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Ensuring Food Safety and Quality from Modern and Conventional Production Systems

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Executive Summary

"If you give bad food to your stomach, it drums for you to dance"

African Proverb

1. The issues of food safety and quality have become topical as a result of realization of increasing foodborne diseases due to food contamination, and the fact that SDG 2 requires that food produced should be safe and nutritious to meet people's dietary needs and food preferences for active and heathy lives. The overall objective of the study is to analyze Ghana's food safety and quality policies and strategies with regards to modern and conventional food production and related agri-food systems and propose effective actionable interventions.

2. Literature review was comprehensively carried out by accessing relevant published and unpublished documents; and key informant interviews (KII) and focus group discussions (FGDs were held with identified stakeholders across the country. Information was also obtained through observation in farms, food drying and storage facilities, slaughterhouses and abattoirs, markets and food processing centres.

3. The information obtained showed that there are serious food safety and quality issues at all levels of food chains. Food contamination takes place at all levels of the food chain in crop, livestock (including poultry) and fisheries/ aquaculture production. Food contamination is also at different levels of severity and seriousness in both conventional and modern food production systems depending on the sources of contamination and the types of food.

4. Chemical contamination tends to be more in the modern production systems while aflatoxin and other mycotoxins contamination seem to be more in conventional production systems. It is however difficult to be categorical because the causes are from different sources and depend on so many factors and husbandry practices of farmers.

5. With respect to livestock, unsafe food production is from zoonotic sources (such as anthrax, TB, bird flu, Salmonella) and others and antimicrobial resistance (AMR) as a result of antibiotics, growth promotion hormones and veterinary drugs given to the animals. AMR and heavy metals are the critical food safety problems in fish and fishery products.

6. Insanitary production, storage, transportation and processing facilities and inadequate attention paid to personal hygienic by persons involved are critical sources of food contamination in all the cases.

7. Also, inadequate infrastructure in all cases (laboratories, drying and storage facilities, roads etc) contribute to the increasing food contamination and adulteration problems.

8. There are hardly any food safety best practice and success story interventions in food production to marketing (of raw produce) in the country. The intervention that comes near to a success story is the FDA/WIAD/GIZ stainless-steel tables for sales of vegetables and meat in several districts in the country. Unfortunately, it is limited to only a few MMDAs due to resources constraints. There are, however, food safety intervention success stories with respect to export crops.

9. The following are the main recommendations for effective actionable interventions:

    i. Supervisory activities and monitoring of agriculture produce markets by the Environmental Health personnel of MMDAs should be intensified to decrease or prevent the deliberate adulteration of produce and "force ripening" of fruits and vegetables. They should be adequately resourced to undertake these critical activities.

    ii. Well constructed farmer markets, based on high sanitation and food standards, along major highways should be established. They will be good food safety and quality interventions.

    iii. Food safety testing laboratories are required in all regions of the country while simple toxins' testing kits should be available at community and farm levels for routine and constant testing. Accurate and reliable quantification of contaminants in locally produced (as well as imported) food is important for inclusive food safety and quality interventions.

    iv. PPRSD should train food safety and quality and/or agricultural extension personnel on food safety issues and MMDAs should pay

for that training since the personnel are under the local government service. The local government service should fund those activities.

v. Robust legislations that will bring all food safety players on board for effective food safety interventions should be enacted. In particular, there should be a comprehensive review of the Public Health Act and all the key stakeholders, FDA, GSA, PPRSD, VSD, MoFAD, Fisheries Commission, EPA, and others, should actively participate in arriving the new act.

vi. MMDAs are the key institutions for planning and implementation of food policies, plans, programmes and projects. Food safety issues must be incorporated into the medium-term plans of all MMDAs else there will be no food safety interventions. There is also need for those taking decisions at the MMDAs level to be thoroughly sensitized on food safety and quality issues.

vii. The complexity in the causes of unsafe food production at the farm level (to produce marketing) makes it difficult to distinguish differences in food safety in conventional and modern production systems. What is necessary is workable policies, programmes and projects to make food safety and quality key components of all production systems.

LIST OF ACRONYMS

AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AMR	Antimicrobial resistance
AU	African Union
AUC	African Union Commission
CA	Conservation agriculture
CLTS	Community Led Total Sanitation
CSA	Climate smart agriculture
CSIR	Council for Scientific and Industrial Research (Ghana)
ECOWAS	Economic Community of West African States
ECOWAP	ECOWAS Agricultural Programme
FASDEP	Food and Agriculture Sector Development Policy
EPA	Environmental Protection Agency (Ghana)
FAO	Food and Agriculture Organization (of UN)
FDA	Food and Drugs Authority
FGDs	Focus group discussions
FRI	Food Research Institute (of CSIR)
FOSERP	Food Safety Emergency Response Plan
GAP	Good Agricultural Practice
GCAP	Ghana Commercial Agriculture Project
GFSP	Global Food Safety Partnership
GHS	Ghana Health Service
GSA	Ghana Standards Authority
GSS	Ghana Statistical Service
GMP	Good Manufacturing Practice
HACCP	Hazard Analysis Critical Control Points
IFAD	International Fund for Agricultural Development
INFOSAN	International Food Safety Authorities Network
ISSER	Institute of Statistical, Social and Economic Research (of UG)
KIIs	Key informant interviews
MESTI	Ministry of Environment, Science, Technology and Innovation
METASIP	Medium Term Agriculture Sector Investment Plan
MLGRD	Ministry of Local Government and Rural Development
MMDAs	Municipal, Metropolitan and District Assemblies
MoFA	Ministry of Food and Agriculture (Ghana)
MoFAD	Ministry of Fisheries and Aquaculture Development
MoH	Ministry of Health

M&E	Monitoring and Evaluation
NCD	Non-communicable disease
NGO	Non-Governmental Organization
NRGP	Northern Rural Growth Project
OECD	Organization for Economic Cooperation and Development
PPMED	Project Planning, Monitoring and Evaluation Department (of MoFA)
PPRSD	Plant Protection and Regulatory Services Department (of MoFA)
SADC	Southern Africa Development Community
SARI	Savanna Agricultural Research Institute (of CSIR)
SAPIP	Savannah Agricultural Productivity Improvement Project
SDGs	Sustainable Development Goals
SPS	Sanitary and Phytosanitary Standards
SSA	Sub-Saharan Africa
TB	Tuberclosis
UDS	University for Development Studies
UG	University of Ghana
UWR	Upper West Region
VSD	Veterinary Services Department (of MoFA)
WACWISA	West Africa Centre for Water, Irrigation and Sustainable Agriculture (of UDS)
WIAD	Women in Agricultural Development (of MoFA)
WHO	World Health Organization

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BACKGROUND

Food is basic for human survival. The main reason why food is produced is for human bodies to be well-nourished and healthy. Only safe and nutritious food can sustain life and promote good health. According to Fung et. al. (2018), food safety is a basic human right; and Ababouch (2003) says food safety must be an integral part of any food security program but unfortunately food safety and quality programs have received very little attention in many developing countries. According to the World Health Organization (WHO) as many as 600 million people in the world fall ill each year from consuming contaminated food and about 420,000 people from this number die each year, and Africa and southeast Asia are believed to have the highest incidence and death rates associated to foodborne diseases (WHO, 2015). It has also been stated that unsafe foods containing pathogenic microorganisms and toxic chemicals are responsible for more than 200 diseases ranging from diarrhea to cancer and food- and waterborne diarrheal diseases are linked to the deaths of an estimated 2 million people annually worldwide, including many children (WHO, 2015). Food contamination is known to result in kidney and liver failure, brain and neural disorders as well as some non-communicable diseases such as cancer, and it can also adversely affect reproductive health and the immune system (SADC, 2014). Foodborne diseases carry significant disability, morbidity and mortality burdens and their economic burden in terms of total productivity loss in low- and middle-income countries has been estimated to be about US$ 95.2 billion per year, and the annual cost of treating foodborne illnesses is estimated at US$ 15 billion. (Jaffee et. al., 2019).

The United Nations Sustainable Development Goal (SDG) 2.1 aims at ending hunger and ensuring access by all people, to safe, nutritious and sufficient food all year round by 2030, while SDG 3.9 aims at substantially reducing the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination. Also, the generally accepted definition of food security is that "food security occurs when all people, all the time, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and heathy life" (FAO, 1996). Thus, there cannot be food and nutrition security, which is the most basic goal of every nation and society, if the food produced and consumed is not safe and of adequate quality. That means SDGs 2 and 3 cannot be met unless there are effective food safety and quality interventions. There is, thus, need to ensure food safety and quality in all food production systems. A safe food is one that is free of substances that might compromise a person's health, and food quality refers to characteristics of food that determine its value (mainly nutritional value) and/or acceptability to consumers.

Food safety and quality have been of great concern internationally and the WHO and the Food and Agricultural Organization (FAO) of the United Nations have been in the forefront of advocating for food safety at all levels of the food chain, from "fork to plate" or "hoe to bowl". They have worked to establish systems, protocols, standards and guidelines to promote the production, storage, transportation, processing, marketing and consumption of safe and quality food. Food safety management systems and standards such as the Hazard Analysis Critical Control Points (HACCP), Good Agricultural Practice (GAPs), Good Manufacturing Practice (GMP), Good Hygiene Practice (GHP), Codex Alimentarius, International Food Safety Authorities Network (INFOSAN) among others have been established to encourage all countries of the world to ensure food safety and to protect consumers worldwide.

Since the coming into being of the African Continental Free Trade Area (AfCFTA), the African Union (AU) and the Economic Community of West African States (ECOWAS) have been emphasizing on issues of food safety and quality. The AU recognized that it is necessary "to have a continental policy framework on sanitary and phytosanitary standards (SPS) and structures to ensure that AU member countries have robust SPS measures in place, with a specific focus on food safety to achieve expanded trade" (AUC, undated). Countries, including Ghana, have tried to implement various systems, standards and guidelines but the problem of the production and consumption of unsafe food persists and is even on the increase in several countries. In Ghana, evidence points to increasing food safety challenges at all levels of the food chain. At the farm level, there are challenges of unsafe use of agro-chemicals and use of banned (dangerous) chemicals. There are also unsanitary food handling and poor food storage practices resulting in accumulation of mycotoxins such as aflatoxins in cereals, groundnuts, smoked fish and other foods. There have also been reported use of dangerous additives in foods such as Sudan Red Dye in palm oil (Wireku, 2015; Amoako-Mensah, 2017; McArthur et. al. 2021), use of chemicals to hasten the ripening of fruits and misuse of insecticides and fungicides on vegetables (Afari-Sefa et al.; 2015; Mattah et al, 2015; Danquah et al, 2010) Another important food safety challenge in Ghana is antimicrobial resistance (AMR) which results from the consumption of foods with high levels of residual antimicrobials over time. Antibiotics used to treat livestock and poultry and in fish production (aquaculture) usually result in accumulation of residual antimicrobials and thus AMR when the food are consumed over time by humans. The main issue with food safety is therefore contamination. Chemical, microbiological, physical, and allergic contamination are the four basic categories of contamination. Even though Ghana's foodborne diseases burden is not well known or estimated quantitatively, it is considered to be very high and is a major constraint to productivity and thus to socio-economic development. It has been noted that when food safety systems are well developed, they contribute to improved public health, nutrition, enhance access to food trade, reduction of poverty, increased food security and the protection of the environment (MLGRD, 2022).

2

OBJECTIVES AND POLICY QUESTIONS

2.1 Objectives of the Study

Following the above discussion of the food safety and quality challenges in Ghana, the objectives of the study are:

i. Identify, from literature, and analyze key food safety and quality policies and strategies, with regards to modern and conventional food production and related agri-food systems in Ghana.

ii. Undertake rapid expert appraisals and discussions with policy makers and other stakeholders on food safety and quality issues, especially with regards to successes and failures of interventions implemented by government and other actors.

iii. Also identify, from literature and the rapid appraisals, and analyze barriers that hinder and enablers that promote food safety and quality in modern and conventional food production systems.

iv. Synthesize the main issues and policy implications from the desk reviews and field information; with emphasis on best practices and reasons for successes and failures of the food safety and quality interventions as well as lessons learnt.

v. Propose effective actionable interventions to address Ghana's food safety and quality issues.

2.2 Policy Questions

The main policy questions addressed in the study include:

i. To what extent have food safety and quality issues been addressed at the policy level of government and other actors (private sector, NGOs, research etc.)?

ii. What food safety and quality interventions have been implemented by government and other actors at the food production level?

iii. What have been the level of successes and failures of the food safety and quality interventions and what are the revealed and perceived reasons?

iv. What actionable interventions should be undertaken by the different stakeholders to ensure food safety and quality from modern and conventional food production systems?

III METHODOLOGY

3.1 Research Design and Sources of Information

A qualitative research design consisting of systematic literature review of published and unpublished material, key informant interviews (KII), focus group discussions (FGDs) and field observations was used. The information from the varied sources was analyzed using content and thematic analyses techniques.

3.2 Sources of Information and Procedure for Data Collection

a. The systematic literature review was carried by accessing published documents using the method of keywords search. The main keywords were "food safety", "food quality", "food contamination", "agri-food systems", "conventional food production systems", "modern food production systems", "food safety policy" and others.

b. Unpublished documents reviewed included Annual, Technical, Research, Consultancy and other reports mainly from relevant ministries and institutions (Various Departments of MOFA, Nutrition units of GHS, FDA, GSA, FRI, and others).

c. Several Ghana Food and Nutrition Security related Policies, Plans, Strategies, Programmes and Projects were reviewed.

d. Food safety policies and interventions of several other developing countries were also studied for guidance on successful interventions.

e. A comprehensively designed checklist (see Appendix) was used to obtain information from several key informants and through focus group discussions with several groups of persons. Key informants were mainly serving and retired officials of PPRSD, PPMED, WIAD, Animal Production and Veterinary Departments of MOFA, FDA, GSA, CSIR-FRI, CSIR-SARI, farmers, food processors, marketers and others. A combination of face-to-face, phone and virtual meetings were used.

f. Information was also obtained through observation at various farms, food drying and storage facilities, markets and food processing centres. Observations were also made of transportation of fruits and vegetables as well as meat to various markets.

Specific locations visited included:

a. Ministry of Food and Agriculture offices in Accra and PPRSD offices at Pokuase in Ga West District of the Greater Accra Region.

b. Regional, Municipal and District Agricultural, Veterinary and/or GHS offices in Greater Accra, Bono-East, Northern and Upper East Regions.

c. Farms, markets and food processing centres in Offinso North District of Ashanti, Techiman South and North Municipalities of Bono-East Region; as well as several Municipalities and Districts in Northern and Upper East Regions.

All these areas were chosen and visited based on information we obtained on where obvious cases of food contamination at farm, harvest, post-harvest, storage, market and processing can be observed. Information was sourced from so many persons across the country and several places mainly for the purpose of information triangulation to assess the extent of specific contamination problems across the country.

3.3 Methods of Information Synthesis

Information collected from literature reviews, key informants, FGDs, field observations etc was synthesized by thematic and content analyses. It involved several stages:

a. The sources and types of food contamination at farm, harvest, post-harvest, storage, transportation, and processing levels with respect to different food groups: cereals, legumes, roots and tubers, fruits and vegetables, livestock and livestock products; and fish and fishery products.

b. The relative importance of the problems in modern and conventional food production systems.

c. Diagrammatic conceptualization of the prevailing food safety issues.

d. Identification and critical evaluation of interventions by various institutions, agencies or persons and the results (successes or failures).

e. Drawing inferences and suggesting effective actionable interventions to address the issues.

3.4 Limitations of the Study

The major limitations of the study are the general limited research done on food safety and quality. The main limitations are at the production level of almost all types of foods in Ghana and Africa, the qualitative nature of the research and limited scope in terms of geographical coverage and sampling procedure. Even though considerable information was obtained through the FGDs and KIIs from different parts of the country; north, middle belt and south; quantitative information was not collected for more robust analysis.

Figure 1: Map of Districts Visited for Stakeholder Consultations

IV

SITUATIONAL, STAKEHOLDER RESPONSE AND GAP ANALYSES

4.1 Food Safety and Quality in Ghana – A Review of Policies, Plans, Strategies, Programmes and Projects

It is activities under the agriculture, health, water and sanitation sectors that directly have impact on food safety and quality. For the purposes of this study, it is largely activities under food and agriculture sector that is relevant since food safety and quality issues with respect to consumption are not being considered for now. The five sub-sectors of the food and agriculture sector are crops, livestock, fisheries, cocoa, and forestry/logging and the issues of concern in this research is with respect to the first three sub-sectors: crops, livestock and fisheries. MOFA is responsible for the crops and livestock while the Ministry of Fisheries and Aquaculture Development (MoFAD) is responsible for fisheries. The review of policies that concern food safety and quality is thus mainly with regards to the food and agriculture (including fisheries) policies and laws. Health (including nutrition), water and sanitation policies, strategies, plans, laws etc have also been reviewed since they impact considerably on food production, storage, and processing. With decentralization, decisions and activities at the MMDAs impact directly on food safety and quality, thus, they should also be concerned with food safety issues. Therefore, some policies and strategies at those levels, especially their medium-term development plans, are expected to be concerned with food safety and quality issues. The Local Government Act 463 of 1993 (10.3 and 10.5) states that "a District Assembly is responsible for the overall development of the district and shall ensure the preparation and submission, through the Regional Coordinating Council, of development plans of the district to the National Development Planning Commission for approval" (10.3.1) and that "a District Assembly shall coordinate, integrate and harmonize the execution of programmes and projects under approved development plans for the district, any and other development programmes promoted or carried out by Ministries, departments, public corporations and any other statutory bodies and non-governmental organizations in the district" (10.5). That law makes the District Assemblies the key institutions for planning and implementation of policies, plans, programmes and projects in the various districts, municipalities, and metropolitan areas. If food safety issues are not incorporated into the medium-term plans of MMDAs it means, there will be no food safety interventions. With the decentralized system, some of the ministries, such as MOFA with headquarters in Accra, undertake policy formulation, planning, and monitoring and evaluation functions but the District Departments are the executing agencies.

Table 1: List of food related policies, plans, strategies, projects and programmes showing number of times "food safety" and "food quality" are mentioned in the documents1

Date	Policy, Plan, Strategy, Project or Programme	Number of pages	Number of times "food safety" and "food quality" mentioned
September 2002	Food and Agriculture Sector Development Policy (FADEP) I	66	1 (safety); 0 (quality)
June 2007	National Water Policy	72	Nil
Aug. 2007	FASDEP II	77	8 (safety); 0 (quality)
2008-2017	Northern Rural Growth Programme (NRGP) (Africa Development Fund Appraisal Report)	29	1 (safety); 0 (quality)
December 2009	West Africa Agriculture Productivity Programme (WAAPP) Baseline Report	159	Nil
2011	National Irrigation Policy, Strategies and Regulatory Measures	37	Nil
2011– 2015	Medium Term Agriculture Sector Investment Plan (METASIP I)	114	3 (safety); 1 (quality)
2011-2016	Ghana Fisheries and Aquaculture Sector Development Plan (FASDP)	33	Nil
2012-2016	Ghana National Aquaculture Development Plan (GNADP)	91	30 (fish food safety)*; 2 (food safety); 0 (quality)
2013– 2017	National Nutrition Policy for Ghana	43	25(safety); 4(quality)
2014-2017	Medium Term Agriculture Sector Investment Plan (METASIP II)	74	2 (safety); 0 (quality)
2014	Ghana Agriculture Sector Investment Program (GASIP) (Design Completion Report)	120	3(safety); 0 (quality)
2014-2018	Ghana Commercial Agricultural Project (World Bank Project Appraisal Document February 2012)	164	Nil
2015	National School Feeding Policy (Ministry of Gender etc)	55	0 (safety); 1 (quality)
2015 – 2019	Fisheries Management Plan of Ghana - A National Policy for the Management of the Marine Fisheries Sector	56	2 (safety); 0 (quality)
May 2018	Assessment of Implementation of Planting for Food and Jobs (PFJ) Programme: Lessons and Ways Forward - Technical Report (Mabe et. al. 2018)	65	Nil
March 2022	National Policy on Non-Communicable Diseases (GHS)	45	Nil
December 2008	Regional Agricultural Policy for West Africa: ECOWAP (Summary for Paris Conference)	12	Nil
2015-2025	Africa Regional Nutrition Strategy	40	1 (safety); 0 (quality)
2015 – 2025	SADC 2014 Food and Nutrition Security Strategy	51	21 (safety); 0 (quality)
2016-2025	Feed Africa: Strategy for Agricultural Transformation in Africa AfDB	79	Nil

11It is agreed that other words or phrases could have been used in the documents to imply food safety and quality, but this analysis still points to the little emphasis put on food safety and quality in the policies, plans, strategies etc.

*Fish food safety is critical for safety of food for humans

Source: Authors' Compilation, 2022

Key food and agricultural policies, strategies, plans can be traced back to the early 1990s but for the purpose of this study the review will concentrate on policies, strategies, plans, projects and programmes from 2000, the time of the first Food and Agriculture Sector Policy (FASDEP I). Table 1 is a list of various food related policies, plans, strategies, projects and programmes with indications of the number of times "food safety" and "food quality" are mentioned in the documents.

Table 1 clearly shows that food safety and quality have not been serious concerns in Government of Ghana policies, strategies, plans, programmes and projects over several decades. As indicated in the table, out of 16 food related policies, strategies, plans, programmes and projects documents, 7 (almost 50%) did not mention "food safety" nor "food quality" at all while 4 mentioned either only once. The only documents that indicated some concern for food safety were FASDEP II, the National Nutrition Plan for Ghana and the Ghana National Aquaculture Development Plan (GNADP). All the documents listed above, however, highlighted pursuance of food security (or food and nutrition security) as key goals; yet so many of them did not seem to consider food safety and quality as important components of food security. Even the Ghana Health Service 2022 National Policy on Non-Communicable Diseases (NCDs) did not mention food safety nor food quality (Table 1) when it is well known that the use of dangerous chemicals in agriculture in the country is on the increase and chemical food contamination is a major cause of some NCDs and can affect reproductive health and the immune system (SADC, 2014).

FASDEP II discussed food safety largely with respect to the need to meet international food safety and phytosanitary standards. Thus, the concern was more with respect to "good agricultural or manufacturing practices (GAP/GMP) among farmers, processors and traders" who produce, process and market foods destined for export. It however did indicate some concern for the use of agro-chemicals on vegetables in particular which are consumed locally. It is stated in the document that "the element of food safety will be a concern in Ghana's pursuit of food security". The policy also identified "low awareness of food safety leading to practices such as use of inappropriate transport in conveying livestock and livestock products" as an important issue worth acting on; yet both METASIPs I and II which were plans based on FASDEP II paid almost no attention to food safety and quality issues. METASIP I mentioned food safety only with respect to cottage industries while METASIP II mentioned it with respect to nutrition sensitive agriculture and production for export. In both documents there was no call for intervention since food safety nor food quality were not mentioned in the "Programme of Action" (MoFA, 2009; 2010, 2015).

The National Nutrition Plan for Ghana (2013-2017) had "the promotion of food security, food quality, and food safety at the individual, household, community, and national levels" as one of its four strategic objectives. It identified chemical residues and microbial contamination of foods; poor harvesting and drying systems for agricultural produce resulting in the production and accumulation of fungal toxins; poor handling and packaging of fresh produce at farm level as well as issues at processing and transportation levels as key food safety challenges (MoH/GHS, 2012).

One of the objectives of the Ghana National Aquaculture Development Plan (GNAP) is improvement of "the environmental sustainability of aquaculture-production, fish health and fish food safety" and the method to do so is "effective monitoring through the adoption, adaptation and refurbishment of veterinary laboratories located within or close to high priority aquaculture-zones for testing water quality, fish health and fish food safety" (MoFAD/Fisheries Commission, 2012). Several courses and sensitization workshops were stated in the plan.

It is noteworthy that in 2020, the Modernizing Agriculture in Ghana (MAG) programme of MoFA supported the development of "Food Safety Guidelines for Metropolitan, Municipal and District Assemblies (MMDAs) in Ghana" as a framework to guide MMDAs "to mainstream food safety issues in their operations and by-laws to ensure that the highest standard of food safety issues are adhered to at all times by actors on the food safety value chain" (MLGRD, 2020). Some implementation activities have been undertaken, mainly through the Women in Agriculture Department (WIAD) of MoFA.

At the sub-regional level, the ECOWAS Agricultural Policy (ECOWAP) did not mention food safety or quality at all in its "ECOWAP at a Glance" document of 12 pages (ECOWAS, 2008). Similarly African Development Bank (AfDB) "Feed Africa: Strategy for Agricultural Transformation in Africa"

document of 79 pages did not mention food safety nor food quality. Also, the Africa Regional Nutrition Strategy (2015-2025) (AU, undated), mentioned food safety only once in the document. However, the Southern African Development Community (SADC) 2014 Food and Nutrition Security Strategy emphasized on the importance of food safety. Food safety appeared 21 times in the 51-page document (SADC, 2014) (see Table 1).

In the SADC 2014 Food and Nutrition Security Strategy it was stated that, "assurance of safe food is essential to improving the quality of life" and "effective control systems are required within Member States as they are essential in protecting the health and safety of population by assuring the safety of imports and exports as well as food produced for domestic consumption". This statement is very important for all countries on the continent. There has been the tendency for African countries to talk of food safety and quality with respect to exports and imports, and to neglect the serious food safety and quality issues in local food production and consumption. As stated earlier both the AU and ECOWAS started talking seriously about food safety with the coming into being of the AfCFTA. The Global Food Safety Partnership also noted that current donor investment in food safety in sub-Saharan Africa (SSA) is substantially focused on access to regional and overseas export markets. Relatively little is being done to reduce foodborne illness among consumers in SSA (GFSP, 2018). As stated by Juergen Voegele, Senior Director of the Food and Agriculture Global Practice at the World Bank, "by focusing on domestic food safety more deliberately, countries can strengthen the competitiveness of their farmers and food industry and develop their human capital. After all, safe food is essential to fuel a healthy, educated, and resilient workforce" (Jaffee et. al., 2019).

Food safety regulatory bodies in Ghana include: 1) Food and Drugs Board (FDA); 2) Veterinary Services Directorate (VSD); 3) Plant Protection and Regulatory Services Directorate (PPRSD); 4) Environmental Protection Agency (EPA); 5) Customs Division of the Ghana Revenue Authority; 6) Metropolitan, Municipal and District Assemblies, (MMDAs) and any other local government authority and 7) Ghana Standards Authority (GSA). It is however the FDA that seems to be spearheading food safety activities in the country.

The FDA coordinated the development of Ghana's Food Safety Policy in April 2015 and another in June 2022 with the support of WHO and FAO. It (the FDA) also developed a 5-year strategic action plan to operationalise the 2015 food safety policy with an estimated implementation cost of GH¢21 million. Funding for implementation was expected from the WHO and FAO. It has been difficult to assess the extent of implementation of the 2015 policy; even though it is known that FDA has been enforcing its food laws by registration of products and inspecting food processing facilities, destination inspection of imported products, and verifies exports and post market surveillance to check product adulteration (GAIN Report 2017). According to Odonkor and Odonkor (2020) "ever since the adoption of the national food safety policy by the Food and Drugs Authority in 2015, official reports or research to access its implementation seems to be elusive".

The Ghana 2015 and 2022 Food Safety Policies have about the same goal and objectives. According to the 2022 policy the goal is "to bring coordination into the regulation of food safety and define the role of stakeholders to ensure public health and facilitate trade in food". The objectives cover issues of harmonization and institutional cooperation, legislation, coordination, surveillance system, laboratories, infrastructure, management systems and information. A National Food Safety Emergency Response Plan (FOSERP) was also launched with the June 2022 policy. The fact that the 2015 and 2022 policies have about the same goal and objectives puts doubts on the effective implementation of the 2015 policy. It is hoped that the 2022 policy will be much better implemented. Food safety activities must encompass the whole food value chain. Food safety interventions or activities are hardly seen at the food production, harvest and post-harvest levels. Other food safety regulators such as the PPRS, the VSD and others are not seen to play their roles in the food safety space. The main reason they give is that they are very poorly resourced. Also, the Public Health Act 851 does not capture food safety and quality concerns in food production aspects, so they do not have sufficient legal authority to enforce some necessary practices that will ensure food safety and quality at food production and marketing.

4.2 General Review of Literature on Food Safety and Quality Issues and Interventions

The issue of food safety is so important that there are several international and national food safety laws, regulations, codes, practice and guidelines governing the production, processing, distribution, retail, packaging and labelling of food stuffs. In Ghana, the Public Health Act, Act 851, of 2012 (MoH, 2012) seems to be the main food safety legislation which empowers the Food and Drugs Authority (FDA) and the Health Departments of Metropolitan, Municipal and District Assemblies (MMDAs) to ensure that safe and quality food is sold to consumers. The Act however concentrates on sale or serving of unwholesome food, sale of food under insanitary conditions, preparation and sale of food unfit for consumption and sale of poor quality food (Sections 51, 52, 53 and 105 respectively). It is silent on the farm and harvest level food safety situations. There is need for a comprehensive review of the Public Health Act which will bring all food safety players on board.

At the Africa level, there was an FAO/WHO Regional Conference on Food Safety for Africa in October 2005 in Harare, Zimbabwe, which concluded with the drafting of a nine-point Five-Year Strategic Plan for Food Safety in Africa for adoption by UN food and health agencies and the African Union (FAO, 2005). That Conference encouraged the strengthening of legislative and institutional frameworks in countries. An analysis conducted by the WHO Regional Office in 2002 also showed significant gaps in national food laws and inadequate linkages between strategies to ensure food safety. The impact of these continental initiatives are, however, yet to be seen.

Despite the fact that foodborne diseases are among the most widespread problems of public health concern, not more than 10%, and sometimes maybe as low as 1%, of the real incidence of foodborne diseases are reported. (Motarjemi and Kaferstein, 1997). Foodborne diseases are often thought to be caused at the consumption end and many studies on food hygiene and safety tend to concentrate on food preparation, sales and consumption (Odonkor and Odonkor, 2020; Owusu-Sekyere et, al. 2014; Sinayobye and Saalia. 2011). It is however now becoming clear that a high percentage has its source in earlier parts of the food chain. The production of food under insanitary conditions and unwholesome foods, however, pose serious key food safety and quality issues. Part III of the Plants and Fertilizer Act (Act 803) of 2010 and Part II of Environmental Protection Agency Act (Act 490) of 1994 mandates the PPRSD and the Veterinary Services Department (VSD) of the MoFA to ensure safety in food production with regards to use of fertilizers, pesticides and other agro-chemicals and veterinary drugs. There is, however, little action seen on the ground partly because of inadequate allocation and disbursement of resources for the responsible institutions to fulfill their mandates.

4.3 Stakeholder Response Analyses and Syntheses of Main Food Safety and Quality Issues

4.3.1 Preamble

The main knowledgeable stakeholders in food safety and quality within the food production, storage, transportation, pre-processing and marketing domains include several past and present personnel of:

a. the Directorates or Departments of the Ministry of Food and Agriculture, particularly the Plant Protection and Regulatory Services Directorate (PPRSD), the Veterinary Services Directorate (VSD) and the Women in Agriculture Directorate (WIAD),

b. the Ghana Health Service, particularly the Nutrition Department and the environments health departments

c. The FDA and GSA

d. The EPA

e. The MMDAs

f. Farmers and Community members

It was these that were engaged to obtain information for the analysis done in this section.

4.3.2 Food safety and quality issues at Crop Farm, Harvest and Post-Harvest Levels

For all of crops (cereals, legumes, roots and tubers, and fruits and vegetables), the major food safety concerns at the farm level are the use of banned agro-chemicals and misuse of other agro-chemicals such as weedicides, insecticides, and fungicides as well as the blanket use of fertilizers and use of untreated farmyard manure. Also, "minimal and zero tillage as conservation agricultural practices have come to worsen the situation". These were the views of focus group discussants and key informant interviewees across the country. Several of the respondents stated that the alarming situation with respect to the practices is relatively recent because "five years ago it was not this bad". Several key informants blamed the situation on the "get quick money syndrome" that pervades every aspect of society, exposure to social media and climate change effects.

FGDs and KIIs with staff of the PPRSD in the Ga West District of Greater Accra Region and several other persons in Accra (see Appendix) revealed that food contamination starts from production and goes all the way to consumption so any effective food safety intervention should consider all stages of the food chain. According to a retired Director of PPRSD, there is need for identification and appreciation of food safety hazards from production to consumption if the problem of food safety is to be addressed comprehensively. He believes "the causes of foodborne diseases are everywhere along the entire food chain". At the farm level the blanket use of fertilizers and pesticides were identified, by several respondents, to be major sources of unsafe food production. According to them, the continued emphasis by policy makers, politicians and even development partners on the urgent need to feed the increasing population and a need to "modernize" agriculture is pushing people to produce unsafe foods using dangerous chemicals. Many of these officials hardly consider the danger caused by uncontrolled use of the chemicals. The only emphasis seems to be yields of crops and cheap food for the people. A key informant claimed that "the Ministry (i.e. MoFA) has a traditional notion that what the people need is food so why worry about food safety'. According to him people do not normally relate deaths to the consumption of unsafe food partly because there is hardly any evidence; very little of that research has been done. Polluted water sources (waste water or water polluted by residual fertilizers and agrochemicals) used in irrigation is also a major source of food contamination. Animal and human faecal waste can contaminate water with dangerous microorganisms. Such contamination affects fruits and vegetables that come in contact with the water and is passed on to humans. It was also pointed out that seed can contain toxins and food contamination can come from poor quality seed.

Thus, even though at the farm level, conventional food production systems are a bit more safe than modern production systems, serious food safety issues exist in both conventional and modern food production systems. Most modern crop production systems tend to be on much larger scale than conventional production systems and more agrochemicals are used in modern production systems. Many of the weedicides contain glyphosate, a well-known dangerous chemical (Picture 1). Even "safe chemicals" have use regulations which if violated can result in serious food safety difficulties. According to several of the respondents, many of the farmers do not stick to withdrawal periods of agrochemicals. They also stated that though food safety issues are very well spelt out in Good Agricultural Practices (GAPs) and HACCP and are used as extension materials, both conventional and modern farmers still tend to ignore them. Agro-chemicals that need six months "to break out" are sometimes used on crops that mature within three months. Farmers in the Tanoso area of Bono-East Region were, for example, using agrochemicals meant for cocoa on annual crops. The use of fake agro-chemicals is also an area with serious problem at the food production level. They tend to be cheaper and more readily available in some areas, especially rural areas and small-scale farmers tend to be the main customers of such agro-chemicals. Crop life Ghana (2022) reported that 25 to 35% of imported agrochemicals are fake or banned and the Organization for Economic Co-operation and Development (OECD) reports that "global revenues associated with the trade of illegal pesticides are estimated at US$6-10 billion".

Local food producers (conventional producers) tend to be less aware and concerned about the negative effects of chemical use and the implications on safe safety. Even in situations where small farmers use untreated animal and farmyard manure, food contamination can occur to make the food produced unsafe. Untreated manure can contribute to the spread of resistant microbes in the soil and the environment. Consumption of food with high

levels of residual antimicrobials over time leads to the development of antimicrobial resistance and it is known to be an increasing problem in Ghana (MoH/MoFA/MESTI/MoFAD, 2017). Another food safety and quality issue at the farm production level is related to soil and water contamination through surface mining activities. Toxic metals such as arsenic, cadmium, lead and mercury are important contaminants of crops and many of these are associated with surface mining activities.

The complexity in the causes of unsafe food production at the farm level makes it difficult to distinguish differences in food safety in conventional and modern production systems. According to a key informant, "what is important is to push for a policy to make food safety a key component of all production systems and institute effective monitoring mechanisms".

There are also food safety issues at harvest and post-harvest levels. Those largely depend on the types of crops and the handling of the produce during harvests and post-harvest. The methods of harvesting (for example cutting the stocks or only the heads in the case of cereals), heaping (whether differentiate between clean and diseased or contaminated and where the produce is heaped) and the level of personal hygiene of the harvesters determine to a large extent the level of contamination. Heaping the produce on bare farm grounds can result in serious viral and bacterial contaminations. Farmers sometimes dispose their used agrochemical bottles and containers on the farms. The risk in vegetables is particularly very high. The weather (dry or wet situations) and availability of suitable drying facilities (infrastructure) at the farm areas are important factors at the post-harvest level. Haphazard harvesting and bruising of roots and tubers, onions and other crops predisposes the products to contamination. All these manifests in both conventional and modern production systems.

Almost all respondents say the ranking of crops according to degree of seriousness of food safety issues (most serious to the least) are:

1. Fruits and vegetables, especially those produced for the local markets;
2. Cereals, especially maize and rice;
3. Legumes, especially groundnuts and soybeans;
4. Roots and tubers.

Fruits and vegetables produced for the local markets have the highest probabilities of being contaminated deliberately and accidentally. Bacterial and fungi infestations as well as insect pests are common in fruits and vegetables and thus pesticides are used more on those crops. It was also pointed out that in Akumandan area of Ashanti Region and several other parts of Bono-East Region dioxins are used to "force ripen" tomatoes. They make the outside attractive, but the inside will stay green. Carbide is also known to be used to "force ripen" pineapples and that can lead to residual chemical contamination.

Contamination of fruits and vegetables from animal and human solid wastes sources is quite significant in many parts of the country. Dangerous microorganisms are found in human and animal faecal wastes. Animals are hardly confined in most farming areas and human settlements, and they defecate indiscriminately. Rainwater or other means carry the wastes with the dangerous contaminants to contaminate growing fruits and vegetables directly. Also, open defecation by human beings is also quite common in many rural and even urban communities in the country. A Municipal Environmental Health Director narrated how open defecation is even on the increase in urban areas and how an auditor and a pharmacist were among persons arrested recently (during a dawn swoop) for open defecation in bushy areas of a regional capital. These are serious food safety issues especially when supposedly knowledgeable persons do not show good examples.

Weedicides are used more on cereal and legume fields, especially for maize and soybean, than on yam and cassava fields. Also, insecticides and fungicides are used more to control pests and diseases in cereals and legumes than roots and tubers. Some fruits, such as onions, mangoes, watermelon and others are harvested before they are ripe to benefit from high prices. By so doing they either do not store them properly leading to spoilage and infestation by dangerous microorganisms and weevils; and/or force them to ripen by spraying them with dangerous chemicals. It was also noted that some methods of harvesting honey can result in heavy metals contamination. Some materials such as rubber are sometimes used to cause smoke during the harvesting of honey and can cause serious heavy metal contamination of the honey.

Aflatoxin is probably the most serious food safety challenge in cereals and legumes, especially maize,

rice, groundnut and tigernuts; even though other mycotoxins, heavy metals and pesticide residues contamination are also serious food safety challenges in the country. Aflatoxins are a group of mycotoxins produced by molds (fungi), including Aspergillus flavus, Aspergillu parasiticus, and Aspergillu nomius. They are poisonous carcinogens and mutagens. Aflatoxin contamination can take place at any place in the food chain: from the seed through land preparation, crops on the field, harvests, post-harvest, storage, processing, marketing to consumption. Aflatoxins are known to cause about 25% yield loss in agriculture crops every year (FAO, 2008) but the main issue here with respect to aflatoxin is its food poisoning, and thus disease-causing effects. It has been stated that in Africa, the incidence of liver cancer shares a distinctive geographical distribution with that of aflatoxin contamination of food (Ayensu, 2005). It has been shown to be major cause of stunting in children (Grace, 2015). There are, however, promising solutions to the aflatoxin problem. It has been reported that training in aflatoxin management, accompanied by providing plastic sheets for sun-drying crops, has been shown to reduce aflatoxin contamination in maize and groundnuts by about 50 percent at a material cost of US$2.50 per farmer a year in Kenya and Ghana (Pretari, Hoffmann, and Tian 2018; Hoffmann, Moser, and Herrman 2017). A natural product, Aflasafe, has also been produced which is able to solve 80 to 100% of aflatoxin problems. Also

Indian researchers have successfully used edible botanical extracts (including neem) to inhibit the growth of A. flavus and A. parasiticus and aflatoxin production in vitro (Bhatnagar et al., 1990; Pradeep et al., 2003). There are several local producers of neem extracts, in the northern parts of Ghana, which are used as pesticides and against aflatoxin contamination of cereals and legumes.

Picture 1: Weedicides


Picture 2: Ripe tomatoes on the ground

Roots and tubers are more prone to nematode infestation and nematodes cause them to be unsafe for human consumption. It has been reported several times of deliberate adulteration of palm oil with Sudan dye. As was noted by a focal group discussant, "people are now ready to kill others (through food) to live (make money)".

Most of the respondents in FGDs and KIIs believe that food safety issues are more serious with respect to production for local markets and local consumption than production for export. A key informant said, "in local markets, everything is safe and everything is good" and that "it is production for foreign markets that is forcing us to think of food safety". It is necessary for enforce international food safety guidelines on local situations to ensure food safety and the health of the people.

According to the experts the best way to enforce food safety practices at the farm level will be through strict regulations on the inputs used in production, namely seeds, fertilizers, manures and agro-chemicals. Agro-chemical sellers should be one of the targets of food safety education and sensitization. Inputs used by farmers should be traced to their sources of supply so that if there are misuse of chemicals or use of banned chemicals, appropriate sanctions can be applied.

4.3.3 Food safety and quality issues at Crop Storage, Processing, Transportation and Marketing Levels

At the food storage level, the main food safety and quality issues are with respect to storage infrastructure (warehouses and cold stores etc.),

drying (mainly of cereals, legumes and cassava) and the improper use of storage chemicals. A large quantity of farm produce is stored using local storage methods, such as barns of different types, most of which do not seem to adequately consider food safety issues (Pictures 3 and 4). Poor storage facilities will keep the produce moist and thus susceptible to bacterial and viral attacks and can attract rodents which can transfer disease causing organisms to the produce.

Agricultural personnel in the Upper East Region stated that some foodstuffs from conventional production systems are stored in bedrooms and are often exposed to rodents. Those are serious food safe risks. Unfortunately, attempts at providing silos and warehouses have largely failed. It was pointed out by during focus group discussions that the Northern Rural Growth Project (NRGP) built community warehouses for storage of grains and parkhouses (for vegetables) but hardly any farmer patronized them yet other programmes, (GCAP and SAPIP, for example) are providing similar infrastructures without finding out why earlier ones are not being used. Silos and warehouses may be appropriate for medium and large-scale producers but those are very few across the country. Storage chemicals are also used for storage of grains and that can lead to the pesticides' residue problem especially as many farmers do not follow the stated use guidelines. It was stated by a researcher from SARI that there have been instances when instead of using one storage tablet for one tonne of produce (cereals or legumes), some farmers or aggregators use two for greater effectiveness without realizing the danger being posed to consumers ultimately.

Picture 3: Local storage system (Northern Region)

Figure 4: Local storage system (Bono-East Region)

[1]Little attempt has been made to improve local household storage methods. Also, the use of botanicals such as neem, pepper and ash (indigenous technologies) for storage is not being adequately encouraged. Those may be good and innovative ways out of the storage infrastructure problem.

Another aspect of the storage infrastructure problem is drying facilities for cereals, legumes and peeled cassava (kokonte). It is a problem for both conventional (small scale) and 'modern' (medium- / large-scale) producers but it is more serious in the latter because of the relatively large production of crops such as maize, rice, soybeans and groundnuts. Inadequate and improper drying results in molding and thus aflatoxin and other mycotoxin contamination. Generally conventional (small-scale) producers are much better able to dry their produce. Some conventional producers however undertake crude drying methods such as drying the produce (maize, groundnuts, pepper, peeled cassava or kokonte and others) on road pavements and bare floors (Picture 5). Contamination can result from the floors, from emissions from cars and other motor transports or from animals walking over the products and possibly infecting them with urine and/or faeces. According to the Director of WIAD, the most commonly postharvest practice for pepper was drying the fruits on the bare floor in the Ada area of the Greater Accra Region. The practice has adverse effects on the nutritional quality of the dried fruit. The most prevalent and significant negative

impact is the fruit's higher mineral content, which has resulted in its rejection on the global market. There have been attempts to provide private and community concrete drying slabs and solar drying facilities but most of those attempts have been by non-governmental organizations and government/ donor projects and have been basically pilots and the effects are very minimal or non-existent since most projects and programmes are short-term.

One other food safety issue in cassava is cyanide. Consumption of insufficiently processed cassava with high levels of naturally occurring cyanide can cause an acute and devastating form of paralysis with about a 20% mortality rate (GFSP, undated p.16)

Figure 5: Drying produce on road pavement and on tarpaulin (Techiman Municipal)

Figure 6: Drying platform (Techiman Municipal)

Food safety considerations do not seem to feature in the transportation of food stuffs from farms to homes or to markets. Even when food production is done safely the way it is transported can result in a lot of food contamination. Every type of food is dumped into the trucks with very little packaging. The haphazard dumping into carriers often result in injury to fruits and easy contamination. Vegetables are carried very carelessly in trucks ("yellow yellows", "motor kings", "mummy trucks", "KIA trucks" etc.) which are not disinfected or even cleaned and thus can easily be contaminated from produce the trucks carried earlier.

With respect to processing, it is about insanitary conditions of processing units and heavy metals contamination. Many small-scale grinding mills are not made of stainless steel and so milled produce can be contaminated with heavy metals such as lead. Larger mills which are more modern are safer. It was also pointed out that traditional processing involves too much human interaction and thus greater exposure to food contamination. That was witnessed in the case of gari processing in Techiman North Municipal and oil palm processing in Offinso North District in Ashanti Region (Pictures 7 and 8). A study in Accra that examined the safety of tomatoes before and after milling found that milling increased contamination (Sinayobye and Saalia 2011). Modern processing methods are much safer than traditional (conventional) methods.

Figure 7: Gari processing (Techiman Municipal)

Figure 8: Palm oil processing (Offinso North District)

At the marketing level there are several food safety and quality issues. The main ones are general insanitary conditions in many markets, rodents, and use of chemicals to improve the physical attractiveness of produce destined for the market. There does not seem to be any sanitary regulations in many markets or if there are then they are not obeyed and those who disobey are not sanctioned. Also, in one of the FGDs in the Upper East Region, it was pointed out that some fruits such as mangoes, bananas and oranges are washed with chemicals before sale to make them look attractive. Also, chemicals are used on kokonte to turn the brownish colour to white because that is what attracts buyers. Vegetables are sprayed with chemicals a day or even hours before harvesting for sale because they will look very green without any holes and therefore very attractive to buyers.

Food products, especially fruits and vegetables, are not well displayed. For instance, oranges are regularly displayed for sale on bare floors and in the sun when they should be preserved and presented in cool and dry environments. These acts cause contamination and also make the fruits to lose their taste and become discolored.

Figure 9: Sale of foodstuffs in local markets

The following quotes of key informants indicate how people view the insanitary conditions in local food markets:

> *"Everybody is chasing money anyhow, even if it involves killing people and even themselves".*
> *A key informant in Northern Region.*

> *"Accra is sitting on a food poisoning time bomb, Unwholesome food is sold everywhere". Municipal Environmental Health Director, Greater Accra Region.*

It is believed that food safety problems are more acute in urban areas than in rural areas. Yeleliere et. al. (2017) stated that risks are higher in urban than in rural areas with longer distribution, handling and cross-contamination of foods and with the dominance of street food vendors and open traditional markets, often tested for high prevalence of biological hazards. Other researchers have shown high prevalence of pathogens, including Salmonella, Listeria, and E. coli in meat, fish, milk, fruits, and vegetables in urban markets (Sackey et al. 2001; Donkor et al. 2008; Quansah et al. 2018). There is however need for comprehensive research to establish the urban bias of unsafety food prevalence. Food safety research has been more in urban areas than in rural areas and has also been more on food processing and consumption than other aspects of the food value chain (Ababio and Lovatt, 2015). Overall, there has been limited research on food safety and quality in Ghana and Ababio and Lovatt, (2015) have stated that "the media currently serves as the main source for reporting of foodborne diseases".

4.3.4 Food Safety and Quality Issues in Livestock and Livestock Products

There are serious food safety and quality issues in the production of livestock, including poultry even though the FDA has good policy guidelines to regulate food safety in the livestock industry (FDA, 2013). According to a Veterinary Officer in Bolgatanga, "Ghanaians do not see them as issues until we are in a ditch and we try to look for adhoc solutions". He said that in relation to the lack of attention paid to sanitary conditions in poultry houses until there are disease outbreaks, such as the avian influenza (bird flu).

It is known that several animals such as cattle, sheep and goats that are sent to slaughterhouses carry sicknesses or are diseased. It is common knowledge that small-scale farmers in the northern parts of the country tend to sell their animals for slaughter in nearby markets when they suspect that they are diseased. Healthy animals are often sent to big cities such as Accra and Kumasi for

higher prices. According to veterinary doctors in Tamale and Bolgatanga, antibiotics, dewormers and multivitamins used to treat animals usually result in residues in meat and the accumulation of the residues can cause harm to humans. Antimicrobials are commonly used for disease prevention and growth promotion in livestock and poultry production in Ghana and elsewhere especially in modern production systems. Dangerous bacteria such as Streptococci, E. Coli and Salmonella species, which are common contaminants in the livestock industry are known to be resistant to antimicrobials such as ampicillin, tetracycline, cefadoxil, erythromycin, cefotiam, penicillin (Adzitey, 2014, Adzitey et. al. 2020, Ekli et. al. 2020). According to a study by Turkson, (2014) the percentage of resistance to these antimicrobial drugs ranged from 61% to 97%. These bacteria are found in livestock, poultry and their products and from surfaces of tables and knives at slaughterhouses, especially because the insanitary situations in many slaughterhouses are deplorable. The unfortunate situation is that most meat consumers are not aware that they consume antimicrobials with the meat and stand the risk to becoming antimicrobial resistant. The sale of fake antibiotics compounds the problem. Antibiotics can be easily bought even on the streets and villages and from people who have no pharmaceutical knowledge or are barely literate. There is importation of antibiotics from unapproved routes, and it has been shown that antibiotic supplies from the informal sector are of lower quality than those from the formal sector (Bekoe et. al., 2020). According to the Veterinary Doctor in Bolgatanga, "the whole world is sitting on an AMR (antimicrobial resistance) time bomb". There are significant legislative and policy gaps with respect to the safe use of antimicrobials in livestock and humans in Ghana and in several other countries. The Public Health Act (Act 851) of 2012 for example does not cover what individuals do with their livestock. Livestock owners can buy and administer drugs to their animals without any supervision or advice by professionals. There are also no acceptable national standards for antibiotic residue in livestock production in Ghana. Also, there is no testing for antibiotic residue and no minimum allowable weaning period before slaughter and processing of meat. All these are dangerous food safety gaps that must be tackled by legislation and/or policy.

The two main zoonotic diseases of ruminants are anthrax and tuberculosis, and they are serious food safety risks. According to some key informants, anthrax, though not a commonly occurring disease, is very deadly and it is often detected only after the death of the animal. There are people especially in the Upper East Region who insist in eating dead animals and there have been instances where several people have been killed by anthrax as a result. Tuberclosis (TB) is another disease that is easily transferred to humans through the meat, milk or air. TB is also usually detected after the slaughter of the diseased animal. Such carcasses are usually to be quarantined or even destroyed but many butchers will normally sell such meat to unsuspecting customers. Another common source of meat contamination is the use of car tyres instead of gas or firewood to clean slaughtered animals and the general insanitary conditions of slaughterhouses. The tyres contain poisonous chemicals and thus literally poison the meat. The degree of contamination of meat by the very insanitary environments of slaughterhouses and meat sale points can only be imagined. Also, there are a large percentage of livestock (ruminants) and poultry that are not slaughtered in slaughterhouses. Also. the consumption of pork and dog meat has been on the increase in many parts of Ghana and most of those are not slaughtered in slaughterhouses. There are high food safety risks with animals slaughtered in homes.

In the case of poultry, food contamination usually result from what is fed to the birds. Corn meals fed to poultry can contain aflatoxin. Unsatisfactory storage of poultry feed can also result in aflatoxin and other mycotoxins contamination. The modern poultry production methods where broilers are raised quickly (between 8 to 10 weeks) can result in aflatoxin build up in the poultry farm. In the case of egg production, the main food safety issue there is Salmonella. Poultry birds are carriers of Salmonella and that is usually passed to humans through the eggs. Continuous use of poultry houses without constant fumigation can lead to build up of Salmonella. Thus, the recommendation has been "all-in-all-out" husbandry practice. The problem of AMR is also quite serious in poultry (Boamah et. al. 2016).

Avian influenza (bird flu) is a major zoonotic disease of poultry. It is virus spread by droplets. Bird flu is so deadly that when a farm is attacked it is recommended that all the birds should be destroyed. Because of the great loss farmers incur when there is a bird flu attack farmers find ways to sell diseased and dead birds to consumers and thus causing serious human food safety problems.

4.3.5 Food Safety and Quality Issues in Fisheries and Fishery Products

There are several serious food safety and quality issues in fisheries and fish products as with the other products. The antimicrobial resistance (AMR) problem is quite acute in fisheries especially cultured fish production (Donkor et. al. 2018). Use of inputs such as antibiotics, growth hormones, and pesticides for disease prevention and control in fishponds and cages can lead to AMR. Consumption of such cultured fish, especially in situations where withdrawal periods are not adhered to results in the spread of AMR. Heavy metals are also commonly found in fish feed ingredients. According to Shah (2012) bacteria from tilapia and other species have been found to be antimicrobials that are commonly used in treating human diseases even in farms where the antimicrobials have not been used. Several key informants have noted that, if untreated livestock manures which contain resistant bacteria are used as feed for fish and the effluent is discharged without being processed, it can contaminate the environment and thus contaminate food produced within such environments.

Insanitary landing sites for marine fisheries are sources of fish contamination. The current landing sites for fisheries need to be improved considerably. Some key informants indicated that there have been cases of use of formalin (a chemical used to preserve dead human bodies) as preservative for fish. Also, the smoking of fish can lead to considerable food contamination.

Picture 10: Landing sites for marine fisheries.

4.3.6 Synthesized Summary of the Main Issues and Attempted Interventions in Ghana

Table 2 is a summary of synthesis of the main food safety and quality issues in conventional and modern production systems and attempted interventions in Ghana and Figure 2 is a diagrammatic representation of the food safety and quality issues along the food chain.

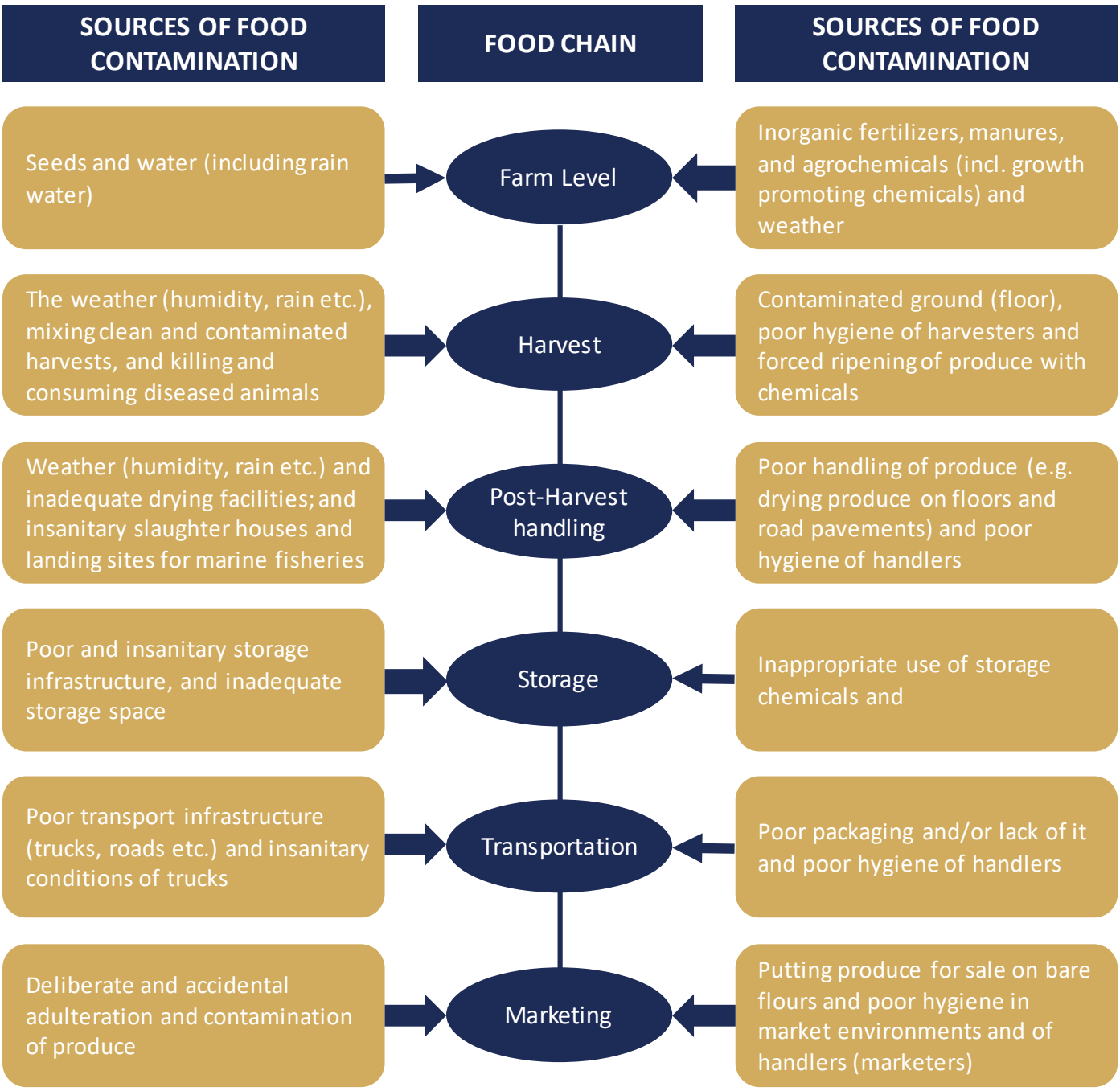
Table 2: Main Food Safety and Quality Issues, Existing Situations, Interventions and Success Stories (if any)

	Common food safety and quality issues	Existing situations, interventions and success stories (if any) in Ghana
General Issues		
Food safety and quality legislations/ laws	Local Government Act 463 (1993); EPA Act 490 (1994); Plants and Fertilizer Act 803 (2010); Biosafety Act 341 (2011);	
Public Health Act 851 (2012)	All these laws exist. Almost all of them seem to be concerned about exported and imported products as well as manufactured goods and services. Little in the laws tackle many of the domestic food safety and quality issues, especially with respect to food production. Also, implementation of the few areas that touch on domestic food safety and quality is poor and hardly effective mainly due to resource constraints.	
Food safety and quality issues in policies, strategies, projects and programmes	Only four of 17 well documented policies, strategies, projects and programmes reviewed considered food safety and quality issues and none of those were by MoFA.	Food safety and quality issues in conventional and modern food production are yet to be taken serious in Ghana's food production policies, projects and programmes including those promoted by international organizations and donors. Some of the policies etc. literally promote food contamination. Increasing use of agrochemicals is an example.
Crops		
Farm, Harvest and Post-Harvest levels	Use of dangerous (banned) agro chemicals and misuse of others chemicals and fertilizers	Several input dealers have very little or no knowledge of the dangers of agrochemicals to human and animal health and thus cannot advise farmers. Extension personnel are also too few and too poorly resourced to be of any help. Very little is being done to stem the increasing use of weedicides and pesticides.
	Aflatoxins, other mycotoxins and heavy metals contamination	Again, these are food safety and quality problems that very little is being done except for exports and imports. Contamination of these poisonous carcinogens and mutagens can be from seed, through land preparation, harvests all the way to consumption. There have been limited trainings and sensitizations, but the problem is so widespread that more targeted and well-resourced interventions are required. Use of botanicals have been effective in some jurisdictions and should be promoted in rural areas.

Storage	Inadequate and unsuitable storage infrastructural interventions; including drying facilities	These are serious problems especially in modern food production systems where large volumes of produce are harvested. There is very high food contamination as a result of poor storage at community and market levels. Improvement of local storage systems can be useful. Science and technology must be used to improve indigenous knowledge.
	Misuse of storage chemicals	Limited knowledge and/or disregard for laid down rules results in storage chemicals becoming contaminants. Improvements in local methods such as use of pepper, neem and ash may make use of storage chemicals unnecessary especially in the case of small-scale producers.
Transportation	Inappropriate and Insanitary conditions of transport vehicles	This is a problem that has not had any intervention to the best of our knowledge. Transport owners decide how to clean their vehicles and trucks to carry produce including vegetables. There is need for some inspection intervention in this area to reduce food contamination
Processing	Insanitary conditions of processing units and heavy metals contamination	This is very serious in the non-industrial processing centres. Heavy metals contamination in milled produce has been shown to be high. Small and medium scale agricultural produce processors should be supported financially and technically to improve their production and make the products much safer.
Marketing	General insanitary conditions in markets	This is surprising because organizing marketers to keep their working places clean should not be a problem. The problem seems to be lack of inspection and sanctions by the Environmental Health Departments of the MMDAs.
	Deliberate adulteration of produce	This is criminal and offenders must be punished severely but that does not seem to be happening at an appreciable scale. The other problem is lack of evidence of adulteration. There should be simple ways of testing the wholesomeness of agricultural produce at the point of purchase.
Livestock and livestock products		

Farm level	Insanitary conditions in livestock and poultry houses	These situations have led to great losses and great danger to human lives. The bird flu situation where thousands of poultry birds had to be destroyed is a good example. Bird flu is zoonotic and very dangerous to humans. Anthrax and TB are other deadly zoonotic diseases which can be contracted through careless livestock husbandry practices.
	Aflatoxin and other toxins, and Salmonella in livestock feed	These come through poor storage and poor husbandry practices. The contamination can be through the meat (toxins) or eggs (Salmanella).
	Use of growth promoting hormones, antibiotics and other veterinary drugs	This is known to result in AMR in the animals as well as in humans who consume the meats. Livestock and poultry farmers need constant refresher training.
Slaughter and meat transportation and sale	Insanitary conditions in in slaughterhouses, means of transport and abattoirs	Veterinary inspection in slaughterhouses is required by law but it has been quite difficult to implement adequately. Cooperations from butchers is required but that can be a problem. Also, several animals are not slaughtered in slaughterhouses. The way meat is also transported openly from slaughterhouses to abattoirs and meat shops is a serious source of contamination.
Fisheries and fishery products		
Marine fisheries	Contamination in insanitary landing sites	The sanitary conditions of landing sites for marine fisheries across the shores of Ghana are deplorable. Attempts are being made to improve some of them (e.g. Jamestown in Accra).
Fishponds	Use of antibiotics, growth promoting hormones, and pesticides inputs	As in livestock, this results in AMR in the fish and humans who consume the fish.
Marketing	Lack of cold storage facilities. Also, fish smoking and other preservation methods can lead to contamination	Cold storage though necessary is expensive and not affordable for artisanal fisheries. The result is spoilage of fish, contamination, and consumption of unsafe fish. Also, the smoking of fish and use of formalin to preserve the fish are sources of contamination of the fish. There needs to be some level of supervision and monitoring of fish preservation methods.

Figure 2: Diagrammatic Representation of Food Safety and Quality Issues along the Food Value Chain



The thickness of the arrows suggests the relative importance of the food safety and quality problem.

Source: Authors' construct (August 2022)

V

BARRIERS HINDERING AND ENABLERS PROMOTING FOOD SAFETY AND QUALITY IN MODERN AND CONVENTIONAL FOOD PRODUCTION SYSTEMS

From the literature review and the rapid appraisals several challenges or barriers that hinder the attainment of food safety and quality include the following:

1. There is limited knowledge at several levels; community, policy making, governmental and non-governmental levels; of food safety and quality issues. As a result, there is generally very low appreciation of the seriousness of food safety and quality problems and thus limited commitment in terms of political will and resource allocation.

2. There has also been limited realization that food safety and quality problems span the whole food value chain and not only at the consumption level. That is partly the reason why the FDA seems to be the only governmental agency undertaking active supervision of food safety in the country. PPRSD and VSD of MoFA should have key roles in ensuring food safety and quality along the different food value chains. Currently they are very poorly resourced to be able to undertake any food safety supervisory and monitoring activities. Strong multi-sectoral collaboration between the relevant organizations is necessary for the complexities in food safety and quality issues to be addressed.

3. Allied to the above is inadequate capacity to enforce food safety and environmental laws. The inadequacy is respect to personnel, equipment, logistics and financial resources.

4. There are also inadequate social and economic infrastructures to facilitate good food safety and quality practices. Laboratories are very inadequate. The working conditions of some of the institutions are also demotivating. There seems to be total dependance on donor organizations to fund food safety and quality interventions and that is unsustainable and thus demotivating.

5. The degree to which government agencies, development partners and non-governmental organizations (NGOs) encourage the use of agro-chemicals by farmers is disturbing. These bodies are either ignorant of the dangers of

these chemicals or are simply being deliberately hypocritical and destructive.

6. There is limited research on food safety and quality especially with respect to production aspects of the food value chain and also production for home consumption and sale in domestic markets.

7. Some beliefs and culture hinder food safety and quality. Eating of dead animals with the belief that there are certain herbs can be used to cleanse the dead animals of infections, for example, continues to exist in parts of the country.

8. Consumer tastes determine to a large degree what farmers produce for sale. Some demands such as deep red palm oil is the cause of the use of Sudan dye in palm oil. Similar demands exist for very green vegetables and deep yellow bananas resulting in the use of chemicals to obtain those colours.

9. The several stages of handling of foodstuffs from producers to consumers is a major barrier to food safety and quality. The likelihood that such food will be exposed to unsanitary conditions, and thus contamination and adulteration is very high.

These barriers apply to both conventional and modern production systems though there may be differences of severity in the different systems.

Enablers that promote food safety and quality along the food chain include the following:

1. Infrastructure: Availability of food safety testing laboratories, drying and storage facilities, hygienic slaughterhouses and abattoirs etc.

2. Well-structured food safety and quality advocacy and sensitization units with adequate logistical and financial support to undertake mass education of the populace on food contamination hazards along the entire food chain is a good enabler. The dangers of agro-chemicals and growth promoting chemicals must be highlighted since there is considerable tradeoff if farmers have to forego the use of these inputs.

3. Promotion of personal hygiene for all persons involved in the food value chains.

The above stated enablers and others also apply to both conventional and modern production systems though there may be some differences in effectiveness in the different systems.

VI

BEST PRACTICES, SUCCESS STORIES AND LESSONS

Food safety interventions have been minimal in Ghana and thus it is difficult to state best practices that have taken place especially with respect to the food production aspects of the food chain, our main area of interest. However, the following are worth mentioning as interventions that can pass as best practices if they are well-resourced.

1. Appropriate legislations and policies are the starting point of best practices in food safety and quality. For food safety and quality practices to be effective almost everybody should behave in particular ways and it is appropriate laws with well-designed sanctions that ensure compliance. After the legislations, appropriate policies, programmes and policies should also be put in place and implemented with effective monitoring and evaluation (M&E) mechanism instituted. Policies are intensions that must be backed by political commitment and resource allocation.

2. Simple post-harvest practices such as hygiene consciousness of handlers of harvested foodstuffs can reduce aflatoxin contamination considerably.

3. The testing of aflatoxin contamination in virtually all areas at farm, harvest, post-harvest etc, levels. The test is quite simple and relatively low-cost. Investing is such can reduce the problem considerably.

4. The FDA/WIAD/GIZ collaboration in providing stainless steel tables (with training in food safety and quality) for the sale of vegetables and meat in several districts in the country may be regarded as one of the best food safety practices in the country and a success story. Unfortunately, it can be limited to only a few MMDAs.

5. The provision of community drying facilities is also proving to be a good food safety practice and a success story. Ada, in the Greater Accra Region, is known for good pepper as a result of the introduction of community solar drying facilities in the area.

6. There are likely to be other food safety intervention success stories with respect to export crops. Safe bananas are being produced by Golden Exotics (a farm at Asutsuare in the Greater Accra Region) for export.

VII

CONCLUSIONS AND RECOMMENDATIONS

There are serious food safety and quality issues at all levels of numerous food chains. Food contamination takes place at all levels of the food chain in crop, livestock (including poultry) and fisheries/ aquaculture production. Food contamination is also at different levels of severity and seriousness in both conventional and modern food production systems depending on the sources of contamination and the type of food. For cereals and legumes, agro-chemical, as well as aflatoxin and other mycotoxin contaminations are the most common and are quite severe in both conventional and modern production systems. Chemical contamination tends to be more in the modern production systems while aflatoxin contamination seems to be more in conventional production systems. It is however difficult to be categorical because the causes are from different sources and depend on so many factors and husbandry practices of farmers. In the case of roots and tubers, nematode infestation is the main cause of food contamination. In the case of livestock and poultry unsafe food production is from zoonotic sources and AMR. The main zoonotic diseases are anthrax, tuberculosis, bird flu and Salmonella. For fish and fish products AMR and heavy metals are the critical food safety problems. In all cases insanitary production facilities and inadequate attention paid to personal hygienic by persons involved are important sources of food contamination.

Several recommendations have been given in various parts of the write-up. What is being presented here are summaries.

1. There is need for robust laws that will bring all food safety players on board for effective food safety interventions. There should be a comprehensive review of the Public Health Act and all the key stakeholders, FDA, GSA, PPRSD, VSD, MoFAD, Fisheries Commission, EPA, and others should actively participate.

2. Food safety interventions or activities are hardly seen at the food production, harvest and post-harvest levels. Food safety regulators such as the PPRS, the VSD and others should be adequately resourced to play their roles in the food safety space.

3. MMDAs are the key institutions for planning and implementation of food policies, plans, programmes and projects. Food safety issues must therefore be incorporated into the medium-term plans of all MMDAs else there will be no food safety interventions. There is also need for those taking decisions at the MMDAs level to be thoroughly sensitized on food safe issues.

4. PPRSD should train the food safety extension personnel or agric extension personnel on food safety issues and MMDAs should pay for that

training since the personnel are under the local government service. LG service should fund that activity.

5. The complexity in the causes of unsafe food production at the farm level makes it difficult to distinguish differences in food safety in conventional and modern production systems. What is necessary is workable policies, programmes and projects to make food safety a key component of all production systems.

6. Food safety testing laboratories are required in all regions of the country while simple toxins testing kits should be available at community and farm levels for routine and constant testing. Accurate and reliable quantification of contaminants in locally produced (as well as imported) food is important for inclusive food safety and quality interventions.

7. It is necessary to enforce international food safety guidelines on local situations to ensure food safety and the health of the people. Standards used for food for domestic consumption should be comparable to those destined for exports.

8. There should be investments in household storage and drying facilities, and it should be on a public private partnership arrangement. The arrangement can involve MMDAs, farmers and the aggregators/marketers. As suggested by the Director of WIAD, richer MMDAs can take the lead and if successful, others will follow.

9. The problem with demonstrations is the coverage and follow up activities. The Government of Ghana should show commitment in ensuring food safety and quality for all by allocating and releasing adequate funds for the purpose. Development partners and donors should not be expected to pilot and also upscale.

10. Well-built farmer markets, based on high sanitation and food standards, along major highways should be established. They will be good food safety and quality interventions.

11. Environmental hygiene and overall personal cleanliness need to be promoted at all levels: communities, markets, slaughterhouses, abattoirs, means of transport etc. Strong inclusive sensitization and advocacy on food safety and quality, personal hygiene and environmental cleanliness needs to be undertaken since the concepts means different things to different people.

12. The use of fertilizers and agrochemicals in farming cannot be discarded, thus, safe and effective ways of applying various agrochemicals must be well understood by agricultural extension personnel and taught to farmers.

13. Without data it is not possible to target interventions. There is hardly any data on levels and trends in the different types of food contamination along the food value chain. Research should prioritize the provision of such information.

14. The usefulness of indigenous knowledge in tackling challenges has been established in almost every area of endeavors. Existing indigenous or local knowledge on food safety and ways of countering contaminations should be pursued.

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APPENDICES

LOCATION	Stakeholders consulted
Upper East Region (Municipal Directorate Agriculture)	Lantana Osman (Director) John Anaba Asigre Sarah Ayamba
Upper East Region (Agricultural Extension)	Director
Upper East Region (Veterinary Services Department)	Dr. Nii Aryi Anang (Director) Dr. Robert Bayuo
Upper East Region (Environmental Health)	Evans Bornaa
Upper East Region (EPA)	Solomon
Upper East Region	Bolgatanga Market women and men
Northern Region (Ghana Health Service)	Abdulai Abdul Rauf Cynthia Kubio Abdul Wadudu Mohammed Adisa Mohammed
Northern Region (EPA)	Abu Iddrisu (Director)
Northern Region (Veterinary)	Dr. Suraj
Northern Region (CSIR-SARI)	Dr Issah Sugre
Northern Region (Processor)	Queen Gaf
Northern Region (FDA)	Director
Northern Region	Tamale market and women
Bono-East Region (Farmer – Award Winner) and Extension Officer	Patrick K Acheampong Also Agricultural Extension Officer
Bono-East Region (Gari Processing)	Ofori Amanfo and others

Bono-East Region	Techiman market women and men
Bono-East Region	Road side marketers
Ashanti Region (Offinso North District) – Farmers and Palm oil processing	Nana JJ, Nana Appiah and others.
Ga West Municipal (PPRSD)	Eric Quaye – Director Prudence Attipoe Gifty Boakye Mohammed Nurudeen Christopher Gaitu Fred Asante
Ga West Municipal (Retired Director of PPRSD)	Vesper Suglo
Accra – Food Research Institute	Dr. Joline Nyarko
Accra (MoFA)	Angela Danson
Accra (WIAD)	Paulina Addy Gideon Ashitei
Accra (GSA)	Nathaniel Brakoh
Accra (GSA)	Nathaniel Brakoh

Appendix 2:

DARAP Checklist for Stakeholder Consultations (Extension personnel, researchers, farmers, processors and marketers etc)

1. What are the main causes of unsafe cereals production at farm, post-harvest, processing and marketing levels? What should be done to reduce or prevent the problem at the different levels? [Maize, rice, sorghum and millet]. **PLEASE DISTINGUISH BETWEEN THE PROBLEMS IN CONVENTIONAL AND MODERN PRODUCTION SYSTEMS, if any!**

	1.1 What causes unsafe cereals production? You may be specific with respect to specific cereal crops.	1.2 What should be done to reduce or prevent the problem?	1.3 What interventions have taken place and by who?
A. Farm level			
B. Post-harvest			
C. Storage			
D. Processing			
E. Transportation			
F. Marketing			

1.3 General comments: .....

2. What are the main causes of **unsafe legumes** production at farm, post-harvest, processing and marketing levels? What should be done to reduce or prevent the problem at the different levels? [Beans, groundnut and soybeans]. **PLEASE DISTINGUISH BETWEEN THE PROBLEMS IN CONVENTIONAL AND MODERN PRODUCTION SYSTEMS, if any!**

	2.1 What causes unsafe legumes production? You may be specific with respect to specific legumes.	2.2 What should be done to reduce or prevent the problem?	2.3 What interventions have taken place and by who?
A. Farm level			
B. Post-harvest			
C. Storage			
D. Processing			
E. Transportation			
F. Marketing			

1.3 General comments: .....

3. What are the main causes of **unsafe roots and tubers** production at farm, post-harvest, processing and marketing levels? What should be done to reduce or prevent the problem at the different levels? [Cassava, yam, cocoyam and sweet potato]. **PLEASE DISTINGUISH BETWEEN THE PROBLEMS IN CONVENTIONAL AND MODERN PRODUCTION SYSTEMS, if any!**

	3.1 What causes unsafe roots and tubers production? You may be specific with respect to specific root and tuber crops.	3.2 What should be done to reduce or prevent the problem?	3.3 What interventions have taken place and by who?
A. Farm level			
B. Post-harvest			
C. Storage			
D. Processing			
E. Transportation			
F. Marketing			

3.3 General comments: .....

4. What are the main causes of **unsafe fruits and vegetables** production at farm, post-harvest, processing and marketing levels? What should be done to reduce or prevent the problem at the different levels? [plantain, bananas, mangos, oranges, tomatoes, pepper, onions, pineapple, exotic vegetables etc]. **PLEASE DISTINGUISH BETWEEN THE PROBLEMS IN CONVENTIONAL AND MODERN PRODUCTION SYSTEMS, if any!**

	4.1 What causes unsafe fruits and vegetables production? You may be specific with respect to specific fruits and vegetables crops.	4.2 What should be done to reduce or prevent the problem?	4.3 What interventions have taken place and by who?
A. Farm level			
B. Post-harvest			
C. Storage			
D. Processing			
E. Transportation			
F. Marketing			

4.3 General comments: .....

5. What are the main causes of **unsafe livestock and livestock products** production at farm, post-harvest, processing and marketing levels? What should be done to reduce or prevent the problem at the different levels? [large and small ruminants, poultry, meats, milk etc.]. **PLEASE DISTINGUISH BETWEEN THE PROBLEMS IN CONVENTIONAL AND MODERN PRODUCTION SYSTEMS, if any!**

	5.1 What causes unsafe livestock and livestock products production? You may be specific with respect to specific livestock and livestock products.	5.2 What should be done to reduce or prevent the problem?	5.3 What interventions have taken place and by who?
A. Farm level			
B. Post-harvest			
C. Storage			
D. Processing			
E. Transportation			
F. Marketing			

5.3 General comments: .....

6. What are the main causes of **unsafe fish and fish products** production at farm, post-harvest, processing and marketing levels? What should be done to reduce or prevent the problem at the different levels? [Fishing and aquaculture]. **PLEASE DISTINGUISH BETWEEN THE PROBLEMS IN CONVENTIONAL AND MODERN PRODUCTION SYSTEMS, if any!**

	6.1 What causes unsafe fish and fish products production? You may be specific with respect to specific fish and fish products.	6.2 What should be done to reduce or prevent the problem?	6.3 What interventions have taken place and by who?
A. Farm level			
B. Post-harvest			
C. Storage			
D. Processing			
E. Transportation			
F. Marketing			

6.3 General comments: .....

7. What are the main causes of production of **other unsafe foods** (specify) at farm, post-harvest, processing and marketing levels? What should be done to reduce or prevent the problem at the different levels? [Specify the foods]. **PLEASE DISTINGUISH BETWEEN THE PROBLEMS IN CONVENTIONAL AND MODERN PRODUCTION SYSTEMS, if any!**

	7.1 What causes the production of other unsafe foods? Please specify the foods.	**7.2 What should be done to reduce or prevent the problem?**	**7.3 What interventions have taken place and by who? What level of success?**
A. Farm level			
B. Post-harvest			
C. Storage			
D. Processing			
E. Transportation			
F. Marketing			

6.3 General comments: .....