Food and Agriculture Organization
of the United Nations

TESTING MULTI–CRITERIA APPROACHES FOR FOOD SAFETY DECISION MAKING

FAO SUPPORT TO UGANDA AS A PILOT COUNTRY

PILOT PROJECT REPORT

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DRUG
NATIONAL AUTHORITY

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EXECUTIVE SUMMARY

Food safety decision-makers often face the challenge of comparing and weighting the impact of multiple food safety issues on various factors, including health, trade etc. In order to make robust, informed decisions to manage food safety risks, decision-makers need to collect data and analyze evidence on the impact of unsafe food on those factors which are most relevant to their national context. Impact on public health by chemical and microbiological risks should be a key factor to consider. At the same time it is important to recognize that food safety issues can impact health in other ways (e.g. malnutrition, obesity, disease associated with malnutrition) as well as social, trade, economic and food security impacts. By considering a broad set of factors, the national policy is better informed and decisions are not driven by a single consideration.

In order to improve the effectiveness of, and accuracy of the food safety decisions made at national level Uganda initiated collaboration with Food & Agriculture Organization (FAO) of the United Nations through a pilot project of using multi-criteria approaches for food safety decision making. The Ministry of Health, Uganda, through National Drug Authority was the main coordinator of the pilot project.

Applying a multi-criteria decision analysis offers a structured process to establish priorities amongst diverse and competing policy options. Using this approach, policy decisions are made after considering a set of country-specific factors, collecting evidence on these factors and weighting the evidence in a balanced way.

In Uganda food safety control is characterized by a multi-agency system whereby food safety and quality infrastructure is shared between several government ministries, departments and agencies. At national level, the National Food Safety Advisory Committee (NFSAC) was formed by Ministry of health as a policy advisory body to advise the Minister on all matters of national food safety including policy direction. Efforts to continually improve coordination between multiple government departments and institutions involved in making food safety related decisions are to be commended, and while progress has been made some challenges still remain. These include duplication of activities hence a drain on the limited resources; limitation to collect and interpret rigorous evidence/data for other risk factors in order to complement the science-based methods that are used to assess public health risks. To effectively implement the pilot study, engagement with several stakeholders to prioritize food safety issues was essential in addition to developing a methodology that is clear and transparent to all stakeholders.

Therefore the overall goal of this project was to enable prioritization of national food safety policies and/or decisions, in the context of limited resources by considering a range of factors other than depending on a single factor, such as the public health factor alone. This project also built the capacity in improving the evidence based decision

procedure and facilitates stakeholder engagement in decision making and coordination between the different bodies.

To enable the prioritization process, a set of priority national food safety issues and criteria for comparing their impacts were identified at a stakeholder workshop held in November, 2012. Participants identified five food safety issues considered to be important for Uganda. These were namely: *Brucella* spp. in dairy products, aflatoxins in maize, acute diarrhea in children under five, *Taenia solium* cysticercosis in pork, and methanol in unregulated alcohol. Participants also identified four risk factors as critical in influencing the food safety decision, namely impact of the food safety issue on public health, market, food security and social factors.

An important source of data for this study was the Uganda national burden of disease due to food safety hazards [Uganda is a pilot country for the WHO Foodborne Disease Burden Epidemiology Reference Group (FERG)]. Additional information on the food production and consumption, trade patterns and socio-economic and cultural issues surrounding food in Uganda was driven from the “Situation Analysis study” within the mentioned project. Furthermore, data collected from various resources such as hospitals and abattoirs, etc. and consultation with the experts along the value chain provided valuable information when data were scarce and aggregated. In the second workshop organized on May 2013, participants evaluated and ranked the food safety issues using the criteria (multiple risk factors). Due to time limitations, three food safety issues out of five were handled. The remaining two food safety issues were subsequently addressed by specialists and the decision of priorities was based on all five food safety issues.

All of the 5 food safety issues were rated as “high” risks based on one or more of the three sub-factors for public health (i.e. immediate illness, long-term illness and deaths), confirming that these are significant food safety issues in Uganda. In terms of the other criteria, at least one factor was recognized as an area of concern for each of the 5 issues. Workshop participants decided that public health impact should be the most important factor in prioritizing food safety issues. Although social factors were considered, there was consensus that the current evidence was weak and this criterion was not included in the multi-factor prioritization. Therefore the table below summarizes the ranked order of food safety issues as well as a multi-factor prioritization based on 3 criteria. (Social factors is not considered)

Table I. Prioritization of the Five Case Studies based on Public Health, Market-level and Food security impacts

Selected food safety issues	Single Criterion Rankings			Multi-factor prioritization
	Public Health	Market-level	Food Security	
Acute diarrhoea in children	1	5	1	Highest
Brucellosis – milk products	2	5	2	Second highest
Aflatoxin - maize	5	1	3	Third highest
Methanol – unregulated alcohol	3	5	5	Fourth highest
Cysticercosis – pork	5	5	4	Lowest priority

Overall, acute diarrhea in children under five was identified as the highest priority issue in the five case studies. This issue scored highest on both public health (in terms of causing immediate illnesses & deaths) and food security impacts. This was followed by Brucellosis in milk as the second highest priority. Aflatoxins in maize were recognized as a significant risk in terms of Hepatocellular Carcinoma but methanol in unregulated alcohol has caused significant number of deaths and was ranked higher in terms of public health impact. In the multi-factor prioritization, Aflatoxins ranked higher than Methanol because of the potential for maize to be rejected as an export product due to high levels of Aflatoxin and possible harm to nutritional status, specifically stunting and wasting in children due to chronic exposure.

Prioritization of food safety issues by using multiple factors (social, economic, food security factors &public health factor); finalization of the Uganda /FAO/WHO /FERG Burden of Food Borne Diseases; and strengthening of the National Food Safety Coordination mechanisms and stakeholder engagements, are among the outputs from testing a multi-criteria decision analysis approach in this pilot study.
This approach is therefore very important in guiding policy makers in deciding where to make immediate, medium and long term interventions in light of limited resources when addressing food safety concerns.

However there are some challenges and gaps identified mainly related to provision a systematic approach in collecting qualitative data on social and food security factors. Recommendations and lessons learned from this project hold the window open for continual improvement and further collaboration in capacity building based on the outcomes of this project.

Using the results of this pilot project, FAO is developing a global guideline on evidence-informed food safety decision making (including such decisions as risk prioritization) to enable national policy makers to improve their capacity on food safety risk management

in order to make more effective and sustainable decisions. The work is made possible through FAO/EC program on Global Governance for Hunger Reduction.

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- The National Food Safety Advisory Committee for providing technical and policy oversight
- The National Codex Committee for providing Technical oversight.
- The National Technical Committees (Taskforces) for conducting the *Food borne* BOD study.
- The national consultants, namely Dr. Winyi Kaboyo, Professor Kaaya, Mr. Geoffrey Onen, Ms. Stella Sengendo and Dr. Wamala Joseph for supporting the national taskforce of BOD study with data.
- Prof. Rob Lake and the FAO/WHO Food Epidemiology Reference (FERG) Group - for providing technical support for the Burden of Disease evidence

Workshop participants who participated in the three workshops (March, 2012; November 2012 and May 2013): Ministry of Health, Ministry of Agriculture Animal Industry & Fisheries, Ministry of Trade Industry & Cooperatives, Makerere University, School of Public Health, Uganda Manufacturers Association, Consumer Education Trust, Members of National Codex Committee, and National Drug Authority. A full list of participants for all workshops is attached as annex 4(a), (b) & (c).

FOREWORD

Unsafe foods have negative impacts on all levels of socio – economic development namely on: human health, national economies, tourism and the nutritional status of our communities. Issues impacting/influencing food safety are broad and include, among others, environmental pollution, challenges of food security, inadequate import food control leading to import of poor quality foods, pressure from external buyers in other countries, and requirements by private standards.

Therefore, food safety decisions such as national policy requirements and resource allocations should be based on clear evidence for a broad range of risks that are created by foodborne hazards. By considering a broad set of factors, the national policy base is better informed and decisions are not driven by a single consideration, for example, supporting export market for a particular commodity.

It is therefore important to address food safety in the broader context, including relating food safety to food security and nutrition, namely public health burden, linkage to food security (nutritional and safe food supplied, access and availability issues),linkage to agriculture and agro-industry development (integrated safety and quality), effect on producers and agro-processors (access to markets, income generation, livelihoods), impact on trade and economic development (national, regional and international), and food traditions and culture.

The Multi-Criteria Decision Analysis Tool (MCDA) is ideal for development of comprehensive food safety policies and interventions through an *integrated national food safety control system* because the apparoach addresses issues characterized by multiple options, multiple criteria, potentially many stakeholders, the need to justify selections and the need for transparency and accountability for decisions or actions taken.

An integrated national food safety control system is of national strategic interest; first for the protection of consumers at national and global levels and also to ensure that our foods meet international standards for trade in foods and food products. The translates into fair trade in food.

An effective national food safety control system requires the integrated effort of all elements of government that have a role in food safety at the national and local levels. It also requires central direction and coordination, with ultimate accountability by the nation's top officials. This also calls for close collaboration and cooperation at national and international levels. Development of such elaborate systems also calls for more resource mobilization, human resource development and logistical capacity building.

Effective implementation of national food safety control systems requires collective responsibilities and inputs from all stakeholders and from every citizen of Uganda. Some stakeholders in the health sector have more comparative advantage in delivery of some components of health services than others.

However, it is the sum total of all efforts and related activities that contribute to the reduction of the national disease burden; and other related positive impacts and

outcomes. This sum total of efforts can be easily archived through application of the MCDA Tool for formulating food safety and food security policies by adopting a multi-factor approach to risk analysis for example in estimation of the national and global Burden of Food Borne Diseases.

The MCDA Approach can also be useful in implementation of the *One – Health concept*, a continuum of health risks and benefits from the interactions of the environment, animals, plants and people; resulting in sustainability food security, health promotion and eco-health or a collaborative, cross - sectoral approach to minimizing harm and maximizing benefits from the eco – management of human, animals, plants and environmental health.

On behalf of Government of Uganda and Ministry of Health, I would like to extend our gratitude and appreciation to FAO for choosing Uganda as a pilot country for the Multi-Criteria Decision Analysis Tool (MCDA) Study whose main objective was to develop improved tools for formulating food safety policies and making food safety decisions by adopting a multi-factor approach to risk analysis, i.e. Considering the range of important risk factors.

Uganda is also grateful to the World Health Organization (WHO) for choosing Uganda for the Foodborne Disease Burden Epidemiology Reference Group (FERG) study. The purpose of the FERG Country Study was to enable countries to conduct their own burden of disease studies and translate the findings into food safety policy making and practice.

Hence the FAO MCDA Study and the WHO FERG country study were complementary in terms of information needed to assess public health risks and a broader need to understand the political, economic and social context for food safety policies in Uganda.

I urge the Food and Agriculture Organization (FAO) to work together with the World Health Organization (WHO) and other Development Partners to further support Members States in application of the Multi-Criteria Decision Analysis Approach (MCDA) for development of comprehensive food safety policies and interventions, and for other cross – cutting public health issues.

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18th February 2015

ACRONYMS

1.	AU	African Union
2.	BOD	Burden of Disease
3.	CFSVA	Comprehensive Food Security & Vulnerability Analysis
4.	COMESA	Common Market for East and Southern Africa
5.	DALY	Disability-Adjusted Life Year
6.	FAO	Food & Agricultural Organization
7.	FAOSTAT	FAO Statistics
8.	FERG	Foodborne Disease Burden Epidemiological Reference Group
9.	GDP	Gross Domestic Product
10.	IFPRI	International Food Policy Research Institute
11.	ISO	International Organization for Standardization
12.	MAAIF	Ministry of Agriculture Animal Industry & Fisheries
13.	MCDA	Multi Criteria Decision Analysis
14.	MOH	Ministry of Health
15.	MTIC	Ministry of Trade Industry and Cooperatives
16.	NCC	National Codex Committee
17.	NDA	National Drug Authority
18.	NFMA	National Food & Medicines Authority
19.	NFSAC	National Food Safety Advisory Committee
20.	OIE	World Animal Health Organization
21.	POPS	Persistent Organic Pesticides
22.	RASSF	Rapid Alert System for Food & Feed
23.	SPS	Sanitary and Phyto-Sanitary
24.	TBT	Technical Barriers to Trade
25.	UBOS	Uganda Bureau of Statistics
26.	UNBS	Uganda National Bureau of Standards
27.	WHO	World Health Organization

1. INTRODUCTION

Food safety decision-makers often face the challenge of comparing and weighting the impact of multiple food safety issues on various factors, including health, trade etc. In order to make robust, informed decisions to manage food safety risks, decision-makers need to collect data and analyze evidence on the impact of unsafe food on those factors which are most relevant to their national context. For example, high levels of mycotoxins in staple food such as maize and sorghum, not only could damage a country's reputation in export market and trade but also chronic exposure to this toxin could lead to growth stunting in children. Brucella contamination of drinking milk would cause immediate and long term illness but also has social and food security related implications; Taenia solium cysticercosis infection in pig and porcine products imposes a significant burden on public health, depresses the pork meat market and affects household food security.

These examples show that decision makers are faced with the challenge of comparing and weighting the impact of multiple food safety issues on various factors. When setting food safety priorities, impact on public health by chemical and microbiological risks should be a key factor to consider. But as the examples above show, at the same time it is important to recognize that food safety issues can impact health in other ways (e.g. malnutrition, obesity, disease associated with malnutrition) as well as social, trade, economic and food security impacts.

Access to safe food is one of the main axes for food and nutrition security and making strategic, sound decisions based on each country's resources, needs and issues is an essential task for policy makers in particular in the context of food safety. The Food & Agriculture Organization (FAO) of the United Nations launched a program known as the *Improved Global Governance for Hunger Reduction* in 2012 aimed at improving food security governance at global, regional and national levels. One of the components of this program is development of improved tools for formulating food safety policies by use of a multi-factor approach to decision making. Multi-Criteria Decision Analysis (MCDA), is a multi-step, iterative process enabling decision makers to communicate across the sectors and be transparent about the criteria. This approach is based on the accurate data available at national and international level and facilitates the stakeholder engagement in the high level food safety decision making.

In March 2012 FAO launched a pilot project known as '***Evidence-informed decision making for national food safety policy: Use of multi-criteria decision analyses'***., With the Ministry of Health and National Drug Authority as the implementing partners this approach also facilitated stakeholder involvement and interaction in food safety decision making.

The Multi-Criteria Decision Analysis approach can be applied to any decision where a number of criteria need to be considered and weighted against each other in a balanced way. The methodology applied is to assess the likelihood or probability of harm occurring and the severity of harm that is caused by the hazard. A key objective of the pilot study was to understand what elements and approaches of a multi-criteria decision analysis could be used to reinforce food safety decision and policy making in a country such as Uganda.

MCDA methods have been developed by experts in management and decision sciences and have been applied to complex environmental and health Issues (Gregory A. Kiker et al, 2005; Baltussen & Niessen, 2006; Fazil et. al, 2008). However there has been limited application of MCDA methods in the field of food safety. In the case of Uganda, the overall goal of this pilot study was to focus on prioritization of food safety issues by considering a range of factors namely: impact of the policies on public health, trade, food security and social factors. More specifically, the outcome of the pilot project is to: enhance understanding of the use of multi criteria approaches in developing food safety policies and decisions; discuss food safety policy development in Uganda and consider the suitability of multi criteria approaches to strengthen the national food safety policy; and determine other areas were application of multi criteria approaches may be applied in Uganda.

Uganda was chosen as a pilot country because at that time, there was an ongoing complementary study entitled the national burden of food borne disease. This study that was being conducted by the WHO Foodborne Disease Burden Epidemiology Reference Group (FERG) was aimed at translating the burden of foodborne disease results into national food safety policy. Hence the FAO project and the WHO/FERG country study are complementary in terms of information needed to assess public health risks while considering a broader political, economic and social context in formulating food safety policies.

In addition to the FAO project, multi-criteria decision analysis is also being tested in Uganda as a tool for prioritization of SPS Capacity Building Options. The Common Market for Eastern and Southern Africa (COMESA) secretariat in collaboration with the Standards and Trade Development Facility (STDF) of the World Trade Organization and United States Agency for International Development (USAID) are spearheading the use of Multi-Criteria Decision Analysis as an economic analysis tool for assisting governments and private sector in making investment decisions on Sanitary and Phytosanitary (SPS) capacity building options. Multi-Criteria Decision Analysis has been applied by the STDF in several countries in Africa. In Uganda, a priority-setting exercise

for SPS capacity-building was initiated in July 2012 and this resulted in identification and prioritization of 14 distinct SPS capacity-building options (Byanyima, 2013).

This report provides an overview of how the Multi-Criteria Decision Analysis pilot project in Uganda was conducted, the feasibility of using the Multi-Criteria Decision Analysis approach in food safety decision making, as well as highlighting the experiences of Uganda as a pilot country.

The next part of the report is organized into the following sections: Section 2 on background, food safety context & priorities highlights the policy, social, political, economic and environmental aspects that have an impact on food safety. Section 3 gives detailed explanation of how the pilot project was conducted and section 4 gives pilot project findings. Limitations of the study are identified in section 5 while section 6 and 7 give lessons learnt from the pilot project and key recommendations respectively.

2. BACKGROUND: NATIONAL FOOD SAFETY CONTEXT AND PRIORITIES

2.1Food Production in Uganda

Uganda is a predominantly agriculture based economy having about 81% of all households engaged in agriculture, which contributes about 22.5% to GDP. The major crops grown by households include: maize, beans, bananas (plantains), cassava, sweet potatoes, millet, sorghum, rice, field peas, cow peas, pigeon peas, groundnuts, simsim, soy beans and Irish potatoes (CFSVA, 2013). In addition to crop production, households also engage in livestock production which contributes to about 5.2% to total GDP. The major animals produced include cattle, goats, sheep, poultry and pig. The country also has an estimated production potential of over 800,000 metric tonnes (MT) of fish (CFSVA, 2013).

2.2 Food Consumption Patterns

According to the CFSVA report of 2013, more than 50% of Ugandans depend on markets to access food. This may contribute to households being vulnerable to food insecurity if food prices rise sharply. Food consumption patterns and diet are variable due to the variability in foods, prices, climatic conditions, socio-economic status and traditions in different parts of the country. However, starchy roots (cassava & sweet potatoes), plantain (green cooking bananas locally known as *matooke*) and cereals (maize, millet and sorghum) are the main staple foods in the diet (CFSVA, 2013; FAOSTAT, 2014).

In general, starchy roots contribute about one-quarter of the Dietary Energy Supply (DES), followed by cereals and fruit and vegetables. The contribution of pulses/nuts/oil crops to the DES is also relatively important. Foods of animal origin (milk/milk products, meat/offal, fish/shellfish) together contribute only 6 percent of DES, (FAOSTAT; 2014). Ugandans are also recorded to have the world highest per capita alcohol consumption in litres of pure alcohol (WHO, 2004).

2.3 Food Trade in Uganda

The country is a significant producer of food within central and east Africa, and is traditionally considered to be the most important food exporter in the region. Wheat and rice are the main food imports coming from global markets, although the main sources

of calories for the population come from crops that are not extensively traded – matooke (cooking banana), cassava, and sweet potato (Todd *et al,* 2008).

Uganda typically produces a surplus of maize and beans and these are commonly traded within the region. Between 2005 and 2007, Uganda exported an average of 167,000T maize and 88,000T of beans annually, primarily to Kenya, with smaller quantities going to Tanzania, Sudan and Rwanda (Haggblade and Dewina, 2010). Table 1.below provides a summary of the commonly tradable commodities in Uganda.

Table 1. Production and Trade of Food Staples in Uganda

Commodity	Production (1000 T)	Imports (1000T)	Formal Exports (1000T)	Imports: percentage of apparent consumption	Formal exports: percentage of production
Maize	1230	33	41	2.7%	3.3%
Cassava	4986	-	7	0.0%	0.1%
Plantains	9110	-	-	0.0%	0.0%
Beans	446	3	19	0.7%	4.2%
Rice	105	63	18	42.0%	16.7%
Wheat	17	365	1	95.8%	7.4%
Others	8867	523	513	5.9%	5.8%
Total	24761	986	598	3.9	2.4%

Source: (Haggblade and Dewina, 2010).

2.4 Socio–Economic Impact of Food Safety in Uganda

Food safety is of particular concern not only with respect to food-borne illness and related hazards, but also because of the considerable socio-economic issues associated with the safety of a country's food supply. Whilst the entire range of potential food-borne hazards are of concern world-wide, relative risk and perceived importance differs according to a range of factors including levels of economic development, climatic conditions, cultural and social norms, prevailing infrastructure etc. (Henson, 2003). An added dimension is the impact of food safety regulations on global trade in agricultural and food products.

In Uganda, problems of food safety are compounded by low levels of sanitation, hygiene and water supply coverage. Achieving basic food hygiene is made difficult by the lack of necessary sanitation infrastructure in many areas of the country and

segments of the food system. Cholera, caused by *Vibrio cholera,* one of the hygiene failure indicators, is a common occurrence. The 1997/98 El Nino weather phenomenon triggered off a cholera epidemic in many parts of the country and it was estimated that about 4.3% of those who contracted cholera died between 1997– 2002 (BOD, 2014).

In the period 1991- 2001, outbreaks of cholera and suspected fish poisoning with an agro–chemical resulted in fish export bans to the EU markets and this imposed a heavy negative economic impact on the nation. During this period, the country registered reduced foreign exchange returns to the tune of US Dollars 36.9 million; loss to fishermen community on account of reduced prices and less activity of fishing was US Dollars 720,000 per month. Furthermore, out of 11 fish factories in Uganda, 3 were closed and the remaining factories were working at 20% capacity, laying off 60% to 70% of their labor force (BOD, 2014).

Urbanization and population growth is another phenomenon that has heightened the increase of street and highway food vending. Whilst such an arrangement is appreciated for their convenience and assurance of food security for low-income urban populations, it is recognized that these informal food outlets are operated by people who lack appreciation for safe food handling practice. Consequently, street foods are perceived to be a major public health risk.

The social impact of food safety on the community is not well documented. However, the studies show that during heightened episodes of diarrhea particularly in children at family level, school attendance is reduced, this is accompanied by poor class performance; and sometimes such children are isolated by their peers.

At household level, cases of unsafe food that result in hospitalization will translate in the caretakers being denied other responsibilities such as gardening and other economic and social activities. This will in turn lead to food insecurity. An example of the social impact of a food safety issue includes the impact of epilepsy due to the consumption of cysticercosis infected pork meat on individuals' wellbeing such as loss of employment, difficulty integrating in the society such as getting married as the disease is considered a shameful illness.

Putting all these issues in context emphasizes the need to consider food safety in a broader way, thus recognizing the linkage between disease and social, economic, political and the physical and cultural environment in which people live (Henson, 2003).

2.5 Food and Nutrition Security Situation in Uganda

Overall, Uganda does not lack food. The *Comprehensive Food Security and Vulnerability Assessment Report of* 2009, prepared by the UN World Food Programme (WFP) in Uganda indicated that 6 percent of households were “food insecure”, 21 percent “moderately food insecure” and at risk of becoming food insecure should the conditions then deteriorate. The remaining 73 percent were classified as “food secure”.

However, malnutrition is recognized problem in children below five years. Inadequate food intake, either in quantity or quality- is an important cause of malnutrition and illness and infection is identified as another factor contributing to malnutrition among young children (CSFVA, 2013; Okello et al, 2013).

Practices such as insufficient or inappropriate caring and hygiene practices, poor infant and young child feeding practices (i.e. initiation of breastfeeding, breastfeeding practices and introduction of solid/semi-solid foods), use of unsafe food and water, inadequacy or absence of sanitation systems and inadequate access to maternal and child health services can all lead to ill-health, which affects a person’s ability to absorb the required nutrients from available foods, leading to malnutrition.

In Uganda, the overall contributors to child mortality are malaria (25%), anemia (14%), pneumonia (10%) and diarrhea (13%). Patterns of repeated episodes of diarrhea can aggregate kwashiorkor, a severe form of protein-energy malnutrition. In the late 1990s, 10% of Ugandan children were estimated to have kwashiorkor. Diarrhea is usually caused by exposure to and use of contaminated water and unhygienic practices in food preparation and disposal of excreta. Severe diarrhea causes dehydration and high mortality rates (Gerald & Jing, 2012; CSVFA, 2013; Okello et al; 2013)

The above scenario underscores the problem of a vicious cycle in which low nutritional status weakens immunity to infection, and subsequent infection results in poor nutritional status. Where food is unsafe, this situation is clearly exacerbated.

2.6 Institutional and Legal Framework for Food Safety

Food safety control is characterized by a multi-agency system whereby food safety and quality infrastructure is shared between several government ministries, departments and agencies. The multi-agency structure leads to overlap of legal provisions; suboptimal linkages and coordination, lack of accountability for food safety related incidences and duplication of control activities. Examples of institutions engaged in food

control include: Ministry of Health that acts as a lead agency; Ministry of Agriculture; Ministry of Trade, Industry & Cooperatives; and National Bureau of Standards (UNBS).

Stakeholder Analysis

Annex 1. provides details of the different institutions and their food safety roles.

- Uganda currently has a multi-agency food control system embodied in various statutes implemented by various Government ministries/departments and regulatory agencies.

- The coordination mechanism among these institutions is currently inadequate.

- This has created inefficiencies in national food safety control system resulting in recurrence of food borne illnesses.

Because of the multiplicity of control agencies; food legislations are also fragmented in various ministries and government agencies. Many laws have not been updated for a long time hence they do not address modern concepts of food safety management. For instance the Food and Drugs Act (1964) does not address the following concepts: Risk Analysis; responsibilities of stakeholders along the food chain; safety of Genetically Modified Foods, bioterrorism & emerging incidences; among others.

Therefore making harmonized national decisions for nutrition, food safety and food security requires an approach or a tool to address key considerations on public health, economic/trade and other social factors. The MCDA approach is one such a tool that enables comprehensive decision making for such scenarios.

In order to address the challenges of multiple agencies, fragmented and outdated laws, the Government of Uganda through the Ministry of Health has embarked on transforming the current National Drug Authority (NDA) into a National Food & Medicines Authority (NFMA) to widen the regulatory scope and mandate to include food, food supplements and other substances used in public health& Veterinary health. This will also make NFMA a one-stop center for food safety control and management.

2.7 National Policy Development Process and Decision Making

Policy development is a consultative process involving participation of key stakeholders with respect to the policy being developed. National policies are made by the responsible government ministry and either ratified by Cabinet, if they do not need legislation, or by Parliament for those requiring new legislation or amendment of laws. With regards to food safety, the Ministry of Health (MOH) is the lead agency with the ministerial mandate to formulate food safety policies, laws and regulations.

At the hierarchy of the policy formulation process within the ministry is the Minister responsible for Health. The National Food Safety Advisory Committee (NFSAC) was instituted by the Minister as a policy advisory body whose responsibility is to advise the Minister on all matters of national food safety including policy direction.

Development of a new policy or amendment of an existing policy can be triggered by any of the following:

- The Ministry may request for a change in policy to address emerging issues.
- To respond to a change in policy that has been recognized regionally or internationally, and which may have impact on existing operations.
- Researchers may identify evidence that there is need to change policy
  Demand by civil society

2.7.1 Policy Formulation Process

In general, the policy formulation process followed by government is outlined below:

a. A background policy paper is developed by the concerned government ministry. This may also be done by a government department or institution, in consultation with the relevant Ministry.
b. Key stakeholders are identified to solicit their participation and contribution to the policy. The stakeholders include other relevant government ministries, service

providers, civil society organizations, academia, special interest (pressure) groups, local (district) governments and development partners.

c. A draft policy is generated and reviewed by the technical team of the department or institution managing the policy development process.
d. The draft document is distributed to stakeholders for review and to provide comments.
e. A stakeholders meeting(s) is organized for in-depth discussions on the draft policy by all stakeholders.
f. A final draft, that includes the views of stakeholders, is prepared and presented to Permanent Secretary (PS) for onward presentation to the Minister.
g. The Minister presents the final draft policy to the Cabinet for ratification; or Cabinet may seek approval of Parliament.
h. After approval, policy implementation is undertaken by the relevant ministry or identified ministries and institutions.
i. Monitoring progress in implementation and impacts of the policy is conducted once implementation of policy starts, including feedback to relevant authorities for example Cabinet, Parliament and other key stakeholders.

2.8 External Factors (International Laws & Regulations) that Affect National Food Safety Policy& Decisions

There are a number of trade related international protocols ratified by Uganda which place a number of policy related obligations to which the country must compile. Some of the protocols are highlighted below:

a. World Trade Organization Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) agreements that govern food and agricultural products in international trade. The country recognizes standards and guidelines established by the FAO/WHO Codex Alimentarius Commission (CAC), the phytosanitary measures stipulated by the Plant Protection Convention (IPPC), and the animal zoonoses guidelines of the World Animal Health Organization (OIE).

b. East African Community regional initiatives such as a requirement for partner states to implement regional harmonized standards; establishment of Food & Medicines Authority under the the draft Protocol on the Establishment of the East African Medicines & Food Safety Commission; recognition of product certification marks within the region; among others.

At African Union (AU) level, the AU is to establish a food safety authority as well as a Rapid Alert System for Food and Feed (RASFF)', to prevent the spread of food-borne diseases and facilitate trade in foodstuffs.

c. Uganda is also a member of ISO, an international standard setting body for majority of product standards, Food Safety System Standards and test methods among others.

d. Uganda is a member of COMESA and hence subscribes to the SPS program under the COMESA Partner States

3. RATIONALE AND APPROACH OF THE PILOT PROJECT

3.1 Rationale

Uganda has initiated the process of upgrading the national food control system. This in turn requires putting in place a robust legal framework that will address food safety issues in a consistent and predictable manner. A study on the burden of food borne diseases has been undertaken with the aim of translating the data findings into food safety policy and the Food Law. While data on the burden of food borne diseases is clearly important, a comprehensive policy decision requires analysis of other underlying and legitimate national factors such the impact of food safety and regulation on trade, food security, and other social factors. By considering a broad set of factors, the national policy is better informed and decisions are not driven by a single consideration.

There are other challenges that are encountered in policy decision making such as having competing national priorities versus a limited resource envelope; multiple government departments and institutions involved in making food safety related decisions with limited coordination between these agencies. This often leads to duplication of activities hence a drain on the limited resources; the inability to collect and interpret rigorous evidence/data for other risk factors in order to complement the science-based methods that are used to assess public health risks. Furthermore, prioritizing food safety issues typically requires the engagement of several stakeholders from different agencies and institutions. This requires a methodology that is clear and transparent to all stakeholders.

In order to improve the effectiveness of and accuracy of the food safety decisions made at national level Uganda initiated collaboration with FAO through a pilot project of using multi-criteria approaches for food safety decision making. The added value of this approach includes its evidence based nature as well as considering the impact of a single food safety risk across multiple criteria. This approach ensures evidence informed prioritization of food safety risks improves the capacity of the country in initiating a systematic method in collecting related data and evidence in the context of scarce resources and facilitates stakeholder involvement and interaction in food safety decision making.

3.2 Overall Goal and Objectives of the Pilot Project

The overall goal of the pilot project is to enable prioritization of national food safety issues by considering a range of factors in addition to public health factors to enable a

more integrated and sustainable decision making. Effective implementation of this project is expected to achieve:

a. Enhanced understanding of multi criteria approaches to inform transparent and evidence based food safety policy and decisions.
b. Prioritization of key food safety issues in Uganda.
c. Increased knowledge and capacities in applying multi-criteria approach in food safety decision making process.
d. Agreement on follow up action to engage policy makers across the required range of Ministries.
e. Identification of needs at national level in order to apply this methodology or how the results of this study could lead to an actual change/improvement in food safety related policies.

3.3 Vision of the Pilot Project

The above expected outputs are in line with what the policy makers in Uganda envisage the project to achieve. In a national workshop on “evidence-informed decision making for national food safety policy: use of multi-criteria decision analysis tool”, participants presented the following vision on use of multi-criteria approach**.**

a. Enables prioritization and hence best use of scarce resources
b. The process is participatory and implementation requires bringing many players in different sectors together hence forces collaboration
c. Using the multi-criteria approach enables identification of which Ministry needs to do what to contribute to resolving a cross-cutting food safety issue
d. It’s a structured way to look at food safety issues
e. Captures consensus hence leading to buy-in by all stakeholders
f. Good tool for areas that are quantifiable
g. It’s a dynamic process, iterative and can be revisited periodically hence supporting changing policy priorities
h. The MCDA approach can be used to inform a range of food safety decisions, not only food safety policy. Hence the tool can be used to support decision making in the entire legal framework such as law, strategy, standards

To achieve the desired goal, the pilot project focused on the following issues: data collection, identification of the priority food safety hazards in Uganda; identification of key criteria or factors that would guide the prioritization process; and finally ranking or prioritization of the food safety issues. This in effect was the systematic process followed by the pilot project in achieving prioritization of food safety issues.

3.4 Methodology of the Pilot Project

A structured framework was used in establishing food safety priorities in Uganda as outlined below

3.4.1 Consensus building:

First and foremost, there was a need for consensus building between the key stakeholders and enable them appreciate the importance of MCDA tools in decision making. To achieve this, the pilot project was launched at a high level meeting organized by Ministry of Health/National Drug Authority in conjunction with WHO/FAO/FERG in March, 2012. The meeting was attended by top Officials from the Ministry of Health, members of the National Food Safety Advisory Committee (NFSAC), members of the National Taskforce for the *Food borne* Burden of Disease study, representatives from academia, and the private sector.

During the launch, the FAO representatives (Mary Kenny & Ms. Valerie Davidson) introduced the concept of using MCDA in policy decision making; its use in aligning food safety strategies with food security goals; and also identified the synergies between the pilot project and the then ongoing FERG burden of disease study. FAO identified the need to support data generation, particularly data on socio, political and economic analysis .i.e. situational analysis study. This data was to be integrated with the FERG BOD study in prioritizing national food safety issues.

3.4.2 Data collection

The MCDA tool requires concrete data upon which decisions can be made. This required bringing together available information on food safety hazards and other food safety issues at the national level so as to facilitate informed selection of the options to be considered.

FAO provided technical and financial support to four national consultants to collect data in four thematic areas namely: food borne diseases due to enteric hazards; food borne diseases due to parasitic agent; food borne disease to chemical agents & toxins; and situational analysis study.

The first three thematic areas provided information on the public health aspects of food safety. The major diseases contributing towards the burden of disease for enteric food borne disease were identified as: acute watery diarrhea syndrome including Rotavirus and cholera, bacillary dysentery, typhoid fever, hepatitis E virus, brucellosis, and anthrax (Wamala, 2014). Food Borne Diseases due to parasitic agents were identified

as: *Entamoebahistolytica*, Giardia spp, Cryptosporidium spp, Fascioliasis (*F.hepatica&F.gigantica)*, *Taeniasolium*, *T. Saginata,* Ascariasis (*Ascarislumbricoides)* and Intestinal flukes (Kaboyo, 2012). Chemicals and natural toxins of the public health concern included aflatoxins, fumonisins, cassava cyanide, dioxins & other POPS, Lead, Methyl Mercury, Cadmium, Organophosphate pesticides, methanol, microcystins and arsenic (Onen, 2012).

The situational analysis study was a scoping study that systematically gathered baseline data on market-level and socio-economic factors linked and underpinning food safety and food security in Uganda. This study also gathered information on the key stakeholders and their roles, market-level information, socio-economic factors and the political and policy environment surrounding food and food security in Uganda. The outcome of the situational analysis study identified the various factors that affect food safety decision making in addition to public health factors (Sengendo, 2012).
Although, these studies provided a significant amount of baseline data for the national experts, the challenge of insufficient and aggregated information on specific food safety issue was persistent. Through the data collection activities it was realized that data is dispersed among different government bodies or private sector agencies and the key to access is to improve coordination of information systems. Therefore involvement of different stakeholders in the procedure is a key success factor.
As a result, data for the study was extracted from situational analysis reports; BOD reports, various literature review, as well as through expert opinion involved in different stages of the value chain and government offices.

3.4.3 Defining the Set of Food Safety Hazards/Issues to be Considered in The Priority Setting Process

The next step was to define a set of food safety hazards/issues to be considered in the priority setting process. These were food hazards that were considered to be important in the country.

In November 2012, a stakeholder workshop was convened to review the BOD study, Participants in this workshop included the National Taskforce for BOD study and decision makers from stakeholder ministries and institutions concerned with food safety. In this workshop, participants were tasked to identify important food safety issues/hazards in Uganda they would consider for urgent attention in light of limited resources. Through brain storming, as well as considering the hazards identified in the BOD studies, and using expert opinion, the participants identified the following five issues as important:

a. *Brucella*spp. in dairy products
b. Aflatoxins in maize
c. Acute diarrhoea in children under five
d. *Taenia solium* cysticercosis in pork
e. Methanol in unregulated alcohol

3.4.4 Identification of key criteria

Having identified the food safety hazard options to be considered, the next stage was to define the decision criteria against which these food safety options will be compared. Participants were tasked to identify underlying factors that would guide or influence a policy maker in making a decision in light of an identified food safety issue. These factors would then form the risk criteria against which the food safety issues would be prioritized. Using the brainstorming approach, participants identified four broad risk criteria against which the five food safety issues would be ranked and prioritized. To make prioritization easier, the broad risk criteria were each subdivided into sub criteria as outlined in table 2 below.

Table2. Risk Criteria Identified By Participants for Ranking Food Safety Issues

No	Broad Risk Area	Specific Risk factors
1.	Public health impact	➢ Immediate Illness (numbers & severity) ➢ Long-term illness/impaired health numbers & severity) ➢ Mortality (number of fatalities) ➢ DALYs (long-term goal)
2.	Market (Economy) Impact	➢ Reduced sales/trade (domestic and export markets) ➢ Negative effects on tourism
3.	Food Security impact (individual & household levels)	➢ Reduced nutritional status ➢ Reduced accessibility (household income is reduced due to loss of employment and/or cost of treatment) ➢ Reduced availability (e.g. reduced productivity/food losses)
4.	Impact on social Factors	➢ Impacts on vulnerable sub-groups (children, those with weaker immune systems, small producers) ➢ higher impact on one gender, a particular region ➢ indirect consequences (e.g. children dropping out of school, slower development) ➢ harms country reputation

3.4.5 Evaluation & Ranking of the Food Safety Issues Using the Criteria (Multiple Risk Factors)

To facilitate a better understanding of the multi-criteria approach, case studies (or issue briefs) were developed for the five priority food safety issues in Uganda. The information for the case studies was drawn from plenary discussions at the November workshop; Task Force reports for the FERG Burden of Disease Study; expert opinion; as well as literature review. Each case study illustrated background information about the food safety issue and evidence about the impact of the food safety issue on the four risk areas (i.e. Public Health, Markets, Food security, & Social factors). Details of the case studies attached as Annex 2).

Evaluation of the five food safety issues against the four risk factors in table 2 above was done in a stakeholder workshop organized by FAO and the Ministry of Health in May 2013. The objective of the workshop, entitled "*Evidence-informed decision making for national food safety policy: use of multi-criteria decision analysis tool",* was to discuss and agree on appropriate measures for evaluating risks in each of these areas.

The risk or potential harm was characterized using a risk profile tool shown below in Figure 1. The tool is based on two components of risk: the likelihood or probability of harm and the severity of harm that is caused by hazards (pathogens and chemicals) in foods. Both the likelihood and severity of the harm were evaluated according to three possible levels that are described in qualitative terms.

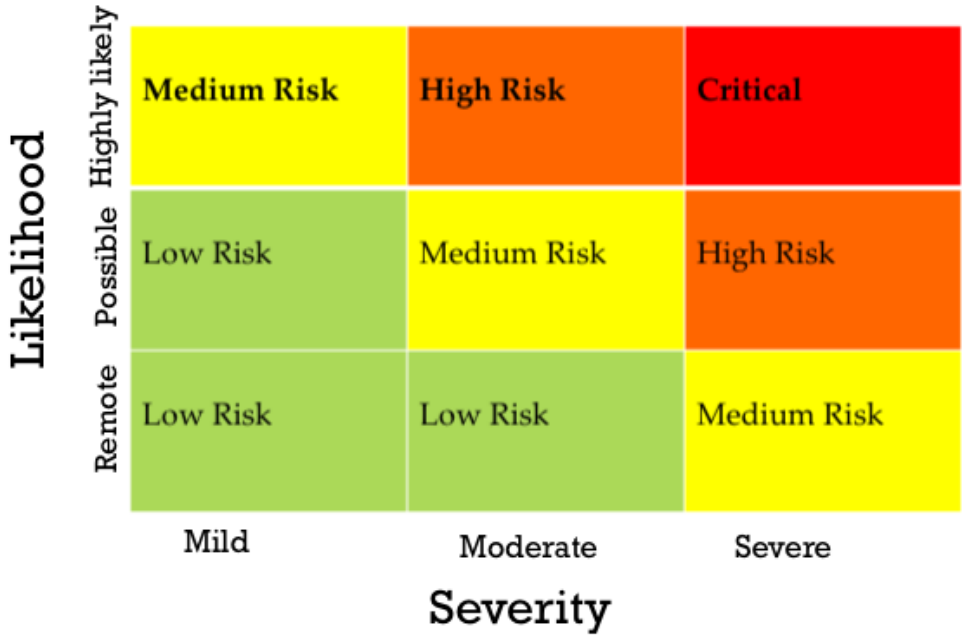


Figure 1: Risk Characterization Tool used in May workshop

One of the first steps in the characterization process was to come to agreement among the participants about the meaning of the qualitative levels for likelihood and severity of harm for each aspect of risk. This discussion was based on information drawn from the issue briefs as well as “expert” opinions from workshop participants as noted in Annex 3.

Due to time limitations during the workshop, only three of the five case studies were evaluated. The remaining two issues (Aflatoxins in maize and *Taenia solium* cysticercosis in pork) were evaluated in 2014 using the same methods that were applied in the workshop.

Details of the characterization of each food safety issue are attached as Annex 3.

4.0 PILOT PROJECT FINDINGS

The five case studies were assessed against four criteria of public health impact; food security risk, market impact and social factors with their corresponding specific risk factors (table 1). A summary of the findings are outlined below.

4.1 Characterization of the Food Safety Issues Using the Public Health Impact

Public health risks include the immediate illness that is caused by a foodborne hazard as well as sequelae that result from serious infections and/or inadequate treatment of the initial illness. Some severe cases of illness result in death. Table 3 shows results of the food safety issues characterized using the public health criteria.

Public Health Impact	**Immediate illness**	**Long-term**	**Deaths**	**Ranked order**
Acute diarrhea in children	*high-critical*	*medium*	*high*	**1**
Brucellosis – milk products	*high*	*high*	*medium*	**2**
Methanol – unregulated gin	*low-medium*	*medium*	*high*	**3**
Aflatoxin – maize	*very low*	*high*	*medium*	**5 (tie)**
Cysticercosis – pork	*very low*	*high*	*medium*	**5 (tie)**

All of the food safety issues are rated as “high” risk based on one or more of the three sub-factors, confirming that these are significant issues in terms of public health impact. However the results in Table 3 illustrate a common challenge in multi-criteria analysis - the risk ratings differ across the 3 sub-factors. Some hazards are high risks in terms of immediate illness while others have greater impact on long-term health. It is possible to develop a ranked order for the 5 case studies based on the qualitative risk levels. As shown in Table 3, acute diarrhea in children under five years is ranked as the highest public health risk overall followed by Brucellosis attributed to milk products and methanol in unregulated gin. Although Aflatoxins in maize and cysticercosis caused by *T.solium* are the lowest ranked issues in this group, it should not be forgotten that both hazards have serious impacts on long-term health.

4.2 Characterization of the Food Safety Issues Using the Market Impact

Food safety issues can cause harm or losses at the levels of export and domestic markets. For example export products are frequently subject to strict limits on levels for specific hazards (e.g. Aflatoxins) and are monitored by national agencies as well as by importers. If the acceptable levels are exceeded, the product is rejected resulting in loss

of revenue in the immediate and potentially longer term (due to loss of reputation). In general, in developing countries, domestic markets are not monitored as closely as export markets. However an outbreak or problem (e.g. methanol in locally produced waragi) would potentially reduce regional sales as well as cross-border trade. There may also be a negative impact on sale of foods on local market where there is awareness among consumers of a food safety problem.

As with risk to public health, market level risks were evaluated on the basis of the severity of harm as well as the likelihood. Wherever possible, the severity of harm was based on estimates of monetary values (e.g. trade, sales) for both domestic and export markets. Likelihood of harm (i.e. actual losses) for the export and domestic markets was based on the existence of regulations and monitoring systems. It was acknowledged that consumer awareness of outbreaks or regional differences in prevalence may affect purchases but it was difficult to quantify the risk to domestic sales (value and duration of impact). Table 4 gives results of the market impact analysis.

Table4. Characterization of Market-level risks for five case studies

Market-level Impact	**Export**	**Domestic**	**Ranked order**
Aflatoxin - maize	*medium*	*low*	**1**
Acute diarrhoea in children	*low*	*low*	**5 (tie)**
Brucellosis – milk products	*low*	*low*	**5 (tie)**
Methanol – unregulated gin	*low*	*low*	**5 (tie)**
Cysticercosis - pork	*low*	*low*	**5 (tie)**

Results in Table 4. show that the 5 food safety concerns had a low impact on the market with the exception of maize exports which may be limited by aflatoxin levels. Further work is needed to understand and assess the economic impacts that can arise from food safety issues, particularly in countries with limited infrastructure for inspecting and monitoring hazards in the food system (often described as the informal sector).

4.3 Characterization of the Food Safety Issues Using the Food Security Impact

Three areas of risk were discussed within Food Security factor, namely:

- Reduced nutritional status – including acute malnutrition, wasting and growth stunting,
- Reduced availability – including reduced production, losses due to infestation, etc. and

- Reduced accessibility – including reduced household income and/or increased costs for food products.

Table 5 presents a summary of the food security risks.

Table5. Characterization of food security risks for five case studies

Food security risks	Nutritional status	Food availability	Food accessibility	Ranked order
Acute diarrhoea in children	*high*	*low*	*medium*	**1**
Brucellosis – milk products	*very low*	*high*	*medium*	**2***
Aflatoxin- maize	*high*	*low*	*low*	**3***
Cysticercosis - pork	*low*	*low*	*medium*	**4**
Methanol – unregulated gin	*very low*	*low*	*medium*	**5**

***Brucellosis-milk products was ranked higher than Aflatoxins-maize due to a "medium" risk rating for food accessibility**

Three of the food safety issues were rated as "high" risks for one of the food security sub-factors. Brucellosis attributed to milk products was ranked higher than Aflatoxins in maize because the "medium" rating for food accessibility impact was considered to be significant.

However as noted in the summary of the workshop discussion in Annex 3, a number of the decisions were really "judgment calls" based on expert opinions and knowledge of the group. Further work is needed to clearly define the food security factors and appropriate measures to assess potential impacts caused by food safety issues.

4.4Characterization of the Food Safety Issues Using the Social Factors Impact

The discussion focused on a number of aspects of risk but it was challenging to develop metrics. However, the best effort was made with the available data. In the workshop discussion, disparities in terms of risk based on gender, social class, age groups (very young and the elderly) and geographic location were considered. Table 6 presents a summary of the discussion points related to these socio-economic factors.

Table6. Social Factors Related to the Five Case Studies

	Aflatoxinin maize	Cysticercosis in pork	Methanol in unregulated gin	Brucellosis in milk	Acute diarrhoea in children
Direct effects	*Children <5 are at "medium" risk of growth impairment*	*Social stigma of epilepsy – difficult to find employment and have a normal social life.*	*Males are at higher risk*	*Remote communities may be at higher risk*	*Children <5 are at higher risk*
		Some regions of Uganda may be at high risk due to much higher prevalence of Cysticercosis in pigs (e.g. Lira district)	*Very poor are at higher risk*		*Poor children <5 are at higher risk*
Indirect effects			*Productivity of unskilled laborers is reduced*	*Cultural practices*	*Women (as caregivers) feel greater impact Educational development can be slower*
More information needed			*Impact on heads of households*	*Impact on heads of households*	

The need to develop appropriate ways to assess social-level risks caused by food safety problems was recognized. However in the workshop as an interim measure, social factors were considered on a 3-value scale: "no concerns", "some concerns" and "concerns". Table 7 presents the assessments for the five case studies.

Table7. Characterization of Social Factors for the Five Case Studies

Food safety issue	Degree of social concern	Ranked order
Acute diarrhoea in children	*concerns*	**1 (tie)**
Cysticercosis – pork	*concerns*	**1 (tie)**
Methanol – unregulated gin	*concerns*	**1 (tie)**
Brucellosis-milk products	*some concerns*	**5 (tie)**
Aflatoxins-maize	*some concerns*	**5 (tie)**

4.5 Multi-factor Prioritization

At the May 2013 workshop, there was general discussion about how to combine the rankings for each of the major criteria (i.e. public health, market-level, food security and social impacts) for an overall prioritization of the 5 food safety issues. One of the first steps was to decide if all of the criteria should be weighted equally. There was consensus on the importance of public health and agreement that this criterion should have a higher weighting than the other factors in identifying priorities. There was also consensus that social factors should be a minor factor in setting priorities. Two of the working groups thought that food security was also a minor factor but the third group considered that food security was more important than market impact.

Reviewing the rankings across all 4 criteria, it is clear that acute diarrhea in children is the highest priority of the five case studies (ranked number 1 in terms of public health and food security impact). The priority order for the other issues depends on the weighting assigned to each criterion. Although this was not fully resolved at the May 2013 workshop, participants identified these general principles:

- Public health impact must be a primary factor in setting priorities.
- Market-level and food security impacts are not as important prioritization factors as public health.
- Social factors are a minor consideration.

The 5 case studies were prioritized using these principles as guidelines. Public health impact was given above average weighting relative to market-level and food security impacts. The latter factors were given equal weighting and social factors, were not included. The priority order for the 5 case studies is summarized in Table 8.

Table 8. Prioritization of the Five Case Studies based on Public Health, Market-level and Food security impacts

	Single Criterion Rankings			Multi-factor prioritization
	Public Health*	Market-level	Food Security	
Acute diarrhoea in children	1	5	1	Highest
Brucellosis – milk products	2	5	2	Second highest
Aflatoxin - maize	5	1	3	Third highest
Methanol – unregulated gin	3	5	5	Fourth highest
Cysticercosis – pork	5	5	4	Lowest priority

*Workshop participants agreed that public health impact should be given greater weighting than market-level or food security in prioritizing food safety issues. The 2 latter factors were given equal weighting.

For these 5 case studies, the prioritization based on 3 criteria produced a similar order to the rankings based on public health alone. There was a small variation as Aflatoxins in maize moved to third place due to potential impacts at market-level and on food security. In all cases the multi-criteria analysis provided a broader context for the food safety issues because there was at least one area of concern in addition to public health. This is important in developing appropriate management strategies and guiding policy.

The multi-factor prioritization was based on qualitative analysis but this was a useful approach to start with because it demonstrated some of the basic steps in multi-criteria decision analysis. If the numbers of food safety issues increase and/or additional criteria are considered, it would be more efficient to use formal computational algorithms for multi-criteria decision analysis. For example the PROMETHEE outranking algorithm can make use of quantitative or qualitative information to assess criteria and is available in commercial software. This outranking algorithm determines a priority order based on multiple criteria with variable weights and also shows the relative differences in rankings (i.e. how much does one issue outrank the other issues).

4.6 Conclusion of Findings

The importance of using formal structured methods to consider multiple factors in food safety decisions has been widely acknowledged. However beyond the Codex guidelines for risk analysis there is limited direction to countries in terms of recommended methods to assess other factors (i.e. those other than health risk) or practical examples of how to apply multiple criteria in food safety decisions. This pilot study breaks new ground by recognizing the need to consider factors that are relevant in the context of a developing country, including the impact of food safety issues on food security, formal and informal markets and social factors. It was also innovative in gathering and considering evidence to assess potential impacts in these areas.

Stakeholders were able to use the MCDA tool to identify five food safety issues as areas of national importance when it comes to resource allocation. They were also able to prioritize the food safety issues basing on social, economic and food security factors in addition to the public health factor.

This tool is therefore very important in guiding policy makers in deciding where to make immediate, medium and long term interventions in light of limited resources.

Overall, the pilot project has scored the following achievements:

a. Risks concerning food safety were analyzed by considering other factors such as food security and market impact other than basing on public health aspects only.

b. Stakeholder collaboration and synergies were enhanced. The food safety issues identified were cross-cutting in nature and could only be analyzed by involving the different stakeholders.

c. The study enriched the FERG Burden of Food Borne Disease Study. A number of food safety hazards were identified in the FERG study. However the ranking and prioritization to the five food safety issues as the key national issues will guide resource allocation in terms of interventions.

4.7 The Impact/Difference Made By the FAO MCDA Methodology on Food Safety Decision/Policy Making Process in Uganda

The impacts are outlined below:

a. Used and included the multi-criteria approach to finalize the Uganda /FAO/WHO /FERG Burden of Food Borne Diseases Pilot project. There will be need to develop proposals in line with the recommendations, for possible funding; including application of the MCDA Tool food safety decision making in food safety related policies and activities in Uganda.

b. Enhanced national capacity for food safety studies similar to the FERG BOD Study, to be approached in a more holistic manner.
    - Strengthened the National Food Safety Coordination mechanisms and stakeholder engagements, through a more integrated manner. For example the multi-criteria approach will be important in re-institution and functionality of the National Food Safety Advisory Committee. The Food Safety Advisory Committee was established in accordance with the Food &Drug Act 1964: Part V, 40 which mandates the Minister of Health to establish a Food Safety (Hygiene) Advisory Committee. Composed of 5 members as representative of the key stakeholder ministries, research and academia institutions related to Food Safety.

The TOR for the Committee include, among others:

I. To give policy and technical guidance and direction to the Ministry of Health on all matters related to food safety in Uganda.

II. The Minister may, from time to time, refer to the committee for consideration and advice on such questions as he or she may think fit, being questions relating to the Food & Drug Act as it applies in relation to food.

III. Where it is proposed to make regulations relating to food under this Act, the Minister shall, unless it appears to him or her inexpedient to do so having regard to the urgency of the matter, refer the proposals in the form of draft regulations to the committee for consideration and advice.

c. The National Codex Committee (NCC) has adopted a multi-criteria approach to deliberate constructively on food safety issues in Uganda and globally. In future it shall be applied to strengthen the functionality of the NCC. The NCC is a multi – sectorial and multi – disciplinary Committee composed of relevant government regulatory agencies concerned with food safety, food production and trade, research & Academic institutions, consumers organizations, and business associations(the private sector) The NCC provides a forum for discussions and for the formulation of the national position(s) and responses to Codex proposal or policy. The NCC also enables stakeholders with no international affiliation or exposure to represent their interests, or those groups unable to attend the international meetings, an opportunity to discuss the meeting' agenda with their national delegation, develop national positions and send them to the Codex Alimentarius Commission Secretariat for discussion at relevant Commission meetings. The primary objective of the National Codex Committee is therefore to act as a consultative group to the government on matters related to Codex. The primary functions are:

- Formulating the country response to the proposals of the Codex Alimentarius Commission;
- Nominating delegates to represent the country at various Codex meetings;
- Advising the government on the best possible decisions as regards Codex standards and their implementation;
- Appoint such technical sub-committees as may be necessary for the country's effective participation in Codex;
- Undertake such other duties as may be advised by the government.

Application of the multi-criteria approach has enabled the Uganda NCC to effectively and transparently carry out the above functions.

d. Food Safety is multi – sectorial and multi – disciplinary in nature. Ministry of Health has applied the MCDA Methodology to successfully lobby stakeholders,

Cabinet and Parliament for transformation of the current National Drug Authority into the National Food and Medicines Authority, and give it more mandate for comprehensive legislation for regulation of drugs, food& feeds, food supplements, cosmetics, medical & veterinary devices, health care products, chemicals for public health use, blood & biological products and related substances. For example, we are taking into consideration the multi-criteria approach in drafting of the new National Food & Medicines Authority Bill, 2014, Food Safety regulations, standards and guidelines.

e. The multi-criteria approach is also relevant to other public health related policy and activity interventions, since they also influence many sectors of national socio – economic development concurrently.

f. FAO should explore ways of engaging the health sector in Uganda to introduce/apply this methodology to other formulation of health policies, and in delivery systems/approaches which are multi – sectorial and multi – disciplinary in nature.

5.0 LIMITATIONS TO THE PILOT PROJECT

The 5 case studies included a range of foodborne hazards and were a useful way to identify different sources of information and expertise in Uganda and to demonstrate an MCDA approach to priority setting. However it is recognized that there are a number of limitations in the current analysis and challenges to consider in future work.

a. More work needs to be done to develop clear understanding of the direct linkages between food safety and key components of food security (i.e. nutrition, food accessibility and availability) and identify appropriate criteria to assess these effects.
b. Without clear criteria, it was difficult to identify concrete evidence to use in the characterization of food security risks and this is an area where further work is needed.
c. The need to develop appropriate ways of assessing social-level risks caused by food safety problems was recognized. Social factors need to be better determined including sub-criteria and weighting. This challenge can be addressed if social scientists are involved in the project design, implementation and evaluation phases.
d. It was challenging to assess the impact of food safety issues on informal markets yet these are common in developing countries and represent a significant economic value.

e. Similar analysis needs to be applied to other food safety issues in Uganda in order to fully test the criteria and evaluation methods as well as to demonstrate multi-factor prioritization with a larger number of issues.

f. There needs to be further work to explore the use of computational algorithms that can be used for multi-factor decision-making. Key questions that need to be addressed are: will decision-makers accept the methods and results? What are the costs associated with these tools?

6.0 LESSONS LEARNT FROM THE PILOT PROJECT

a. The success of the MCDA tool depends on involvement of different stakeholders. One of the key success factors in the pilot project was the multi-sectorial approach. Participants included both policy level (e.g. Top officials from Ministry of Health, Members of National Codex Committee, Members of National Food Safety and Advisory Committee); and technical people from key stakeholder ministries, agencies and private sector.

b. This study showed that in the context of scarce data, a systematic approach to identify the indirect sources of information on the missing data could result in more precise assumptions and demonstrate the evidence base for decisions. Furthermore, upon identification of the gaps in data and information, a layered methodology was adopted; Collection of the preliminary set of data gave a general view of the situation and revealed the need to further in depth investigation. The complementary evidence narrowed down the information and led to more precise ranking of the risks.

c. The MCDA approach requires baseline data for informed decisions to be made. Data from the situation analysis scoping study and the burden of disease study was very useful in characterizing and ranking the five hazards handled in the project.

d. Generally, there was a challenge of analyzing social factors with respect to food safety. This therefore requires involvement of experts in social sciences in the design, implementation and evaluation of the project. This will ensure articulation of the social factors related to food safety.

e. It’s a highly consultative process and should not be limited to obtaining results in a workshop setting only. It requires reflections to be made on the results obtained from a workshop. Therefore the process should be given ample time

to allow cross-consultations among stakeholders while relating to real life experiences within the policy environment.

7.0 KEY RECOMMENDATIONS

a. Develop a national guideline on how to use the MCDA approach as a key policy planning tool. The guideline should have information for policy level users, but with more emphasis for technical people on how to use the MCDA approach.

b. Integrate learning on MCDA to relevant University curriculum through teaching and research (e.g. MSc on Food Safety at Makerere, School of Public Health).

c. Training Program for Food inspectors on use of MCDA approach in government ministries, recognizing that food inspection programs need to be risk-based

d. Develop clearer guidelines for identifying and assessing food security factors for the prioritization analysis and document concrete examples of the impacts of food safety on food security. More work is needed to establish the most useful indicators for food safety and food security.

e. The assessment of social factors is a challenge for a technically oriented group. Social science methods are needed and it would be helpful to bring in additional expertise to help with this.

f. There is a need to raise awareness on the added value of the Multiple Criteria Decision Analysis approach among the stakeholders and key role players in high level policy making, to ensure the continuality and sustainability of the outcomes. This would facilitate smooth communication regarding sharing the data and information between the government's agency and private sector.

g. Lack of an in-place mechanism to ensure the integration of the outcomes of the project in the high level food safety decision making.

REFERENCES

1. A. Fazil, A. Rajic, J. Sanchez, and S. Mcewen. 2008. General Interest Choices, Choices: The Application of Multi-Criteria Decision Analysis to a Food Safety Decision-Making Problem. International association for food protection

2. Byanyima, M. 2013. Establishing Priorities for SPS Capacity-Building in Uganda Using Multi Criteria Decision Analysis. COMESA Secretariat

3. BOD. 2014. National Burden of Food Borne Diseases Study. The Uganda/FAO/WHO /FERG Initiative

4. CFSVA. 2013. Comprehensive Food Security and Vulnerability Analysis. Uganda Bureau of Statistics and World Food Programme.

5. FAOSTAT. 2004. Food Balance Sheet (Uganda). FAO Statistics of 2004

6. Gerald, S. and Jing. H. 2012. A Review of Agriculture, Food Security and Human Nutrition Issues in Uganda. Department of Agricultural Economics, Purdue University West Lafayette.

7. Gregory A. Kiker, Todd S. Bridges, Arun Varghese, Thomas P. Seager and Igor Linkovj. 2005. Application of Multicriteria Decision Analysis in Environmental Decision Making. Integrated Environmental Assessment and Management Volume 1, Number 2 — pp. 95–108

8. Kaboyo, W.R. 2012. WHO/FERG National Burden of Disease Study: Parasitic Diseases. Veterinary Public Health Unit, Ministry of Health. Uganda

9. Okello, B; Immink,M, &Mischler, F. 2013. Integrating Food and Nutrition Security and the Right to Food in Local Government Development Planning and Budgeting: Uganda. FAO Publication.

10. Onen, G. 2012. WHO/FERG National Burden of Disease Study: Chemicals and Toxins in Food. Uganda

11. Othieno, L; Musa, M.L. 2012. Impact of EU Common Agricultural Policy reform on Uganda's food trade with EU**.** Economic Policy Research Centre, Makerere University. Uganda

12. Rob Baltussen and Louis Niessen. 2006. Methodology Priority setting of health interventions: the need for multi-criteria decision analysis. BioMed central

13. Sengendo, S. 2012. WHO/FERG National Burden of Disease Study: Situational Analysisfor Food Safety Policy. United Nations Food and Agriculture Organization. Uganda.

14. Henson, S. 2003. The Economics of Food Safety in Developing Countries: ESA Working Paper No. 03-19.Department of Agricultural Economics & Business. University of Guelph.

15. Haggblade, S. and Dewina, R. 2010. Staple food prices in Uganda.Prepared for the COMESA policy seminar on “Variation in staple food prices: Causes, consequence, and policy options”, under the African Agricultural Marketing Project (AAMP).

16. Todd. B, Mugarura, S and Kelly, W. 2008. An assessment of the likely impact on Ugandan households of rising global food prices: Uganda Strategy Support Program (USSP). International Food Policy Research Institute

17. Wamala, J.F. 2012. WHO/FERG National Burden of Disease Study: Enteric Food Borne Diseases. Ministry of Health, Epidemiology and Surveillance Division. Uganda.

18. WHO. 2004. Global Status Report on Alcohol. World Health Organization Department of Mental Health and Substance Abuse. Geneva.

ANNEXES

Annex 1: Institutions Involved In Food Safety in Uganda

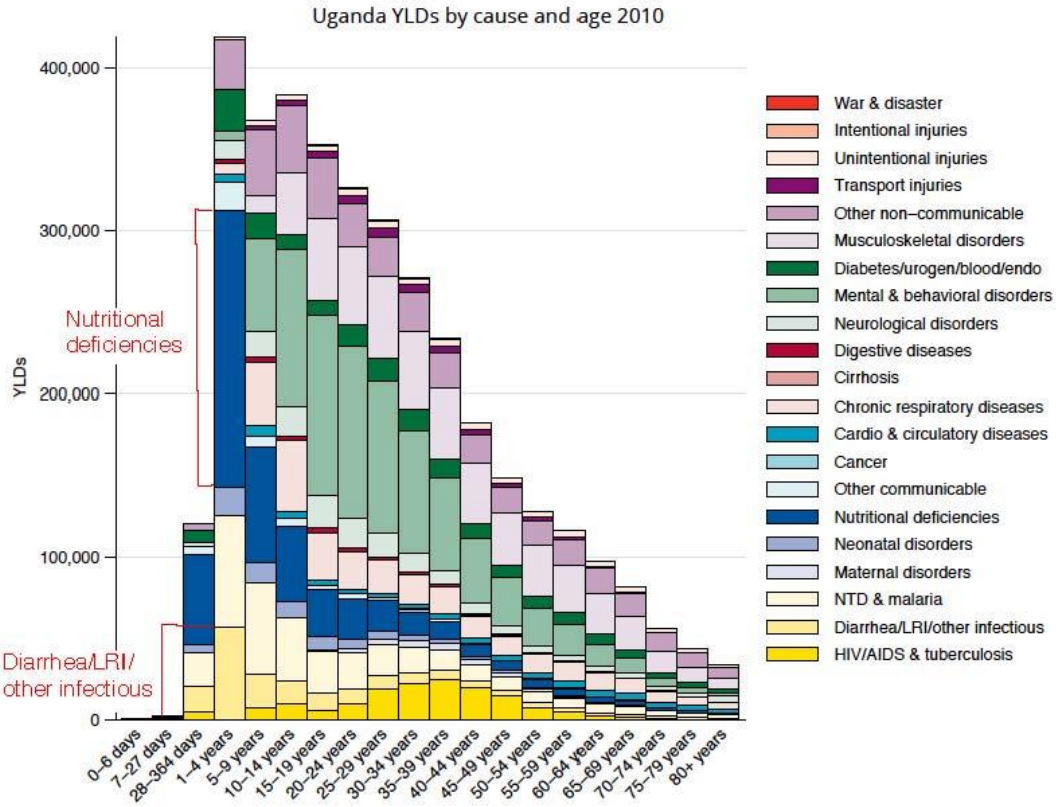
Ministry	Institution	Responsibilities
Ministry of Health	Ministry of Health	• Lead Institution for Food Safety • Inspection of all foods • Delegates food inspection to districts and city councils
Ministry of Agriculture Animal Industries and Fisheries	Crop protection Department	• Enforcing regulations on registration of Agro-chemicals, plant protection and phyto-sanitary issues; plant health import and export certification
	Department of animal production and marketing	• Animal diseases, animal health certification
	Department of fisheries resources	• Enforcing fisheries regulation, • carrying out inspection of factory premises, processing lines, landing sites, fish transport and export points for adherence to safety and quality requirements • Fish for export and fish for the local consumption • Fisheries products • Fish export certification • Lake and coastal waters protection
	Department of Livestock and Entomology	• Animal disease • Veterinary inspection of abattoirs • Inspection of meat processing establishments • Import and export certificates for animal and animal products • Certification for organic honey
	Uganda Coffee Development Authority	Lincenses coffee roasters, processors and exporters, • Carries out quality inspection and • Regulation of all coffee exports • Carries out training of quality controllers, cup testing and some extension among processors.
	Dairy Development Authority (DDA)	Marketing and Processing of Milk and Milk Products
Ministry of Trade Tourism and Industry (MTTI)	Uganda National Bureau of Standards	• Standard setting • Technical assistance and training for industry • Standard enforcement • Testing certification of standardized products • Inspection of food imports • Testing • Product certification

		• ISO, WTO, codex Alimentarius focal point • East African community standards Harmonization • Metrology
Ministry of Water Resources and Environment	Directorate of Water Development	• Development and improvement of water sources for communities • Water quality control • Water quality surveillance
	National Environmental Management Authority	• Compile a national profile on management of chemicals for Uganda • Development of environmental standards
Local Governments Authorities Municipal authorities	District and municipal authorities	Food inspection
	National Food Hygiene Advisory Committee: .	The MOH established a multi-sectoral National Food Safety Advisory committee charged with giving policy and technical guidance and direction to the Ministry of Health on food safety in Uganda.
	National Codex Committee:	The Uganda Government established a multi-sectoral National Codex committee (NCC) chaired by the MOH. This committee provides advice on matters of international food standards and food safety issues in general. The committee was established in line with the Codex Alimentarius Commission (CAC) guidelines, and the composition of the committee is drawn from MOH, the NDA, MAAIF, MTIC, Government Analytical Laboratories, academia, Uganda Consumer Protection Association and the Uganda Manufacturers Association

Annex 2: Details of the Five Case Studies

1.0 CASE STUDY ON ACUTE DIARRHOEAL DISEASE IN CHILDREN (UNDER 5 YEARS):

The Global Burden of Disease 2010 report[1] shows that diarrheal diseases are ranked 9th as a cause of premature death in Uganda (all age groups). The report also shows that for Ugandan children nutritional deficiencies and the combined factors of diarrhea, lower respiratory and other infectious diseases account for about 30% of the impaired health of children under 5 years. Impaired health is measured by the years of productive life lost due to illness and disability (YLDs) and is shown by age groups in the graph below.



Diarrheal disease can be caused by a number of transmission routes – food, water and environmental. This case study will focus on trying to estimate the amount of illness and mortality that is caused by food sources as compared to the other transmission routes. It will not focus on particular food sources and hence it does not consider market-level factors for this food safety issue.

(1) Public Health impacts of acute diarrhoeal disease

[1] http://www.healthmetricsandevaluation.org/sites/default/files/country-profiles/GBD%20Country%20Report%20-%20Uganda.pdf

Immediate illness: Lamberti *et al.* (2012) ran a systematic review of diarrhoeal disease in low- and middle-income countries. For children less than 5 years, the authors estimate that the majority (64.8%) present with mild diarrhoeal symptoms that last 4 days. Moderate disease symptoms occur in about 34.7% of cases. The remainders (0.5%) are severe cases that require hospitalization and the average duration of symptoms is 8 days.

Long-term illness/impaired health: Some of the hazards that cause diarrhoeal disease may have long-term health impacts. For example, campylobacteriosis can lead to Guillain Barre syndrome and reactive arthritis. However the long-term impacts are specific to a particular hazard and are not considered in this case study.

Exposure and cases: Acute diarrhoeal disease is transmitted through unsafe drinking water as well as through food contaminated by hazards at the food source (e.g. zoonotic pathogens), by unsafe water and environmental pathways (e.g. inadequate personal hygiene). The challenge for this case study is to estimate how much disease is caused by contaminated foods as compared to drinking unsafe water in Uganda. In making this estimate, we may want to consider differences between rural and urban populations.
The number of reported cases of acute diarrhoeal disease for children under 5 years of age increased significantly in Uganda between 2005 and 2012 and represents two-thirds of the total reported cases. In 2012, about 48,000 children (< 5 years old) were hospitalized and there were 762 fatalities attributed to acute diarrhoeal disease.

(2) Market impacts

This example considers diarrhoeal disease that is foodborne but does not attempt to identify specific food products. As a result risks to trade and markets are not relevant.

(3) Food security factors

Since acute diarrhoeal disease impairs the uptake of nutrients, it contributes to nutritional deficiencies in children.

Acute diarrheal disease in children may also have an impact on livelihoods because primary caregivers in the household may also be primary income earners.

(4) Social factors

Children under 5 years are vulnerable and should be protected from disease.

2.0 CASE STUDY ON BRUCELLA SPP. IN MILK AND DAIRY PRODUCTS

Brucellosis in humans is usually associated with the consumption of unpasteurized milk or products made from raw milk and with occupational exposure of farm workers, veterinarians, and slaughterhouse workers to infected animals. Person-to-person transmission is extremely rare. Based on a review of the literature, it is likely that majority (if not all) of the cases are foodborne.
Brucellosis causes fevers, weakness and muscular and bodily pain. If not treated at an early stage, it can result in chronic debilitating conditions that prevent people from working so it has significant cost in terms of livelihoods.
In most areas of Uganda, milk is sold or traded without pasteurization. Control steps that reduce the levels of *Brucella* spp. in dairy products are thermal treatment (i.e. pasteurization) and fermentation to reduce pH.

(1) Public Health Impacts of Brucellosis

The severity of the disease in humans is influenced by the type of organism and its source. In general, *B melitensis* (sheep, goats and sometimes cattle) is more virulent for humans than *B. Abortus* (cattle).

Immediate illness: Brucellosis is a systemic infection that can involve any organ or tissue of the body. Symptoms include fever (sometimes intermittent), sweats, fatigue, malaise, anorexia, weight loss, and headache, joint and back pain which can persist for weeks or months. Often patients feel better in the morning but develop worsening symptoms as the day progresses. Common symptoms are profound fatigue and depression.

Long-term illness/impairment of health: Without early treatment with antibiotics, the disease can progress to persistent infections that may require hospitalization. The long-term effects are highly variable and may include “chronic fatigue syndrome”, hepatitis, anemia, arthritis, meningitis and endocarditis.

Exposure and cases: Per capita milk consumption in Uganda is about 25.4 kg per year (DDA, 2010) and only 10% of production is pasteurized before marketing. A recent risk assessment estimated that 12.6% of informally marketed milk in Kampala was contaminated with *B.Abortus* at purchase (Matika et al., 2010). It is customary for Ugandans to boil milk before consuming but this may not be sufficient. Reports have shown that at high levels of contamination ($>10^6$/ml), heating at 85^oC for 30 minutes is not sufficient to reduce *Brucella* spp to safe levels. Ugandans also consume yoghurt/clotted milk products and fermented butter made from raw milk. Since *Brucella*dies off fairly rapidly when the acidity drops below pH 4, and very rapidly below pH 3.5, fermented products are lower risk than raw milk.
For the period 2008 to 2012, 3193 human cases of brucellosis were reported to the Ministry of Health (average = 798 cases per year). There is some evidence of regional variation in human brucellosis across Uganda. Ndyabahinduka and Chu (1984) referenced studies based on *B. abortus* agglutination tests that showed a human prevalence of 18% in Kabale (South Western, 1976) and 24.4% in Karamoja (North Eastern, 1966).

A study among hospital patients with chronic fever in Kampala found 13 percent had antibodies to *B. Abortus* and 26 percent antibodies to *B. melitensis* (Natala, 2003).

Death occurs in less than 1% of brucellosis cases, most frequently due to infective endocarditis. Brucellosis during the course of pregnancy carries the risk of spontaneous abortion or intrauterine transmission to the infant.

(2) Markets affected by Brucellosis

Annual volume of marketed milk in Uganda was estimated at 741 million liters of which 90% is sold through informal markets as unprocessed milk (TechnoServe Uganda 2008).
The dairy industry in Uganda has many players along the entire value chain. There are millions of small-scale dairy farming households (estimated to be about 3.8 million in 2008), tens of thousands of middlemen trading in milk, and a small number of registered dairy processors (15 in 2008). The total value of milk in Uganda (excluding imported milk) was $332.5 million based on 2008 volumes and prices (TechnoServe Uganda 2008). There is a price difference between the informal and formal market channels and the value of milk marketed through the informal channel was about $265 million in 2008.
UHT-processed milk is the main dairy export product, mainly to regional markets, including Rwanda, Kenya, Tanzania, DR Congo, Southern Sudan and Mauritius. The total value of dairy exports was USD$11.04 million dollars in 2010 (Dairy Development Authority Annual Report).

(3) Food security factors

Brucella infections in dairy cattle reduce milk production as a result of abortions and mortality of infected calves. The cost of brucellosis in terms of milk production has been estimated at 2-4 kg/cattle/year in sub-Saharan Africa (Magnen*et al.* 2002). This is a cost in terms of reduced livelihoods and availability of a nutritious food. In terms of milk consumption per capita, Uganda is significantly below the WHO recommended levels: 25 l vs 200l). The practice of boiling milk is important in terms of creating a safer product but it does reduce the nutritional value. Livelihoods are also impacted for those who suffer from chronic fatigue syndrome as a result of brucellosis infections.

When a patient is ill from brucellosis, this has a significant impact on the household economy in terms of out-of-pocket contributions to health costs and change in income. Treatment of all forms of human brucellosis requires effective antibiotics at as early a stage as possible and for an adequate length of time. Treatment of *Brucella* endocarditis requires specific bacteriocides to prevent heart valve damage and if not successful, surgical replacement of damaged valves is required.

(4) Social factors

At this point there is no information about the age and gender distribution for brucellosis cases reported to the Ministry of Health. Antibiotic treatment of brucellosis in neonates and children less than 8 years of age is more difficult because certain drugs inhibit bone growth and others are not recommended for use in young children.

3.0 CASE STUDY ON METHANOL IN UNREGULATED WARAGI

Unregulated waragi accounts for nearly 80% of the liquor produced in Uganda, according to the Uganda National Bureau of Standards (UNBS), which oversees production of legal products in the country (Gatsiounis 2010). Homemade waragi is produced by distilling fermented bananas, millet, cassava or molasses but unless the distillation is carefully controlled there is a high risk of adulterating the product with methanol. When ingested, methanol is converted to formic acid which is highly toxic and can cause metabolic disturbances, blindness, permanent neurologic dysfunction and death.

The government recognizes that homemade waragi is an important source of income for the entrepreneurs who produce it but the Ministry of Health is also pressured to take action to prohibit homemade alcohol due to the large number of deaths that have resulted from the consumption of products that were adulterated with methanol.

(1) Public Health Impacts of Methanol:

Immediate illness and mortality: Methanol has a high toxicity in humans. The initial symptoms are similar to ethanol-induced inebriation: central nervous system depression, headache, dizziness, nausea, lack of coordination, and confusion. A second set of symptoms arises, 10 to 30 hours after the initial exposure to methanol, due to the formation of formic acid and accumulation of format in the blood. The ingestion of as little as 10 mL of methanol can cause damage to the optic nerve resulting in blurred vision or permanent blindness. Sufficiently large doses (generally cited as a minimum of 100 mL but there is considerable variability) can cause unconsciousness and death due to respiratory failure (Details taken from Kruse 1992).

Exposure and cases: The incidence of acute methanol poisoning in Uganda is a major public health problem. A Ministry of Health investigation of outbreaks in 4 districts (Luwago*et al.* 2007) reported 61 cases and 39 fatalities (case fatality rate 64%). A higher proportion of the victims of methanol poisoning were male (65%) compared to females (35%) and the average age of victims who died was 43 years (range 21 to 70 years).
Between 2009 and 2010, 8 major incidents of methanol poisoning were reported across a number of districts in Uganda. In total there were 377 cases and 94 fatalities (case fatality rate 25%). The 2009 incident was raised in question period in the Ugandan parliament and it was noted that 4 of the victims in Gulu were teachers who became blind as a result of the methanol poisoning. In Kabale, blindness resulted in 20 victims (Ministry of Health 2010). Two commercial products were implicated in 2 of the 8 incidents: Viva gin from Kamengo and Rio Vodka alcohol from Buloba in Wakiso district.

(2) **Market impacts**

The Ugandan Bureau of Standards (UNBS) oversees production of legal distilled products and currently about 65 producers are approved. However the UNBS estimates that unregulated (illegal) waragi accounts for nearly 80% of the liquor produced in the country (Gatsiounis 2010). Homemade (unregulated) waragi is significantly less expensive than regulated products - about one-sixth the cost of the leading regulated brand.
In 2008 Uganda lowered the tax on domestically produced alcohol, boosting both production and consumption of regulated and illegal waragi. In 2008 legal distilled products were Uganda's sixth-highest revenue source, accounting for 10% of national revenue, according to Uganda Youth Development Link (UYDEL), one of the country's leading voices against alcohol abuse. "Drinking has been made way too

easy," says Mutaawe Rogers, UYDEL's Program Officer. "Business interests are winning out over national interests." (Gatsiounis 2010).
The EnguliAct which regulates the alcohol industry has not been updated since 1964 despite efforts by the Ministry of Health to advance a new alcohol policy in 2009. At the present time the fine for illegal production is only about $1.50 and the maximum jail term is six months. However offenders' cases are often dropped before they reach a courtroom" (Gatsiounis 2010).

(3) Food security factors

There is little political will to pursue illegal producers because it would have a negative impact on household livelihoods. (Quote from Uganda Hansard, February 2008 "women involved in brewing *Waragi,* who by and large are engaged in its brewing to feed, educate and support their families.").
The potential to cause blindness also has serious implications for livelihoods. For example, the four teachers in Gulu would not be able to return to the classroom.
Although unregulated waragi is less expensive than regulated alcohol, its purchase reduces household resources to purchase food and other necessities. Rural Ugandans have been known to sell clothes, furniture, even cars and property to support their alcohol habits (Gatsiounis 2010).

(5) Social factors

The recent outbreaks of methanol poisoning have been reported widely in the international press (Time Magazine, BBC). This has a negative impact on Uganda's reputation.

4.0 CASE STUDY ON FLATOXINS IN MAIZE[2]:

Aflatoxins are toxic compounds produced by certain fungi (*Aspergillus* spp.)That can infect foods during production and storage, particularly in tropical regions. Aflatoxins have been detected at levels that exceed recommended maximum limits in a number of staple foods, including maize, groundnut and cassava samples, in Uganda(Data from Makerere University, Department of Food Science and Technology).
Maize is consumed about 2 to 3 times per week in most regions of Uganda and it accounts for 40% of calories consumed per capita in both rural and urban areas (FAOSTAT data). Maize is also an important source of income at the country level as well as for individual households.

(1) Health impacts of Aflatoxins:

Acute exposure to aflatoxins can result in aflatoxicosis which causes severe damage to the liver and has a case fatality rate of 25% (Strosnider*et al.* 2006). There has been 1 reported case of aflatoxicosis in Uganda -a 15-year old boy died after eating highly contaminated cassava in 1967. It is recognized that chronic exposure to aflatoxins also causes health problems, including higher risk of liver cancer and growth stunting. When people are exposed to Hepatitis B virus as well as to aflatoxins, the risk of hepatocellular carcinoma (HCC liver cancer) increases up to 30-fold (Groopman and Kensler, 2005). Information from the National Cancer registry (2011) shows that is a high incidence of HCC in Uganda, particularly in the age range between 25 and 55 years. There is also a high prevalence of Hepatitis B in Uganda. At this time, it is not possible to quantify the amount of HCC that is due to aflatoxin exposure, to Hepatitis B virus and to the interaction between the 2 factors but the increased risk needs to be included in the assessment of health impact.
Studies in western Africa using biomarkers suggest that aflatoxin exposure in utero and after weaning is linked to impaired growth in children (Gong *et al*., 2002, Gong *et al*., 2004, Turner *et al.,* 2007).Analysis at Makerere University, Department of Food Science confirms that aflatoxin levels in infant food samples can exceed the maximum tolerated levels that have been established (4 -20 ppb range). The prevalence of stunting in Ugandan children has been decreasing but the national average was reported to be 33% in 2011. To date there has not been any analysis of aflatoxin biomarkers in Ugandan children. However it is likely that some of the growth stunting in Ugandan children is linked to chronic aflatoxin exposure (*demographic data – size of population under 5 years*).

(2) Markets:

Maize is grown in all regions of Uganda, with the Eastern Region estimated to produce the largest quantity. In the household survey that was conducted for the 2009 Comprehensive Food Security and Vulnerability Analysis (CFSVA, World Food Program), about 10% of the households were categorized as "Maize Farmers" – those who cropped maize in about 70% of their total area. However all farmer groups planted about 5-10% of their total crop area in maize.
About 20% of the total maize production in Uganda is retained for household consumption. According to the 2009 CFSVA for Uganda, cereals are the most traded food items and maize represents the largest share in terms of market volumes handled. The maize market includes players at the local, regional and national levels. There are "assemblers'' who buy maize from other farmers for the purpose of reselling it

[2]Maize has been chosen as the focus for this case study since it is a staple food in Ugandan diets and it is traded in local and export markets. It is not the only source of aflatoxin exposure for Ugandans and other sources should be considered in future analysis.

to consumers or local and regional wholesalers. Market data from the World Food Program shows that maize prices in Uganda averaged about 800 shillings per kg in 2007-08. Across regions, the price varied between 500 and 1000 shillings per kg with highest prices in Kampala).
It is estimated that about 50% of maize production in Uganda is traded through local markets compared to about 10 to 15% that is traded through export market. Maize is a minor component of formal agricultural exports – contributing 1-2% to the total earnings (2007-2011 data). However maize contributes US $22.1 million per year through informal cross-border trade, about 15% of the total value of informal agricultural exports (2010-2011 data).

The formal export markets enforce maximum limits for aflatoxin levels. For example, maize that is exported to the EU for human consumption cannot exceed 10 ppb aflatoxin. (*Is there a Ugandan standard? Also need to check EAC and COMESA standards?*). It is unlikely that aflatoxin levels are monitored in the local markets and informal cross-border trade.
Food security factors - need to recognize that lack of maize would be a significant threat to food security.

The CSFVA analysis of maize prices indicated that maize is a fairly expensive cereal in Uganda and price volatility would have a significant impact on food security.
Maize is a staple food in Uganda and a large number of households grow and store maize for their own consumption. It is likely that many households face chronic aflatoxin exposure. In addition to the health impacts that have been noted, growth stunting may impair educational development in children. Maize trading is an important source of household income.

(3) Social factors:

Chronic aflatoxin exposure has significant impacts for children and young adults (HCC incidence).

5.0 CASE STUDY ON TAENIA SOLIUM CYSTICERCOSIS IN PORK

Taenia solium cysticercosis is a public health and agricultural problem in many developing countries. It is caused by a pork tapeworm, *T. solium*, which forms cysts in humans and pigs that can lead to epilepsy, death and other health conditions in humans. It is considered endemic in Latin American, Asian, and African countries where pigs are raised using traditional methods, veterinary meat inspection is insufficient, and sanitation is poor (Rachana et al, 2013).

(1) Public Health Impacts of Cysticercosis

Immediate and long-term illness: There are two primary forms of infection associated with *T. solium*: taeniosis and cysticercosis. Patients suffering from taeniosis (adult tapeworm in small intestine) are typically asymptomatic, but can suffer from gastrointestinal discomfort characterized by diarrhea and abdominal pain. Cysticercosis (egg form of tapeworm in organs) on the other hand has much more significant impacts.

The primary health outcome of concern associated with cysticercosis occurs when larvae develop in the brain or spinal cord (neuro cysticercosis or NCC). The most common outcome among diagnosed NCC patients has been reported to be epileptic seizures (78.8%) followed by headaches (37.7%), focal deficits (16%), and cranial hypertension/hydrocephalus (11.7%) (Carabin et al, 2011).

Exposure and Cases:

Humans are the natural definitive host of *T. solium*. Eating undercooked pig meat containing the larval stage of the tapeworm (cysticercosis) leads to Human Taeniosis. Taeniosis results from the larvae developing into the adult tapeworm and establishing in the small intestine of humans. Consumption of food contaminated with *T. solium* eggs leads to human cysticercosis.

Several factors have been found to facilitate the occurrence of cysticercosis. These include open defecation, poor personal hygiene, free ranging pigs, and lack of safe drinking water. These factors facilitate both human and animal host access to human faecal materials, which may contain *T. solium* eggs. Domesticated pigs play the major role in the transmission cycle of the parasite because of their close proximity to humans, especially in rural areas, and the increasing popularity of pig keeping and pork consumption in many developing countries.
Uganda has the highest consumption per capita of pork of any country in Africa (3.4kg/person/year) and has the 3rd highest number of pigs on the continent (http://livestockfish.cgiar.org/2011/12/31/uganda-pigs/; http://www.globaleducationmagazine.com/pig-production-marketing-uganda-limited).

As a result, the population is potentially at significant risk from cysticercosis based on potential exposure. In 2012, Dr Emilia Ahimbisibwe, the KCCA senior veterinary officer of the public health department, warned that the pork sold in Kampala was becoming increasingly risky for human consumption, citing the reported unhygienic nature in which meat was being slaughtered, transported and prepared. In addition to the exposure potential, a relatively high prevalence (8.6%) of porcine cysticercosis (PCC) has been reported (Waiswa et al., 2009). An even higher prevalence of *T. solium* infection has been reported for pigs in rural areas (35-45%) (Phiri*et al.* 2003). The prevalence of porcine cysticercosis found in eastern African countries ranks among the highest in the world (Phiri*et al.* 2003).

There is very limited data in the Ministry of Health records related to Taeniosis or Cysticercosis. Data from outpatient clinics (2005 – 2011) indicate number of cases with "intestinal worms" (average of 1.60 million cases per year) but the *T. Solium* fraction is unknown. The case numbers for cysticercosis and epilepsy in Uganda were not available. Since NCC and epilepsy are the most serious health impacts, we have included relevant data from studies in other countries.

At present, two studies have been carried out in Africa evaluating the burden of cysticercosis/NCC. A study in West Cameroon revealed that 1.0% of the total population had NCC-associated epilepsy (based on serological results) and 5.6% of the pig population had cysticercosis (vs 8.6% porcine cysticercosis in Uganda). Average number of DALYs lost due to NCC was 9.0 per 1,000 person-years and the monetary burden per case of NCC-associated epilepsy in Cameroon was estimated to be 194 Euro in 2009 (Praet et al., 2009). Another study conducted in the Eastern Cape Province of South Africa estimated that the monetary burden of NCC-associated epilepsy in 2004 varied from US$632 to US$844 per case, indicating high financial costs associated with this condition.

In addition, Ndimubanzi*et al*. (2010) reviewed the global literature looking at epilepsy patients for which imaging had been conducted to determine how many of them have signs of NCC. These authors found that 29% (23%-36%) of epilepsy cases in endemic areas could have been caused by NCC.

(2) Market impacts

Over the past two decades pig production has become an increasingly important activity in Uganda. In the last 30 years the pig population has increased from 0.19 to 2.3 million, and there are more than 1 million households raising pigs. According to recent FAO statistics, pork (77,000 tonnes) is second only to beef (97,000 tonnes) in terms of meat production in Uganda. Since imports and exports of meat products are negligible; this ranking also reflects the relative importance currently of pork in terms of meat consumption. Based on a current retail price for pork 5,520 (US$ 2.15) per kg, the total value of the pork sector 425 x 109 or US$ 1,660 million.

There are no studies available that provide estimates of the economic impact of *T. solium* in pigs on the Ugandan economy, however there are some estimates on its impact in other countries, other regions and other species that could be used to provide some insight. A review by Murrell (1991) summarizes results from two authors that estimate porcine cysticercosis resulting in a $48.60 per partial carcass loss, and a $1.72 per kilo loss. In Mexico at an infection rate of approximately 1.6% the total loss was estimated to be $68 million per year.

The total annual costs due to *T.solium* cysticercosis in West Cameroon were estimated at 10,255,202 Euro (95% 6,889,048–14,754,044), of which 4.7% (482,000 Euro) was due to losses in pig husbandry and 95.3% to direct and indirect losses due to epilepsy caused by human neurocysticercosis (Praet et al., 2009). A study conducted in the Eastern Cape Province of South Africa estimated annual losses to the agricultural sector at US$5.0 million (95% CI: 2.4 – 8.1) (Bhattarai et al., 2013).

The market impact on the pig industry and economy in general relate to the partial or full condemnation of carcasses and resulting economic losses in areas in which meat is inspected. In areas in which there is no standard inspection, traders look for the presence of cysts and offer lower prices for infected animals (Bhattarai et al., 2013). While Uganda is not a major exporter of pigs or pork, the presence *of T. solium* in the pig population restricts the ability to export in the future until it is eliminated.

(3) Food Security Factors

The primary impact of cysticercosis on food security is reduced prices for infected animals resulting in an overall reduction in income either to the larger producer or the small farmer and surrounding communities. In addition, the infection of both pig farmers and other citizens with neurocysticercosis has the potential to reduce their productivity due to disability subsequently reducing their income and ability to buy food (Ngowi et al 2013).

(4) Social Factors

There are more than 1 million households raising pigs and the majority of pigs are kept by women in smallholder households as part of a large informal subsector.

REFERENCE SOURCES

***Taenia solium* cysticercosis in Pork**

Bhattarai, R., Carabin, H. and C. Budke (2013). The Burden of Cysticercosis, Novel Aspects on Cysticercosis and Neurocysticercosis, Prof. HumbertoFoyacaSibat (Ed.), ISBN: 978-953-51-0956-3, InTech, DOI: 10.5772/51668. Available from: http://www.intechopen.com/books/novel-aspects-on-cysticercosis-and-neurocysticercosis/the-burden-of-cysticercosis

Carabin H, Ndimubanzi PC, Budke CM, Nguyen H, Qian Y, Cowan LD, Stoner JA, Rainwater E, Dickey M. (2011) Clinical manifestations associated with neurocysticercosis: a systematic review. PLoS Neglected Tropical Diseases 2011; 5(5) e1152.

Ndimubanzi PC, Carabin H, Budke CM, Nguyen H, Qian YJ, Rainwater E, Dickey M, Reynolds S, Stoner JA. (2010) A systematic review of the frequency of neurocyticercosis with a focus on people with epilepsy.PLoS Neglected Tropical Diseases 4(11): e870.

Praet N, Speybroeck N, Manzanedo R, Berkvens D, NsameNforninwe D, Zoli A, Quet F, Preux PM, Carabin H, Geerts S. (2009). The disease burden of Taeniasoliumcysticercosis in Cameroon.PLoS Neglected Tropical Diseases 3(3): e406.

Bhattarai R, Budke CM, Carabin H, Proano JV, Flores-Rivera J, Corona T, Ivanek R, Snowden KF, Flisser A. (2012) Estimating the non-monetary burden of neurocysticercosis in Mexico. PLoS Neglected Tropical Diseases 6(2): e1521.

Waiswa C, Fèvre E. M, Nsadha Z, Sikasunge C. S, Willingham III A. L (2009) Porcine Cysticercosis in Southeast Uganda: Seroprevalence in Kamuli and Kaliro Districts. J Parasitology Res; doi:10.1155/2009/375493

Phiri I. K, Ngowi H, Afonso S, Matenga E, Boa M, Mukaratirwa S, Githigia S, Saimo M, Sikasunge C, Maingi N, Lubega G. W, Kassuku A, Michael L, Siziya S, Krecek R. C, Noormahomed E, Vilhena M, Dorny P, Willingham A. L. (2003) The emergence of Taeniasoliumcysticercosis in Eastern and Southern Africa as a serious agricultural problem and public health risk. ActaTropica 87(1) 13_23.

Murrell, K. Darwin (1991) "Economic losses resulting from food-borne parasitic zoonoses." Southeast Asian J Trop Med Public Health 22: 377-81.

Ngowi, Helena A., Samson Mukaratirwa, Faustin P. Lekule, NdichuMaingi, Charles Waiswa, Chummy Sikasunge, Sonia Afonso et al. "Agricultural Impact of Porcine Cyisticercosis in Africa:

Aflatoxins in maize

Gong *et al*. 2002. Br Med J. 325(7354):20-21.

Gong *et al*. 2004. Environ HlthPerspec. 112(13):1334-1338.

Groopman and Kensler, 2005.ToxicolApplPharmacol. 206(2): 131-137.

Strosnider*et al.* 2006.Environ HlthPerspec. 114(12): 1898-1903.
Turner *et al.* 2007. Int J Epidemiol. 36(5): 1119- 1125.

World Food Programme 2009.Comprehensive Food Security & Vulnerability Analysis (CFSVA) Uganda.

Methanol in Unregulated Waragi:

Gatsiounis, I. 2010 "The Battle to Stop Drink from Destroying Uganda" Time World, May 19, accessed at http://www.time.com/time/world/article/0,8599,1989842,00.html

Kruse, J.A. 1992. Methanol Poisoning Intensive Care Med (1992) 18:391-397.

Luwago, L., Najjemba, R., Kirunda, B., Feinstein, L., Beseya, W., Mugagga, M. 2007. Investigation of death due to methanol poisoning in Kampala, Wakiso, Mukono and Mubende. Ministry of Health, Uganda.

Ministry of Health 2010. Annual Health Sector Performance Review Financial Year 2009/2010, p. 42 accessed at http://www.starecuganda.org/files/AHSPR2009-10.pdf

***Brucella* spp. in milk and dairy products**

Makita K, Fèvre EM, Waiswa C, Eisler MC, Welburn SC (2010) How Human Brucellosis Incidence in Urban Kampala Can Be Reduced Most Efficiently? A Stochastic Risk Assessment of Informally-Marketed Milk.PLoS ONE 5(12): e14188. doi:10.1371/journal.pone.0014188

Mangen, M.-J., Otte, J., Pfeiffer, D., Chilonda, P. 2002. Food and Agriculture Organization, Livestock Information and Policy Branch.

Natala, WR 2003.Sero-prevalence of brucellosis among patients with persistent fever attending medical assessment centreMulago Hospital.MSc thesis, Makerere University, Uganda.

Ndyabahinduka DGK, Chu IH 1984. Brucellosis in Uganda**,**Int J Zoonoses 1984, **11:**59-64.
TechnoServe Uganda 2008.
The Dairy Value Chain in Uganda Report for East Africa Dairy Development Program. Accessed at http://cgspace.cgiar.org/bitstream/handle/10568/2406/Dairy%20Value%20Chain%20Uganda%20Report.pdf?sequence=1

Acute diarrhoeal disease in children (under 5 years):

Lamberti, L. M., Walker, C. L. F., & Black, R. E. (2012). Systematic review of diarrhea duration and severity in children and adults in low- and middle-income countries. *BMC Public Health, 12*(276): 1-11. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3364857/pdf/1471-2458-12-276.pdf

Annex 3: Characterization and Prioritization of the Food Safety Issues

Evaluation of food safety issues in terms of multiple risk factors –
Uganda workshop May 27-30th 2013 and follow-up research by consultants 2014

Definition of the linguistic scale:

The first step in the workshop exercise was to come to a group consensus about the meaning of the linguistic scales in the risk characterization tool. In terms of likelihood of harm to human health, the starting point was to establish an upper limit for the annual number of cases of illness or deaths caused by foodborne hazards in Uganda. Based on the case studies, an upper limit of 10,000 was used and the overall range was divided into 3 intervals based on powers of 10 (i.e. 10^0 - 10^1, 10^1 – 10^3, 10^3 - 10^4). As indicated in Table 1, each interval was defined with a label to create a linguistic scale for likelihood of illness or death.

Table 1: Linguistic scale for likelihood of illness (immediate cases and sequelae) or death

Linguistic label	Number of cases or deaths caused by foodborne hazard(s) per year
Remote/low	0 to 10
Possible/medium	> 10 and ≤ 1,000
Highly likely	> 1,000 and ≤ 10,000

Severity of illness or loss of health:

The second linguistic scale is used to assess severity based on the nature of the symptoms as well as the duration of symptoms (i.e. a few days vs. years). As we discussed the case studies, comparisons were made across symptoms in terms of debilitating effects and duration to make sure that we were consistent in our assessment of severity. The table below is a summary of the way we categorized typical symptoms for foodborne illnesses at the workshop.

Table 2: Linguistic categories for severity of health outcomes

Linguistic label for severity	**Immediate illness**	**Chronic conditions**
Mild	Mild diarrhoea	Repeat episodes of diarrhoea
Moderate	Severe headache, Fever, fatigue, joint/back pain lasting for weeks (between moderate and severe)	
Severe	Fever, fatigue, joint/back pain lasting for weeks (between moderate and severe) Hospitalized cases of diarrhoea Epilepsy episodes requiring inpatient treatment Hepatocellular carcinoma Death	Endocarditis Blindness

Risk Characterization for 3 food safety issues –

The following notes explain the rationale for assessing likelihood and severity of harm to health for each of the 3 food safety issues. Based on these values, the matrix in Figure 1 was used to characterize the public health risks for immediate illness, long-term effects and deaths. Table 3 presents a summary of the public health risks.

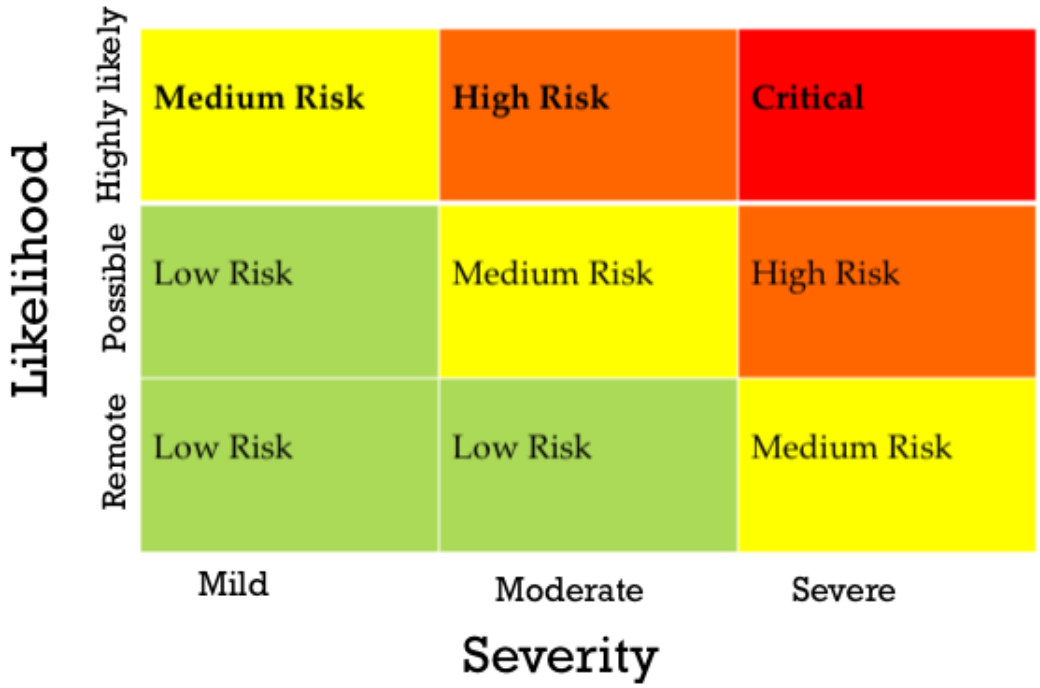


Figure 2: Risk Characterization Tool used in May workshop

1. Acute diarrhoeal disease in children under 5 years of age

The group discussed the fraction of acute diarrhoeal disease that is caused by food sources. There is no data in this area but the group estimated that between 35 and 60% of the illness in children under 5 years is caused by food (including infant formula that is contaminated during preparation by water or poor hygiene).

Immediate symptoms include mild and severe diarrhoea. The number of mild cases is not captured by Ministry of Health (MoH) records because these children are not taken for medical treatment. It was agreed that the mild cases of foodborne diarrhoea were "highly likely" and the severity was "mild" which was characterized as a "medium risk". MoH records indicated 48,000 children under 5 were hospitalized with severe diarrhoea in 2012. This suggests that between 16,800 and 28,800 cases per year were caused by food sources (based on the 35-60% estimates). Severe diarrhoea was assessed as "highly likely", "severe" health impact and "critical" risk level. In terms of immediate illness, the risk estimates were between "medium" and "critical". Based on discussion, it was agreed that the overall risk for acute diarrhoeal disease caused by food was "high-critical" (i.e. between high and critical risk levels).

Chronic illness was considered to multiple episodes of diarrhoea (one expert estimated that children can have 10 episodes a year). The likelihood of multiple episodes was considered "highly likely" and the

severity was rated as “mild” so the risk was “medium”. Chronic nutritional impacts (e.g. malnutrition, wasting and stunting) were evaluated as a sub-criterion under Food Security.

The number of deaths per year caused by food sources was estimated to be between 265 and 460 (35-60% of 762 deaths in 2012). In terms of deaths per year, acute diarrhoeal disease was considered “medium” likelihood, “severe” impact and “high” risk to children under 5 years.

2. Brucellosis in dairy products

After some discussion, the group agreed that 50% of brucellosis cases are caused by drinking milk. Based on Ministry of Health data, there were on average about 800 reported cases per year (2008 – 2012) but group agreed that under-reporting is a problem. Based on an estimate of at least 50% under-reporting, the group estimated about 1000 cases of brucellosis per year were caused by milk products (i.e. at the limit between medium and high likelihood). Symptoms (fever, fatigue, and joint/back pain lasting for weeks) were considered between “moderate” and “severe”. Risk characterization was between “high” and “critical”. Based on a poll, participants agreed to “high” risk.

Infective endocarditis is a “severe” chronic impact that can result from brucellosis. Likelihood was uncertain but assumed to be in “medium” category (between 11 and 1000 cases per year). Assessment of risk due to chronic conditions was rated as “high”.
Deaths caused by brucellosis – estimated to be less than 10 per year (“remote”). Risk of death was rated as “medium”.

3. Methanol in unregulated gin

The immediate symptom is a severe headache (rated as “moderate” on overall severity). Ministry of Health investigated 8 major incidents between 2009 and 2010 so likelihood was rated as “medium” and risk as “low-medium”.

Blindness was considered as a “severe” long-term impact. Likelihood of blindness was rated as “medium” and hence risk was “medium”.

Since case fatality ratio is high for methanol poisoning, likelihood of death was rated as “medium” (> 10 deaths per year). Risk was evaluated as “high”.

4. Aflatoxins in maize

Although the impact is severe (liver damage and in some cases death), aflatoxicosis due to acute exposure in a food source such as maize is very unlikely. Hence the risk of immediate illness caused by aflatoxins in maize was “very low”.

Long-term exposure to aflatoxins in food leads to increased risk of hepatocellular cancer (HCC), particularly in those who have Hepatitis B virus. A national survey (2008) indicated about 10% of adults in Uganda had HBsAg antibody (indicating Hepatitis B infection) and about 52% of adults had HBcAb (indicating a past or present Hepatitis B infection). Analysis at the University of Makerere found average levels of aflatoxins above the 10 ppb standard for samples of maize grains from 5 districts. Maize is

consumed 2 to 3 times per week in most regions of Uganda and it accounts for 40% of calories consumed per capita in both urban and rural areas.

Data from the Kampala Cancer registry for Kyadondo County indicated there were 120 active cases of HCC and 8 deaths in 2011. The population in Kyadondo County represents about 7% of the total Ugandan population and includes urban and peri-urban areas. It is recognized that not all cases of HCC can be attributed to aflatoxins in maize but this is a significant source of exposure in Uganda. Hence the likelihood of HCC cases attributable to aflatoxins in maize was considered to be "possible (or medium)" (i.e. greater than 10 but less than 1,000 cases per year). Since HCC is a "severe" outcome, the risk is considered to be "high".

The likelihood of deaths due to HCC caused by aflatoxins in maize was considered to be "low" (i.e. less than 10 per year) so the risk was considered to be "medium".

5. Cysticercosis in pork:

This case study focused on illness caused by ingesting viable *T. solium* cysts (i.e. the larval stage of *T. solium*not the adult tapeworm). This can lead to a wide range of neurological problems but these develop over time and the risk of immediate illness was considered to be "very low".

Neurocysticercosis (NCC) is a long-term health problem that results when the cysts develop in brain and spinal cord; epileptic seizures and headaches are the most common symptoms. Using the 30% factor suggested by Ndimubanzi*et al.* (2010)[3] and inpatient admissions for epilepsy, it is estimated that NCC was responsible for the epilepsy symptoms in about 850 patients in 2013.

The main food sources for NCC are undercooked pork that contains viable cysts and food that is infected by cross-contamination and poor hygiene practices on the part of people who handle and prepare food. It is estimated that 60% of all pork that is consumed in Uganda is served at roadside markets and bars where it is prepared by roasting. Roasting is less severe than boiling which is the method used to prepare pork at home and may result in undercooked pork. As a conservative estimate, it was assumed that half of NCC cases (i.e. about 400 cases) resulted from foodborne transmission of *T. solium* cysts as compared to other transmission routes (e.g. environmental). This number of annual cases falls into the "possible (or medium)" range of likelihood.

In the Global Burden of Disease 2004 Update[4], epileptic episodes were assigned an average disability weight that was comparable to diarrheal diseases (0.113 for epilepsy vs. 0.105 for diarrheal disease). A 1994 report[5] estimated that the patients with cysticercosis required an average of 8 days in hospital and a further 19 days before returning to work. This is a "severe" health impact and the overall risk is considered to be "high".

The same assumptions were used to estimate the number of deaths that were due to NCC caused by foodborne sources. The total number of deaths in the epilepsy inpatient data for 2013 was multiplied

[3]Ndimubanzi*et al.* 2010, PLoSNeglected Tropical Diseases 4(11): e870

[4] WHO 2004 Global Burden of Disease Update: Disability Weights for Diseases and Conditions (Table 1)

[5] Roberts, Murrell and Marks 1994, Parasitology Today, **10,** 419–423

by a factor of 30% (NCC related) and then a factor of 50% (for food borne sources) to yield an estimate of fewer than 5 deaths per year caused by NCC. In terms of likelihood, death was assessed as "remote" or "low" and a "severe" outcome so the risk was characterized as "medium".

Table 3: Characterization of Public Health Risks for 5 case studies

Public Health impact	***Aflatoxin maize***	***Cysticercosis - pork***	***Methanol unregulated gin***	***Brucellosis milk products***	***Acute diarrhoea in children***
Immediate illness	*Very low*	*Very low*	*Low-medium*	*High*	*High-critical*
Long-term	*High*	*High*	*Medium*	*High*	*Medium*
Deaths	*Medium*	*Medium*	*High*	*Medium*	*High*

Market Impact

Food safety issues can cause harm or losses at the levels of export and domestic markets. For example export products are frequently subject to strict limits on levels for specific hazards (e.g. aflatoxins) and are monitored by national agencies as well as by importers. If the acceptable levels are exceeded, the product is rejected resulting in loss of revenue in the immediate and potentially longer term (due to loss of reputation). In general in developing countries, domestic markets are not monitored as closely as export markets. However an outbreak or problem (e.g. methanol in locally produced waragi) would potentially reduce regional sales as well as cross-border trade. There may also be a negative impact on sale of foods on local market where there is awareness among consumers of a food safety problem.

As with risk to public health, market level risks were evaluated on the basis of the severity of harm as well as the likelihood. Wherever possible, the severity of harm was based on estimates of monetary values (e.g. trade, sales) for both domestic and export markets. Likelihood of harm (i.e. actual losses) for the export and domestic markets was based on the existence of regulations and monitoring systems. It was acknowledged that consumer awareness of outbreaks or regional differences in prevalence may affect purchases but it was difficult to quantify the risk to domestic sales (value and duration of impact).

Risk characterization for 5 food safety issues

The matrix in Figure 1 was used to characterize the market-level risks for each case study. Where available, estimates of total market value are included in the notes. Table 4 presents a summary of the market-level risks.

1. Acute diarrhoeal disease in children under 5 years of age:

In considering this issue, the group recognized that 35 – 60% of the illness is caused by food sources but did not focus on specific food products. As a result, it was not possible to assess an economic value at risk in either export or domestic markets. In the multi-criteria decision table, the risk evaluations were "low" for both sub-criteria.

2. Brucella in milk products

Brucellosis is endemic in Uganda but some regions may be at higher risk than others (this may be something to flag in social factors). Exported milk is heat treated so the likelihood of harm (lost export revenue) is low. The total value of dairy exports is US $ 11 million (2010) and the risk to export markets was rated as "low".

The value of milk marketed through informal markets was estimated at US $ 265 million (2008). This milk is unpasteurized but consumers generally boil before drinking. Consumers may be aware of regional differences in prevalence of brucellosis in dairy herds and may avoid buying milk from certain regions. However there was no concrete evidence to support this idea and at a national level it is probably not significant. Thus the risk to the domestic market was evaluated as "low" based on "remote" likelihood and "medium" severity in terms of economic value.

3. Methanol in unregulated gin

Some waragi is traded across borders (South Sudan, Congo, Rwanda) but unregulated products are not monitored for methanol. If there is an outbreak, cross-border trade may shut down for a short term but economic value is small. The risk to export trade of unregulated gin was assessed as "low".

"Unregulated" gin production is a significant fraction of liquor produced and sold in Uganda (estimated at 80% in 2010) but product quality is not monitored. Hence the impact to domestic trade was rated as "low".

4. Aflatoxins in maize

Informal trade in maize grains and flour had an estimated value between US $ 37 and 46 M while formal maize exports were valued between US $ 29.1 and 38.2 M over the period 2009-2010. There is evidence that Ugandan maize has been rejected by the WFP due to aflatoxin levels above 10 ppb or discolouration (and suspicion of aflatoxin contamination). It is less likely that maize samples are tested in the informal, largely domestic market.

Aflatoxins were considered to be a "low" risk to domestic trade in maize, due to very low inspection rate for compliance. However it was considered "possible (or medium)" likelihood that aflatoxins would to have a negative impact on export trade and the severity was considered "moderate" (i.e. a fraction or all of the export value). Hence the risk for export trade was considered "medium".

5. Cysticercosis in pork:

Although there may be some informal trading of pigs and pork products across borders with neighbouring countries, it is not considered to be significant in terms of economic value. Therefore it was assumed that *T. solium* cysts in live pigs and pork products do not pose a threat to export markets.

Pork consumption at home has been increasing significantly (by a factor of 10 over the last 10 years) and Uganda has the highest per capita pork consumption in Africa (3.4 kg per annum). Large commercial farmers account for less than 15% of the total pig production. Small holders use traditional pig-rearing practices such as tethering and free range. In rural areas, the lack of latrines is a significant risk factor that is associated with prevalence of porcine cysticercosis. The prevalence of cysticercosis in pigs varies from region to region but across Uganda the average prevalence is about 9%.

Based on a wholesale price of US $ 2.50 per kilogram and a production total of 113,000 tonnes (2010), the farm-gate value of pork is about US $ 282.5 million. Based on inspection records from 43 districts (out of a total of 112), it was estimated that the economic loss due to condemned carcasses was US $ 1.2 million (2013). This is a small fraction (< 0.5%) of the total value but it is recognized as a significant under-estimate of the economic impact of cysticercosis in pork. Carcasses are not inspected in villages and some of the urban abattoirs. So a significant amount of pork is not inspected.

Given the low likelihood of inspecting and condemning infected carcasses, the risk to the domestic pork trade was assessed a "low". However it should be noted that infected pigs are sold at lower prices and this depresses the average wholesale price resulting in a lower economic value for the entire pork industry.

Table 4: Characterization of Market-level risks for 5 case studies

Market impact	**Aflatoxin maize**	**Cysticercosis pork**	**Methanol unregulated gin**	**Brucellosis milk products**	**Acute diarrhoea in children**
Export	*Medium*	*Low*	*Low*	*Low*	*Low*
Domestic	*Low*	*Low*	*Low*	*Low*	*Low*

Food Security

During the workshop we discussed 3 areas of risk within Food Security:

- Reduced nutritional status – including acute malnutrition, wasting and growth stunting,
- Reduced availability – including reduced production, losses due to infestation, etc. and
- Reduced accessibility – including reduced household income and/or increased costs for food products.

We had limited concrete evidence to use in the characterization of food security risks and this is an area where further work is needed. A number of the decisions were really "judgment calls" based on expert opinions and knowledge of the group. Table 5 presents a summary of the food security risks.

Characterization of food security risks for 5 food safety issues (notes to explain choices)

1. Acute diarrhoeal disease in children under 5 years of age: It was agreed that acute diarrhoeal disease contributes to reduced nutritional status that manifests as wasting, acute malnutrition and growth stunting.
   In the workshop, these impacts were assessed as follows:

Condition	Severity
Wasting	Mild
Acute malnutrition	Moderate
Growth stunting	Severe

Experts in the group provided estimates of prevalence: wasting affects 5% of Ugandan children under 5 years; 33% of children suffer growth stunting. However it was not clear what fraction of these nutritional problems are caused by acute diarrhoeal disease. At the end of the discussion the group decided that the risk to nutritional status due to acute diarrhoeal disease was "high" since growth stunting was a "severe" impact and the likelihood was assumed to be "possible". We need to gather better evidence that relates acute diarrhoeal disease and the incidence of wasting, acute malnutrition and growth stunting and then re-evaluate the estimates of likelihood for all 3 conditions.

The impact of acute diarrhoeal disease on food availability was evaluated on the basis of the primary caregiver having less time to devote to food production and preparation. This was recognized as an indirect effect on the entire household. It was evaluated as a "low" risk in terms of food availability.

The discussion of the risk to food accessibility followed a similar logic (i.e. impact on primary caregiver who is often the primary food provider). A large portion (70%) of children suffering from acute diarrhoea is taken to hospitals or clinics for treatment. This requires them to take time away from work (paid or unpaid) and this can result in reduced resources to buy or trade for food. The impact would be offset by social networks (e.g. extended families) that can help with childcare. The final decision was to rate the risk to food accessibility as "medium".

2. Brucella in milk products: The practice of boiling milk reduces the risk of illness but also reduces the nutritional quality (rated as "mild" in terms of severity). However milk is a minor component of Ugandan diets so the likelihood of causing a change in nutritional status due to boiling milk was assessed a remote and the overall risk was "very low".

Brucellosis in dairy herds does cause a reduction in the availability of milk due to abortions, loss of replacement stock and impacts on the animal itself (estimated as 2-4 kg of milk/animal/year). This was assessed as a "severe" impact (in part because of the fact that Uganda is significantly below WHO recommended levels for milk consumption). Since brucellosis is endemic in Ugandan herds, the likelihood was considered "medium" (possible) and the risk to food availability was "high".

Brucellosis in humans results in fatigue (immediate and chronic) and pain (joints, back) that affects ability to earn income. Furthermore, treatment of immediate and chronic symptoms requires antibiotics. Paying for antibiotics may reduce household resources and ability to secure adequate food. The final decision was to rate the risk to food accessibility as "medium".

3. Methanol in unregulated gin: Methanol adulteration is a separate issue from alcoholism (which can cause nutritional deficiencies). It was agreed that the risk to nutritional status due to methanol was "very low".

The impact on food availability was discussed in terms of how much of the food supply is diverted into unregulated gin production (mainly bananas and molasses). The risk to food availability was rated as "low".

The impact on food accessibility was consistent with the factors that were considered for the other 2 case studies (i.e. it is "possible" that household income declines due to blindness or death of income earner) and the risk to food accessibility was characterized as "medium" risk.

4. Aflatoxins in maize

Although the scientific community has not come to complete agreement, there is a significant amount of evidence linking aflatoxin exposure to impaired growth and stunting in children. This is a significant impact on nutritional status (see discussion under "Acute diarrhoeal disease in children under 5 years of age").

A recent study in southwestern Uganda included 96 children under the age of 3 years. Most of the children (92) had detectable levels of AF-alb adduct in their blood, indicating exposure to aflatoxins. It is recognized that the children were exposed to aflatoxins through a number of food sources but maize would be a common component in many infant foods. Hence the likelihood of aflatoxin levels in maize causing impaired growth in children was considered "medium" and the impact was "severe". Hence the risk was considered to be "high".

Two-thirds of the HCC cases reported in Kyadondo County (2011) were patients in the 25 to 55 year range for both male and females. Hence HCC has a significant impact on adult members of the population, those who produce food and income for households. Based on the estimate of HCC cases attributed to aflatoxins in maize (see Public Health Impact), it was considered "possible" that this had a negative impact on food accessibility. However there was no information to estimate the magnitude of the impact. . As a conservative estimate, it was assumed that the impact or severity was "mild" and the risk to food accessibility was considered "low".

Although there is no data on quantities of maize that are rejected or discarded due to aflatoxin contamination, it is estimated that this is a "remote" possibility. The risk to food availability was considered to be "very low".

5. Cysticercosis in pork:

Based on the literature review conducted by Dr. Kaboyo, there was no evidence that cysticercosis causes impaired nutritional states such as growth stunting in children. It is more likely that taenosis (adult tapeworm infection) impairs nutrient absorption in the gastro-intestinal tract. Hence the risk to nutritional status due to cysticercosis was considered to be "low".

Pork carcasses are condemned because of the presence of *T. solium* cysts but this is a small fraction of the total pork production. The impact on food availability in rural areas is not significant because there slaughter operations in villages are not inspected, and therefore carcasses are not condemned. Therefore the risk to food availability is considered to be "low".

It is estimated that more that 1.1 million households are involved in backyard pig production, characterized by tethering and scavenging which is a major factor for *T.solium* infection. In Uganda, pig rearing is an important source of income for households – for food as well as discretionary spending such as school fees. Based on an average prevalence of 9%, it was estimated that the risk to individual households of having infected pigs was "medium". Infected pigs sell at a reduced price but they do have some value so the economic impact was assessed as moderate and the overall risk to food accessibility was considered to be "medium".

Table 5: Characterization of food security risks for 5 case studies

	Aflatoxin-maize	Cysticercosis - pork	Methanol in unregulated gin	Brucella in milk products	Acute diarrhoea in children
Nutritional status	*High*	*Low*	*Very low*	*Very low*	*High*
Food Availability	*Low*	*Low*	*Low*	*High*	*Low*
Food Accessibility	*Low*	*Medium*	*Medium*	*Medium*	*Medium*

Social Factors

The discussion focused on a number of aspects of risk but it was challenging to develop metrics. However, the best effort was made with the available data and results are presented here.

In the workshop discussion, we considered disparities in terms of risk based on gender, social class, age groups (very young and the elderly) and geographic location. Table 6 presents a summary of the discussion points related to these socio-economic factors.

Table 6: Social factors related to the 5 case studies

	Aflatoxin in maize	Cysticercosis in pork	Methanol in unregulated gin	Brucellosis in milk	Acute diarrhoea in children
Direct effects	Children <5 are at "medium" risk of growth impairment	Social stigma of epilepsy – difficult to find employment and have a normal social life.	Males are at higher risk	Remote communities may be at higher risk	Children <5 are at higher risk
		Some regions of Uganda may be at high risk due to much higher prevalence of Cysticercosis in pigs (e.g. Lira district)	Very poor are at higher risk		Poor children <5 are at higher risk
Indirect effects			Productivity of unskilled laborers is reduced	Cultural practices	Women (as caregivers) feel greater impact Educational development

					can be slower
More information needed			Impact on heads of households	Impact on heads of households	

We recognize that we need to develop appropriate ways to assess social-level risks caused by food safety problems. However in the workshop as an interim measure we considered social factors on a 3-value scale: “no concerns (= 0)”, “some concerns” (= 0.5) and “concerns” (=1). Table 7 presents the assessments for the 3 case studies.

Table 7: Characterization of social factors for 5 case studies

	Aflatoxins-maize	**Cysticercosis in pork**	**Methanol in unregulated gin**	**Brucellosis in milk**	**Acute diarrhoea in children**
Social risks	*Some concerns*	*Concerns*	*Concerns*	*Some Concerns*	*Concerns*

Annex 4: List of Workshop Participants

4 (a): List of Participants Who Attended MOH/WHO/FAO/FERG Pilot Country Study Kick-Off Meeting: Where the MCDA Pilot Study Was Launched, Golf Course Hotel, 6-7 March 2012,

1. Dr. Rob Lake, FERG/ CSTF Chairperson, WHO/FERG, Geneva
2. Ms. Tanja Kuchenmüller, Technical Officer Food Safety & Zoonoses, WHO/FERG, Geneva
3. Ms. Mary Kenny, FAO, Rome, Italy
4. Ms. Valerie Davidson, FAO Consultant, Rome, Italy
5. Dr. Anthony K. Bonye, Ministry of Health, P. O. Box 7272, KAMPALA
6. Dr. Denis. K. Lwamafa, Director Health Services (Clinical & Community Health Ministry of Health, P. O. Box 7272, KAMPALA
7. Ms. Adongo Florence, Commissioner, Water Quality, Directorate of Water Resources Management, Ministry of Water & Environment, P. O. Box 20026, ENTEBBE
8. Dr. Ben Manyindo, Deputy Chair NFSAC &Deputy Executive Director – Technical
   Uganda National Bureau of Standards, P.O. Box 6329, KAMPALA
9. Ms. Hope Kabirisi, Special Presidential Assistant on Science & Technology, State House
   P.O Box 25497, KAMPALA
10. Prof. J. Kakitahi, Makerere University School of Public Health, P. O. Box 7072, KAMPALA
11. Mr. Henry Richard Kimera, Chief Executive Officer, Consumer Education Trust, Ambassador House, KAMPALA
12. Prof. William Kyamuhangire, Department of Food Science & Technology, Makerere University, P. O. Box 7062, KAMPALA
13. Prof. E. Sabiti, Faculty of Agriculture, Makerere University, P. O. Box 7062, KAMPALA
14. Dr. Sam Mugasi, Coordinator- District Livelihood Support Program, Ministry of Local Government, Workers House, 2nd Floor, KAMPALA
15. Prof. George Nasinyama, Deputy Director Research & Publications, School of Graduate Studies, Makerere University, P. O. Box 7062, KAMPALA
16. Dr. William Ssali, Chairman National Standards Council, Uganda National Bureau of Standards, P. O. Box 6329, KAMPALA

17. Mrs. Ruth Mbabazi Tugume, Uganda National Council of Science & Technology, P. O. Box, 6884, KAMPALA

18. Dr. John Sekamate, National Planning Authority, 158 Clement Hill Road, P. O. Box 21434, KAMPALA

19. Prof. Archileo N. Kaaya, Senior Lecturer, Dept. of Food Science & Technology, Makerere University, P.O. Box 7062, KAMPALA

20. Dr. Charles Muyanja, PhD, Department of Food Science and Technology, Faculty of Agriculture, Makerere University, P.O Box 7062, KAMPALA

21. Mr. David Eboku, Uganda National Bureau of Standards, P.O. Box 6329, KAMPALA

22. Mr. Geoffrey Onen, Principal Government Analyst, Directorate of Government Analytical Laboratories, P.O. Box 2174, KAMPALA

23. Prof. B. T. Kiremire, Chemistry Department, Makerere University, P.O. Box 7062, KAMPALA

24. Dr. Roy Mayega, School of Public Health, Mulago, KAMPALA

25. Mwesigye Collins, World Health Organisation, KAMPALA

26. Stella Sengendo, Food & Agriculture Organisation, KAMPALA

27. Guma Guspard, Central Public Health Reference Laboratory Services, KAMPALA

28. Menyha Emmanuel, Uganda National Bureau of Statistics, P.O. Box 6329, KAMPALA

29. Patrick Atimnadi, Uganda Wildlife Authority (UWA), KAMPALA

30. Mulabya Fred, Senior Principal Health Inspector, Environmental Health Division Ministry of Health, P.O. Box 7272, KAMPALA

31. Dr. Jolly Hoona, Veterinary Public Health, Ministry of Agriculture, Animal Industry & Fisheries, P.O. Box 102, ENTEBBE

32. Mr. Michael Odong, Crop Protection, Ministry of Agriculture, Animal Industry & Fisheries P.O. Box 102, ENTEBBE

33. Mr. Omanyi B. Paul, Department of Fisheries Resources, Ministry of Agriculture, Animal Industry & Fisheries, P.O. Box 102, ENTEBBE

34. Dr. David Mugisa, Occupational Safety & Health Department, Ministry of Gender, Labour & Social Development, KAMPALA

35. Dr. Winyi Kaboyo, ACHS (VPH), Ministry of Health, P.O. Box 7272, KAMPALA

36. Dr. Sendagire Ibrahim, District Health Officer (DHO), Kampala Capital City Authority (KCCA), KAMPALA

37. Dr. Makanga Luwuum, District Health Officer (DHO), Kampala Capital City Authority (KCCA), KAMPALA

38. Kirunda Patrick, District Health Officer (DHO), Kampala Capital City Authority (KCCA), KAMPALA

39. Mr. Sebaggala M. Kigozi, Executive Director, Uganda Manufacturer's Association, P. O. Box 6966, KAMPALA

40. Mr. Gordon Sematiko, Executive Secretary/Registrar, National Drug Authority, P.O. Box 23096, KAMPALA

41. Dr. Agaba Friday, Food Safety Coordinator, National Drug Authority, P.O. Box 23096 KAMPALA

42. Ms. Irene Wanyenya, Deputy Food Safety Coordinator, National Drug Authority, P.O. Box 23096, KAMPALA

43. Mr. Peter Ssali, Quality Manager, National Drug Authority, P.O. Box 23096, KAMPALA

44. Ms. Mary Tumushabe, Secretary, Food Desk, National Drug Authority, P.O. Box 23096 KAMPALA

45. Ms. Mirembe Carolyne, Directorate of Research & Graduate Training, Makerere University, P.O. Box 7062, KAMPALA

4 (b): List of Participants Who Attended Workshop on Mid Term Review of the BOD Study, Imperial Royale Hotel, 26-28 November 2012

1. Dr. Rob Lake, FERG/ CSTF Chairperson, WHO/FERG, Geneva

2. Ms. Tanja Kuchenmüller, Technical Officer Food Safety & Zoonoses, WHO/FERG Geneva

3. Ms. Mary Kenny, Food and Agriculture Organization (FAO) of the United Nations, Nutrition and Consumer protection Division, Rome, Italy

4. Ms. Valerie Davidson, FAO Consultant, Rome, Italy

5. Dr. Jean Kamanzi, FAO Food Safety Officer, Sub -regional Office for Southern Africa based in Harare

6. Ms. Adongo Florence, Commissioner, Water Quality, Directorate of Water Resources Management, Ministry of Water & Environment, P. O. Box 20026, ENTEBBE

7. Ms. Hope Kabirisi, Special Presidential Assistant on Science & Technology, State House P.O Box 25497, KAMPALA

8. Prof. J. Kakitahi, Makerere University School of Public Health, P. O. Box 7072, KAMPALA

9. Prof. William Kyamuhangire, Department of Food Science & Technology, Makerere University, P. O. Box 7062, KAMPALA

10. Prof. George Nasinyama, Deputy Director Research & Publications, School of Graduate Studies, Makerere University, P. O. Box 7062, KAMPALA

11. Mrs. Ruth MbabaziTugume, Uganda National Council of Science & Technology, P. O. Box, 6884, KAMPALA

12. Prof. Archileo N. Kaaya, Senior Lecture, Dept. of Food Science & Technology, Makerere University, P.O. Box 7062, KAMPALA

13. Mr. Geoffrey Onen, Principal Government Analyst, Directorate of Government Analytical Laboratories, P.O. Box 2174, KAMPALA

14. Stella Sengendo, Food & Agriculture Organization, KAMPALA

15. Mr. Walakira Godfrey, Walakira Godfrey, Senior Commercial Officer, Ministry of Trade, Industry and Cooperatives, Box 7103, Kampala, KAMPALA

16. Guma Guspard, Central Public Health Reference Laboratory Services, KAMPALA

17. Menyha Emmanuel, Uganda National Bureau of Statistics, P.O. Box 6329, KAMPALA

18. Mulabya Fred, Senior Principal Health Inspector, Environmental Health Division, Ministry of Health, P.O. Box 7272, KAMPALA

19. Dr. Jolly Hoona, Veterinary Public Health, Ministry of Agriculture, Animal Industry & Fisheries, P.O. Box 102, ENTEBBE

20. Mr. Michael Odong, Crop Protection, Ministry of Agriculture, Animal Industry & Fisheries P.O. Box 102, ENTEBBE

21. Dr. Winyi Kaboyo, ACHS (VPH), Ministry of Health, P.O. Box 7272, KAMPALA

22. Mr. Namanya B Didacus, Ministry of Health, P.O. Box 7272, KAMPALA

23. Ms. Tumuboine Ephrance, Principal Agric Inspector/Phyto Sanitary & Quarantum, Ministry of Agriculture, Animal Industry & Fisheries, P.O. Box 102, Entebbe,

24. Dr. Agaba Friday, Food Safety Coordinator, National Drug Authority, P.O. Box 23096 KAMPALA

25. Ms. Irene Wanyenya, Deputy Food Safety Coordinator, National Drug Authority, P.O. Box 23096, KAMPALA

26. Mr. Peter Ssali, Quality Manager, National Drug Authority, P.O. Box 23096, KAMPALA

27. Ms. Mary Tumushabe, Secretary, Food Desk, National Drug Authority, P.O. Box 23096 KAMPALA

4 (c): List of Participants Who Attended the Workshop on 'Evidence-Informed Decision Making For National Food Safety Policy: Use Of Multi-Criteria Decision Analysis Tool' At School Of Food Science, Biotechnology and Engineering, Makerere University, 27- 30 May 2013

1. Mr. Matwire Benon, Uganda Consumer Protection Association, KAMPALA
2. Dr. Mary Kenny, Food Safety Officer, Food and Agriculture Organization, ROME, ITALY
3. Ms. Valerie Davidson, FAO Consultant, ROME, ITALY
4. Dr. Jean Kamanzi, FAO Food Safety Officer, Sub -regional Office, Southern Africa, HARARE
5. Dr. MakumbiIssa, Ministry of Health, KAMPALA
6. Mrs. Ruth Mbabazi Tugume, Uganda National Council of Science & Technology, P. O. Box, 6884, KAMPALA
7. Prof. William Kyamuhangire, School of Food Technology, Nutrition and Bio-engineering Makerere University, P. O. Box 7062, KAMPALA
8. Dr. Agaba Friday, Food Safety Coordinator, National Drug Authority, P.O. Box 23096 KAMPALA
9. Ms. Hope Kabirisi, Special Presidential Assistant on Science & Technology State House P.O Box 25497, KAMPALA
10. Prof. George Nasinyama, Deputy Director Research & Publications, School of Graduate Studies, Makerere University, P. O. Box 7062, KAMPALA
11. Ms. Irene Wanyenya, Deputy Food Safety Coordinator, National Drug Authority, P.O. Box 23096, KAMPALA
12. Dr. williamSsali, Uganda National Bureau of Standards, KAMPALA
13. Mr. Omanyi.B.Paul, Ministry of Agriculture Animal Industry & Fisheries, ENTEBBE
14. Mr. John Ssekamatte, National Planning Authority, Kampala
15. Mr. Micheal Odong, Ministry Of Agriculture Animal Industry & Fisheries, ENTEBBE
16. Ms. ProfilioTebandeke, National Waters and Sewerage Cooperation, KAMPALA

17. Dr. Kyokwijuka Benon, Ministry of Agriculture Animal Industry & Fisheries, ENTEBBE

18. Mr. Mulabya Fred, Environmental Health Division, Ministry of Health, KAMPALA

19. Prof Charles Mayanja, School of Food Technology, Nutrition and Bio-engineering, Makerere University, P. O. Box 7062, KAMPALA
20. Ms. Naluswata Christine, National Drug Authority, National Drug Authority, P.O. Box 23096, KAMPALA

21. Ms. Mary Tumushabe, National Drug Authority, National Drug Authority, P.O. Box 23096 KAMPALA

22. Mr. Denis Omodi Alyela, Kampala Capital City Authority, KAMPALA

23. Mr. Robert Mawanda, Uganda Manufacturers Association, KAMPALA

24. Mr. Hakim Mufumbiro, Uganda National Bureau of Standards, KAMPALA

25. Dr. Winyi Kaboyo, Ministry of Health, KAMPALA

26. Mr. Namanya. B. Didacus, Ministry of Health, KAMPALA

27. Mr. Archilee N. Kaaya, Makerere University, School of Food Technology, Nutrition and Bio-engineering, Makerere University, P. O. Box 7062, KAMPALA

28. Mr. Onen Geoffrey, Government Analytical Laboratories, KAMPALA

29. Mr. Muhindi Jeanne Bukenya, National Drug Authority, P.O. Box 23096, KAMPALA

30. Ms. Agnes Chandabaku, Ministry of Health, KAMPALA

31. Ms. Noelina Nantima, Ministry of Agriculture Animal Industry & Fisheries, ENTEBBE

32. Dr. Ben Manyindo, Executive Director, Uganda national bureau of standards, KAMPALA

33. Mr. Tumubene Epurance, Ministry of Agriculture Animal Industry & Fisheries, ENTEBBE