins (N'Dede *et al*., 2013). They further mention that the contamination from aflatoxin is most frequent and serious at the storage and processing levels along the marketing chain. However it might be possible that most farmers, traders, millers, and processors are not aware of these conditions but only suffer the consequences. Emmott, (2012) wrote in a Twin report that:

"…aflatoxin contamination is a sensitive issue on trade and public health, but awareness and understanding of aflatoxin is not widely spread."

As a result of the occurrence of aflatoxins, most producers of such crops face challenges like having their crops rejected due to quality purposes, or having to receive reduced market prices, and or the inability to trade internationally due to the international trade standards. This point is further strengthened by N'Dede *et al*, (2013), when they wrote,

"…aflatoxin is a potent carcinogenic toxin that also causes millions of dollars of financial losses to people in Africa…".

This observation translates to reduced revenues in affected localities such as Dora. In some other countries there have been awareness campaigns for example in Malawi and Kenya and unfortunately there has been none in Zimbabwe. With such severe impacts caused by aflatoxins, the agricultural value chain actors need to be aware of it.

The prevalence of Aflatoxins has devastating impacts on the farmers, traders, consumers and national economic development. Groundnuts and other crops which are affected by aflatoxins are important for household food security since they are staples in most farming communities of Zimbabwe. The contamination affects agricultural sector output and therefore, the four pillars of food security which are availability, access, utilization, and stability (PACA, 2013). There is therefore inevitable need to assess the awareness about aflatoxins so as to address the problem holistically. Otsuki *et al.*, (2001) highlights some of the negative economic impacts caused by aflatoxins as i) 25% of world food crops are affected, ii) aflatoxin continues to be a significant problem in Africa and Asia and has enormous economic consequences on commodity losses, health and trade, especially where it is unregulated, iii) contamination is proving to be a major barrier in linking African farmers to markets as aflatoxin prevents commodities from meeting international, region and regulations and standards governing agricultural trade and food safety, iv) only 15 countries in Sub-Sahara n Africa have regulation governing aflatoxin making trade challenging and v) the estimated annual loss to African food exporters of cereals, dried fruit and nuts from attempting to meet EU aflatoxin standards is roughly $670 million.

Value chain actors with affected produce may earn less because of product rejection, reduced market value or the inability to gain access to higher international trade markets, and also reduced alternative options because of safety reasons PACA, (2013). In countries were the general awareness of aflatoxins is high, and there are supporting regulations and institutions, the health impacts due to the contamination tend to be low but the market impact high. The policy regulation environment for aflatoxin would be influenced positively due to awareness. This will promote food safety and the production of quality products which could be traded internationally to gain more revenues.

Thus this study is meant to survey and assess the general level of prevalence and awareness about aflatoxins by groundnuts value chain actors in Mutare urban and the peri urban areas. This will directly inform the adequacy of mitigation methods used by farmers, traders, and processors. Policy makers can therefore use the findings to implement policies for the better good of the economy and the health of the nation.

2. Materials and Methods

2.1. Site Description and Experimental Design

The research was conducted in Mutare District of Manical and Province in South-Eastern Zimbabwe. Mutare, the provincial capital is the third largest city in the country It boarders Zimbabwe and Mozambique. The city has a tropical location but it has a temperate climate due to being located in a mountainous area. The study area has a variable climate from wet to semi-arid. The mean annual temperature of the area is 19^0C and the mean annual rainfall is 818mm.

Part of the research was done in the rural farming peripheral areas of Mutare. Specifically Dora community was the study area. In Dora the research was done in Ward 5 and Ward 35. The area is in Natural farming Region III. The mean annual rainfall is 600mm. The main crops grown in the region are groundnuts, sunflower, cowpeas, small grains, maize and tobacco. Figure 1 shows the study area.

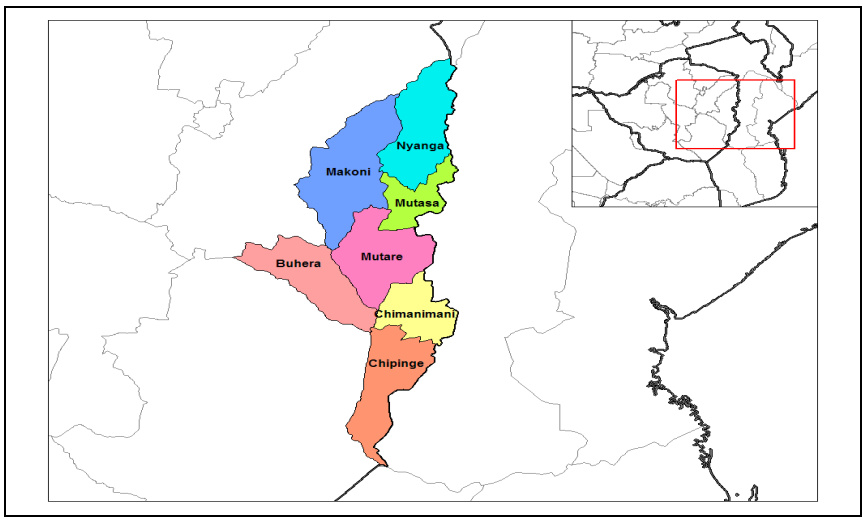

Figure 1: Map of Zimbabwe showing Districts of Manicaland Province and Mutare

The study was focusing on the dominant value chain actors for the groundnut enterprise. Respondents included the major stakeholders along this value chain as delineated by their roles and responsibilities. These included farmers, storage facilities, vendors, processors, retailers, and the policy implementers. Farmers were from two different Wards in Dora, and the rest of the respondents were from Mutare urban. This provided an insightful interaction between rural farmers and the urban markets, thus completing the value chain.
A multistage sampling approach was adopted. The value chain was purposively selected due to the noted increased incidences of molds in groundnuts. Dora farming community provided the desirable attributes in terms of proximity to Mutare City and the dominance of groundnuts production. It was therefore also purposively selected. Wards 5 and 35 were conveniently selected after consultations with the AGRITEX offices. Stratified random sampling technique was used to select the respondents. This was opted for since all the value chain groups had different numbers of potential respondents. Fourteen farmers were selected at random from each Ward. This was done with the aid of the extension workers who kept records of farmers who grew groundnuts. This translated to twenty eighty farmers who responded to the questionnaires. Five key informant respondents were selected from the Agritex office to represent the policy implementers. The snowball technique was used in this case. The District Agricultural Extension Officer (DAEO) was the first point of call and he helped in the identification of Extension Officers in the two Wards. There was one key informant respondent for the storage facility handlers. Three retailers were randomly selected together with ten vendors and seven processors. This generated a sample of fifty four respondents.

2.2. Data Collection

The study used both primary and secondary data. Primary data was obtained from the use of questionnaires which were administered to the different stakeholders in the value chain discussed above, which included farmers, processors, retailers, vendors, policy implementers and the storage facility. Secondary data was accessed from articles and documents on Aflatoxin. Both qualitative and quantitative data were collected. Quantitative data were gathered through the use of close ended questionnaires and the qualitative data through open ended questions from the questionnaire, which allowed personal views on groundnuts and aflatoxins by the respondents. Below is the type of data that was required to fulfill the research's objectives.

Objective	Data Required	Data Collection Method
To assess the level of awareness on aflatoxins.	The knowledge about aflatoxins, its causes, and its effects. Behavior of the people when handling moldy groundnuts.	Questionnaires. Focus Group Discussions. Key Informant Interviews. Observations.
To assess the prevalence and magnitude of aflatoxins along the value chain.	The knowledge and occurrence at each stage. Number of cases/incidences reported or encountered.	Questionnaires. Focus Group Discussions. Key Informant Interviews.
To assess the mitigation strategies for aflatoxins at each stage of the supply chain.	What the farmers, processors, retailers, vendors use against aflatoxins contamination.	Questionnaires. Focus Group Discussions. Key Informant Interviews.

Table 1

2.3. Data Analysis

Data collected from the study was entered into the Statistical Package for Social Sciences (SPSS). SPSS 14.0 was used for data analysis and generation of outputs. Variables were identified and assigned specific values to enable analysis. Quantitative data was analyzed using descriptive statistics like percentages, means, tabulation, and frequency distribution. Graphs and tables are used to present the outputs.

3. Results

3.1. Demographic Characteristics of the Respondents

This section presents the general demographic attributes of the sample respondents. This picture is critical as it provides an insight into the nature of distributions across variables such as gender, marital status and age of respondents.

3.1.1. Marital Status and the Age of the Respondents

Figure 2 shows the marital status distribution of sample respondents in percentages. Of the 54 respondents from the value chain actors of groundnuts, 70 % of the respondents are married, while 20 % widowed and the remaining 10 % were single.

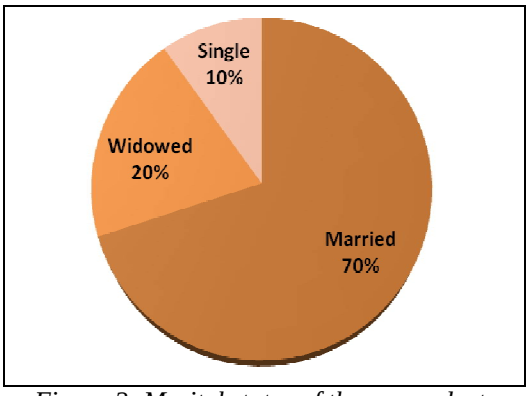

Figure 2: Marital status of the respondents

The dominance of married respondents in the sample can be explained by the cultural traits in most agricultural systems where societies view marriage as an acceptable institution which validates households.

3.1.2. Age of the Respondents

Table 2 shows the age frequency distribution of the respondents from the sample. The youngest of the groundnut value chain actors is 28 years old and the oldest is 85 years old. This shows that people of all ages participate in handling groundnuts at one level of the value chain or other.

Measure of Central Tendency	Value (years)
Mean	51.85
Mode	32.00
Minimum	28.00
Maximum	85.00

Table 2: Age of the respondents

3.1.3. Gender of the Respondents

Figure 3 is a summary of the gender patterns in the sample. This categorical variable is important in explaining decision making patterns in agricultural systems of developing countries.

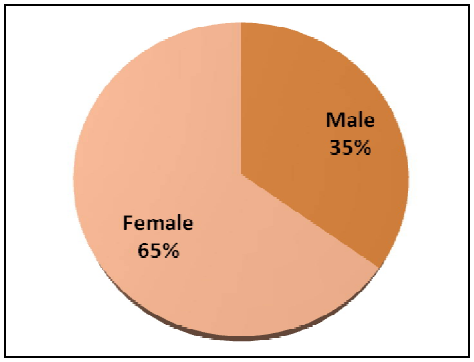

Figure 3: Gender of the respondents

Of the 54 respondents in the value chain, 65 % were female and 35 % were male. This could be due to the fact that men have other income generating activities not related to food production and selling than women.

3.1.4. Dominant Crop Enterprises

Figure 4 shows the major crop enterprises in the study area. Groundnuts and maize dominate since all respondents allocate a portion towards these enterprises. Maize is the staple of the Zimbabweans, and every homestead cultivates it for starch and its carbohydrates.

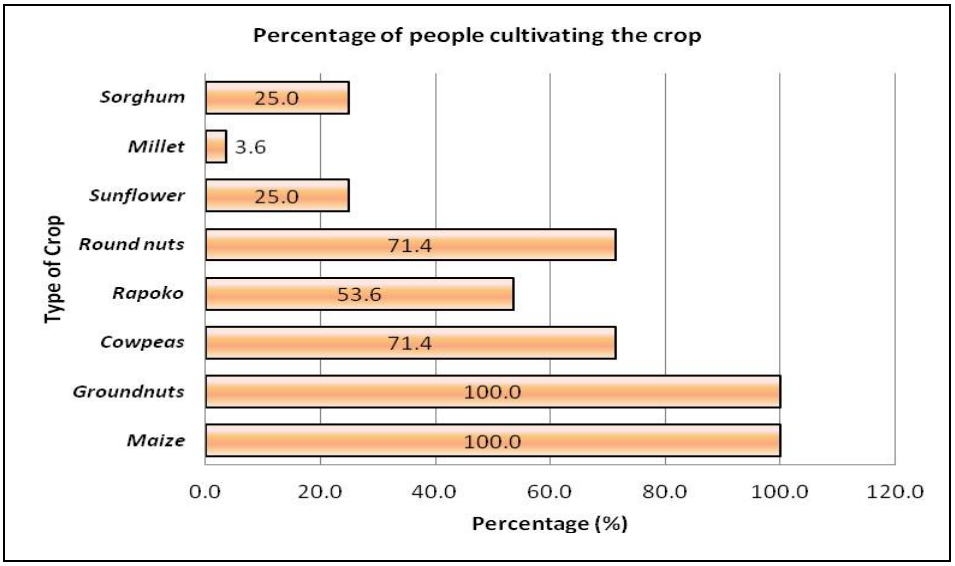

Figure 4: Crops grown in the area

Cowpeas and round nuts are cultivated by 71.4 % of the respondents. The percentages are high due to the protein contents of the crops and the crops are used as relief as a substitute for meat. Sunflower is grown for the oil and also as feed for poultry. A few people grow millet, and this could be due to its unfavorable taste.

3.1.5. Reasons for Growing Groundnuts

An examination of the reasons which drive farmers to grow groundnuts in the study area is presented in Figure 5. Four major reasons were reported by farmers. These are income generation, health, extraction of oil and peanut butter.

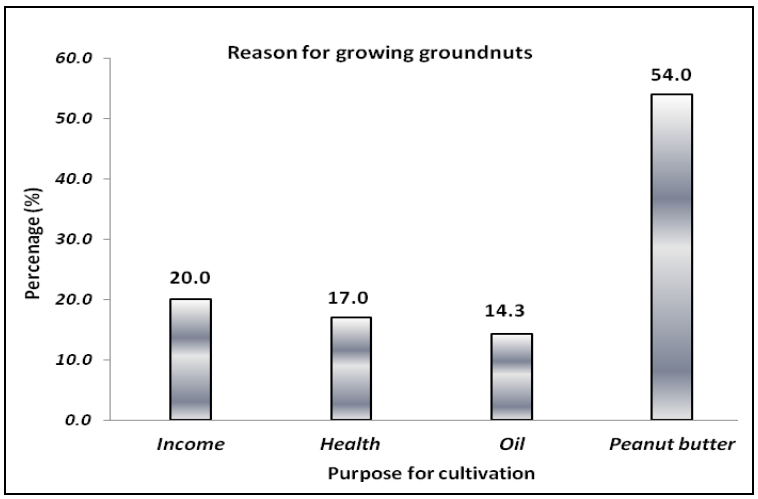

Figure 1: Reasons for growing groundnuts by the farmers

Fifty four per cent of the farmers of the respondents cultivate groundnuts for peanut butter which is used as a spread in sandwiches, an ingredient in relish and porridge. This is therefore an important source of nutritional stability especially for children. Twenty percent stated that they cultivated groundnuts for income purposes, for food, school fees and other necessities the family needs. Approximately 17 % grow the crop for its health reasons, which include proteins and fats and other vitamins. About 14.3 % grow groundnuts for its oil which is used for cooking purposes. This can then be used as a substitute for the more expensive cooking oils in supermarkets.

3.2. Assessment of the Level of Awareness about Aflatoxins and the Levels of Risk Exposure

As shown in Figure 6, the study shows that the majority of the people have never heard about aflatoxin, its cause or its potential effects. The dominant stakeholders who showed knowledge on aflatoxins were the policy implementers from Agritex. This knowledge was obtained from their studies in colleges and has not been frequently updated through workshops and seminars.

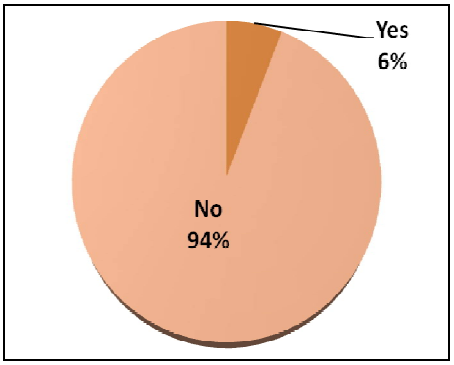

Figure 6: Actors with knowledge on aflatoxin

The other observation from the study is that most people do not know of any ailments caused by groundnut, not even allergies and reactions. Due to the fact that most people do not know about aflatoxins and its effects, most people are at risk of the health impacts caused by the ingestion of aflatoxin. Ingestion of aflatoxin is lethal for both livestock and human beings. Some of its effects are disruption of the immune system, growth retardation of children, cancer and the worst scenario is death (Ayelew *et al.*, 2013). People are ignorant of its acute effects, and that is why some even consume groundnuts which are moldy. From the study when the respondents were asked what they did with moldy peanuts, their responses were as in Table 3.

Item	Frequency	Percentage
Return them	1	2.2
Roast and consume	4	8.9
Sun dry	25	55.6
Throwaway	12	26.7
Stock feed	3	6.7

Table 3: What respondents did with moldy groundnuts

Table 3 shows that the majority of the people which is 55.6 % re-dry the groundnuts using the sun, and then consume the dried nuts, as long as the groundnuts did not taste bitterly. From the results obtained, 26.7 % stated that they would throw the groundnuts away because they were concerned about their health and did not want to upset their stomachs by eating rotten food stuff. Only 2.2 % stated that they would return the moldy groundnuts back to the supplier, and 6.7 % opted to use it as stock feed.
The results of people who confirmed that they do consume moldy groundnuts and the responses correspond to the uses of moldy groundnuts are shown in Figure 7.

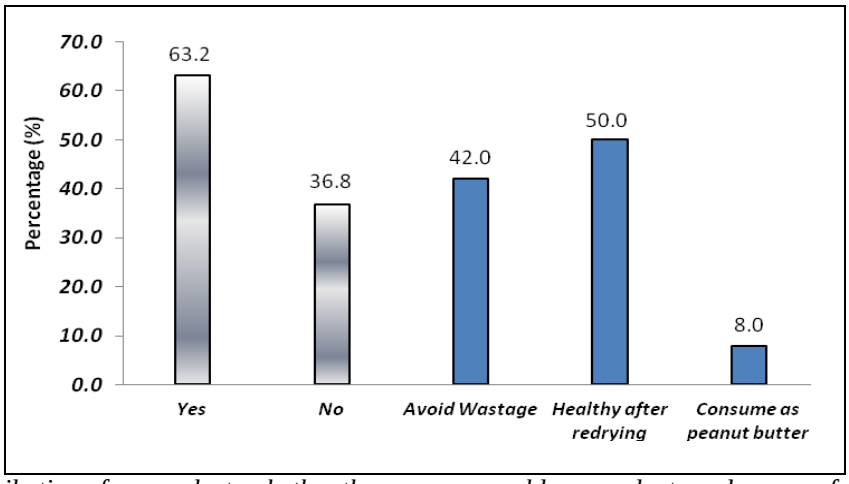

Figure 7: Distribution of respondents whether they consume moldy groundnuts and reasons for consumption.

The majority pointed out that after re-drying, the groundnuts looked healthy, and they had no reason not to consume. Forty two percent stated that they did not want to waste any food. Poverty could be a reason why people would not risk wastage of food. The rest stated that they would consume moldy groundnuts if they are processed into peanut butter, in that way there would be any discoloration visible or bitter taste.
The low level of awareness about aflatoxins means less knowledge about its effects and less precautionary measures by end users and processors alike. If people knew about aflatoxins and its effects, people would not be negligent about their health and lives but be cautious of what they ingest. This means many consumers of groundnuts might be suffering from effects of aflatoxin but they are not aware of it. The scenario can therefore be traced back to the extension domain of the value chain since there are no feeder courses regarding the identification and effects of aflatoxins.

3.3. Assessing the Prevalence of Aflatoxins in Groundnut Value Chains
Aflatoxin is a fungal disease caused by the fungi *A. flavus*. Molds indicate the presence of fungi in grains, nuts and food stuff. In this study, the researcher did not use any scientific methods for analyzing the groundnuts for the presence of aflatoxins, but used primary information from the respondents. Molds and poison were used as a synonym for aflatoxin, and respondent were asked if they had noticed or experienced molds with their groundnuts. Green molds were associated with the presence of aflatoxins by Amaral-Philips et al., (2012) when they stated "… the fungal disease resulting in an olive-green, powdery mold". However some authors like, Fredlund et al., (2009) have written that there is no correlation between molds and the presence of aflatoxin. At the same time there may not be a correlation but the chances of the presence of aflatoxins are higher in moldy groundnuts than the ones that are not.
In the value chain, from the sample of retailers, vendors, processors and retailers 35 %, confirmed to have received groundnuts with molds from sellers, and the remaining 65 % mentioned that they had never received groundnuts with molds (Figure 8). However 54 % experienced molds during storage. This indicates that molds may be passed along the value chain from stakeholder to stakeholder and the contamination may increase due to the length of the storage or the type of storage facilities.

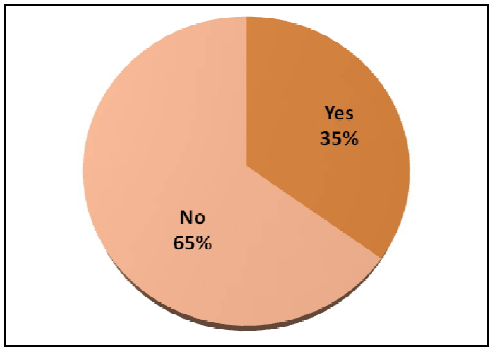

Figure 2: Stakeholders who have received moldy groundnuts

There are different types of storage facilities which are used by different value chain actors. Storage facilities are considered a contributing factor to the accumulation and contamination of molds and aflatoxins (Desai *et al*., 1999). Table 4 below presents the different types of storage materials used and the corresponding number of stakeholders who use them.

Material	Frequency	Percentage
Plastic	2	4.3
Metal/Aluminum	1	2.2
Sack	39	84.8
Reed Basket	4	8.7

Table 4: Storage materials for groundnuts

The majority (84.8 %) of the respondents preferred sacks as the storage material. This was because the sacks are well ventilated and allow free air circulation and less moisture retention. It is therefore expected that the presence of aflatoxin in the value chain is reduced.

3.4. To Assess the Mitigation Strategies

Across the groundnuts value chain, different stake holders use different mitigation strategies against molds. The mitigation strategies used were as a result of the stake holders understanding of molds from the perspective of what causes them, to how to prevent them. Figure 9 below shows what different stakeholders perceived to be causes of molds.

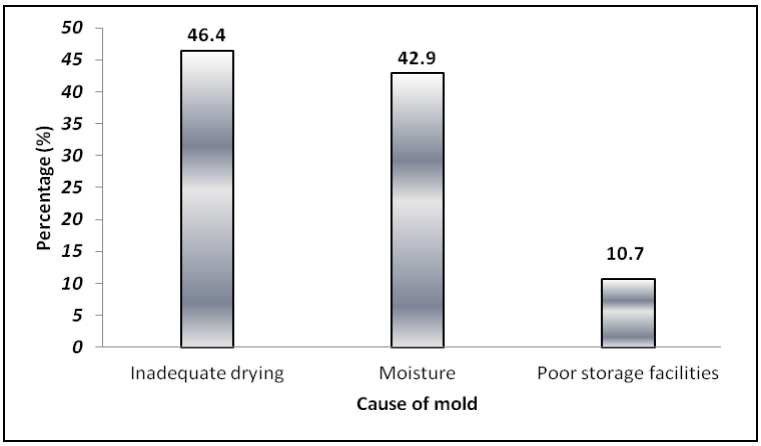

Figure 9: Causes of molds

From the Figure 9 above, 46.4 % of the respondents believed that the occurrence of molds is due to inadequate drying in the field and/or during curing. From the study the researcher noted that there are three different ways of curing groundnuts. This can be by directly using the sun, or under a shade or inside the house using cool air, or using air frames, which allow both the sun and air to dry the groundnuts. Failure to completely dry the groundnuts would induce mold formation.

A total of 42.9 % stated that molds are caused by the presence of moisture during storage or anytime after drying because moist environments are ideal environments for molds to grow. Moisture can result due to the absence of free air circulation in the storage facility or container. Poor storage practices were also raised as a cause of molds. The poor storage practices like directly placing the groundnuts on the floor and leaning the sacks against the wall. This deprives the nuts of free air circulation and as a result molds form.

A number of strategies to prevent molds were mentioned, and they included adequate drying, preventing moisture during storage, buying in small quantities and preventing the nuts to be in contact with the floor or the walls. Figure 10 below shows the four dominant preventive strategies used by the value chain actors.

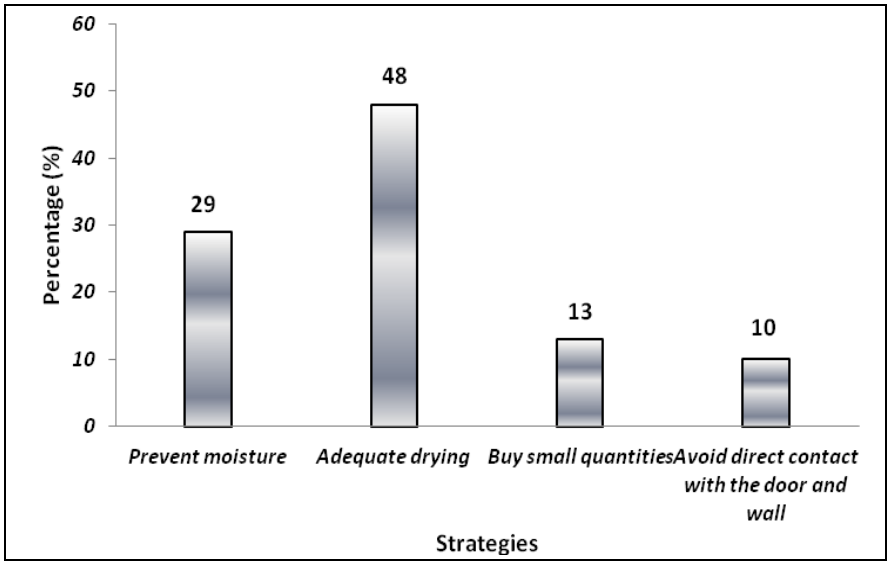

Figure 10: Strategies used to prevent molds

It is visible from the results that that most respondents believe that molds are formed when the nuts are not properly dried. As such, adequate drying would prevent molds from forming. Twenty nine percent of the respondents emphasized on preventing moisture after drying and anytime during storage. This could be achieved by using cheap locally designed storage facilities with a combination of sacks. Storage is an important aspect when it comes to aflatoxin and groundnuts. The type of storage material used is of importance as it determines whether the groundnuts would have free air circulation or not, in order to prevent moisture from setting. Different types of storage materials used which were mentioned are sacks, reed baskets, plastics, and metal/ aluminum drums. These are cheap and locally available to the farmers.

About 65 % of the farmers stated that they re-wetting the groundnut for easy shelling, and this act results on adding moisture to the nuts and encouraging fungal growth. This idea emanates from the observation that contamination can also occur during the shelling stage in cases of hard shells.

3.4.1. Adoption of New Mitigation Strategies

There was acceptability of the extent of magnitude in terms of effects of aflatoxins. Based on the study findings, 85.7 % confirmed that they would adopt new mechanisms that would reduce the effects of aflatoxins at all levels in order to prevent economic losses but most importantly to preserve lives. However the remaining 14.3 % stated that they would not adopt as they do not trust chemicals as they also might be toxic and cancer causing. Some farmers later on stated that, they might adopt after the techniques or chemical is recommended by an extension worker. This proved that the extension services do have an influence in the diffusion and adoption of innovation by farmers. The summary for results is in Figure 11 below which shows the reaction to adopting new strategies by the respondents. However the majority of the respondents mentioned that, the innovations must be affordable and not add more expenses than it would bring profits.

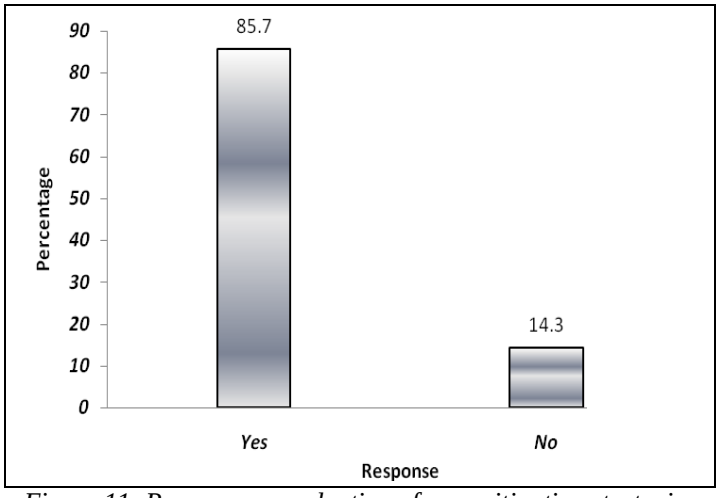

Figure 11: Responses on adoption of new mitigation strategies

4. Conclusion

The main objective of the study was to assess the level of awareness about aflatoxins along the groundnut value chain actors in Mutare urban and peri-urban. The study was inspired by the rising interest on aflatoxins in Africa by a number of organizations including PACA. The study showed that there is a low level of awareness about aflatoxins. From a sample of 54 respondents, only 5.6 % were aware and had background knowledge about aflatoxin, its causes and impacts. These were mainly extension workers.. This finding however shows that the extension workers are not sharing the knowledge they have with the farmers. This may be because of the ignorance of the seriousness of the issue internationally, amongst other reasons. The majority of the stakeholders showed no knowledge of aflatoxins, or poison and ailments caused by groundnuts.

The study also showed that aflatoxins are prevalent along the groundnuts value chain. As such many people are at risk of having aflatoxin induced diseases. About 63.2 % of the respondents consumed groundnuts which had been affected by molds after re-drying them. A number of reasons were given to justify the consumption of molded groundnut and they included, avoiding wastage, groundnuts still looking healthy or processed to peanut butter. Of the respondents, 50 % stated that they consumed molded groundnuts because they still looked healthy after re-drying. This may be caused by the ignorance to the toxin and its impacts. Poverty is also a factor which contributes to people consuming molded groundnuts as they are not willing to throw away any food stuff. Due to the relationships between value chain actors, it has been revealed that the aflatoxin is passed on from one value chain actor to the next value chain. Of the respondents 35 % mentioned to have received groundnuts affected with molds, and 54 % said that they have experienced molding during storage. One way or the other the affected groundnuts would be passed on through selling and thus the prevalence of molds and aflatoxins along the value chain would be persistent.

A number of strategies are used by the stake holders to avoid molds, and this included, proper field drying, avoiding moisture after harvest, and preventing the groundnuts from getting in contact with the floor or the walls during storage and buying groundnuts in small quantities. Most farmers used airframes to ensure proper drying of the groundnuts and recommended the use of airframes. However as much as they properly dry the groundnuts and prevent moisture during storage, 64 % of the respondents introduced moisture to the groundnuts by rewetting for easy shelling, and this act induces mold formation. Eighty seventy point seven percent of the respondents stated that if there were any new and recommend chemicals or strategies for preventing the occurrence and contamination of aflatoxins, they will adopt them, however at the same time, the remaining percentage insisted on not adopting them, especially chemicals as they said, they too might be toxic and cancer causing.

4.1. Recommendations

With reference to the findings of the research, the following recommendations can be made. There is need to raise the level of awareness about aflatoxins though out the nation. This could be achieved through the use of various techniques like, using the extension agents to spread the information to farmers, information on mycotoxins be incorporated in school syllabi from primary throughout tertiary education. Mass media can also be used, for example television and radio shows, and also using print like newspapers, magazines and newsletters. There is need for policies on aflatoxins, groundnut handling and processing, and there needs to be bodies to regulate these policies. This may inspire farmers to adopt methods such as air frames to dry their groundnuts as it has proved to be more effective. There is need for more effective ways of preventing the occurrence and contamination of aflatoxin. Additionally Aflatoxin testing materials need to be accessible to farmers or any stakeholder in need of it, and at affordable prices so that everyone can afford.

5. Acknowledgements

We wish to extend many thanks to Mr Dickson Dube for financial support. Much gratitude goes to the Mutare Agritex Office and the Extension workers Mr Makina of Dora Ward 5 and Mrs Makina of Dora Ward 35 for supporting this work.

6. References

i. Aboloma R. I. 2014. Mycotoxin awareness amongst traders and farmers in Ekiti State, Nigeria
ii. Ayalew A., Chunga W., Sintayehu W. 2013. Aflatoxins: Finding Solutions for Improved Food Safety, Mobilizing Political Support: Partnership for Aflatoxin Control in Africa. IFPR.
iii. Amaral-Philips D.M., Vincelli P., and Lee C. (undated) Common questions regarding Aflatoxin. College of Agriculture, Food and Environment,University of Kentucky.
iv. COMESA 2014. Regional Workshop Report on the Aflatoxin Challenge in Easten and Southern Africa, Malawi.
v. Desai B. B., Kotecha P.M., Salunkhe D. K. 1999. Science and Technology of Groundnut: Biology, Production, Processing and Utilization. NAYA PROKASH, Culcuta.
vi. Emmott A. (2012). Report: Value Chain approach- Aflatoxin (Groundnut), Twin. www.twin.org.uk/resources
vii. Fredlund E., Thim A. M., Gidlund N.,Brostedt S., Nyberg M., and Olsen M. 2009. Moulds and mycotoxins in rice in Swedish retail. Food Additives and Contaminants, 2009, 26 (04), pp.527-533. <10.1080/02652030802562912>. <hal-00577343>
viii. Gnonlonfin G. J. B., Hell K., AdjoviY., FandohanP., KoudandeD. O., Mensah G. A., Sanni A., and Brimer L. (2013). A Review on Aflatoxin Contamination and Its Implications in the Developing World: A Sub-Saharan African Perspective, Critical Reviews in Food Science and Nutrition, 53:4, 349-365, DOI: 10.1080/10408398.2010.535718
ix. Goldblatt L. A. (1968). Aflatoxin and its Control. Econmic Botany Volume 22, pp 51-62.

x. International Crops Research Institute for the Semi-Arid Tropics (ICRASAT). (1986). Agrometeorogy of Groundnut: Proceeding of an International Symposium, India
xi. International Food Policy Research Institute (IFPRI). (2012). The Aflacontrol project: Reducing the spread of Aflatoxins in Kenya: Summary Report.
xii. Kumar G. D. S and Popat M. N. (2010). Assessment of Adoption Gaps in Management of Aflatoxin Contamination of Groundnut (ArachisHypogaea L.),The Journal of Agricultural Education and Extension, 16:3, 309-319, DOI: 10.1080/1389224X.2010.489770
xiii. Kumar G. D. S and Popat M.N. (2010). Factors influencing the adoption of aflatoxin management practices in groundnut (Arachishypogaea L.), International Journal of Pest Management, 56:2, 165-171
xiv. Memon R. A. (1993). Extension Methods. National Book Foundation, Pakistan
xv. N'Dede B.C., Jolly C.M., Vodouhe S. D., and Jolly P.E. (2012). Economic Risks of Aflatoxin Contamination in Marketing of peanut in Benin.
xvi. Narrod C., Tiongco M., Groote, and Bett, et al,. (2014). Knowledge and Practices of Aflatoxin Control Amongst Rural Farmers Role of Capacity Building in Promoting Behavioral Change. University of Maryland.
xvii. Oliveria C. A. F., Goncalves N. B., Rosim R. E., Fernandes A. M. (2009). Determination of Aflatoxins in Peanut Products in the Northeast Region of São Paulo, Brazil. www.mdpi.com/journal/ijms/
xviii. Otsuki, T, Wilson J. S., and Sewadeh M. (2001). Saving two in a billion: quantifying the trade effect of European food safety standards on African exports. Food Policy.
xix. PACA. (2013a). Aflatoxin Impacts and Potential Solutions in Agriculture, Trade and Health. A background paper for regional worshop on the aflatoxin challenge in West African States
xx. PACA. (2013b). Aflatoxin Impacts and Potential Solutions In Agriculture, Trade and Health. Background paper for the PACA strategy development- stakeholder consultation workshop.
xxi. Piere S. (2012). Aflatoxins. ISARA-Lyon Presenation
xxii. Strosnider H.,Azziz-Baumgartner E., Banziger M., Bhat R. A., Breiman R., Brune M et al. (2006). Public Health Strategies for Reducing Aflatoxin Exposure in Developing Countries, Work group report.
xxiii. Waliyar F., Osiru, M,Sudani K. H., and Njoroge S. (2013). Reducing Aflatoxin in Groundnuts through integrated Management and Biocontrol. International Food Policy Research Institute.
xxiv. Washingtonpost. Newsweek Interactive, LLC. (2001). Safety First, Foreign Policy. No. 122 (Jan. - Feb., 2001), p. 19. http://www.jstor.org/stable/3183221