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Ministry of Agriculture

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Agriculture Sector Modernization Project
விவசாய நவீனமயமாக்கல் திட்டம்

Analytical and Policy Advisory Support, Research Report – No 03

Policy Research for Modernization of Food Safety Assurance System in Sri Lanka

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AGRICULTURE SECTOR MODERNIZATION PROJECT

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POLICY RESEARCH FOR MODERNIZATION OF FOOD SAFETY ASSURANCE SYSTEM IN SRI LANKA

Prepared by

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For

Agriculture Sector Modernization Project

Ministry of Mahaweli, Agriculture,
Irrigation and Rural Development

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Preface

This is the report of the study; 'Policy Research for Modernization of Food Safety Assurance System in Sri Lanka', undertaken by Infotechs IDEAS (Pvt.) Ltd., on behalf of the Agriculture Sector Modernization Project (ASMP) of Ministry of Agriculture.

The principle objective of the research was to analyze the existing policy and regulatory gaps of food safety in Sri Lanka in order to formulate an all-inclusive, effective, policy framework towards a better food safety assurance system. This was achieved by a comprehensive situation analyses capturing the; (i) prevalence of safety hazards in agro-food value chains, (ii) views, opinions, suggestions of stakeholders at apex and field level, (iii) gaps and effectiveness of food safety policies, Acts, Regulations and supportive facilities; as well as by (i) examining food safety policies, regulatory and strategies advocated by international agencies, and (v) examining modernized food control systems in other Asian countries.

The study was commenced in January 2019, and following several progress reviews the Draft Report was submitted in May 2020, to the ASMP expert panel of reviewers. This final report has incorporated all their valuable comments and suggestions, making it comprehensive and an all-inclusive report. The report is presented in focused and compactly written five chapters, as; Background, Research Objectives and Methodology, Food Safety Situation Analysis based on Secondary Evidence, Food Safety Situation Analysis based on Primary Evidence, and the Research Recommendations. The five chapters together shed light on the current situation with respect to food safety and plausible recommendations to rectify the situation at national level.

This report is the ultimate accomplishment of arduous efforts by a dedicated team of consultants commissioned by Infotechs IDEAS (Pvt.) Ltd. Dr. Canute De Silva - agricultural economist, who has a tireless passion to delve deep into a subject and derive solutions, headed the team as the Principal Researcher and Team Leader. He was instrumental in designing the research plan and together with team-consultants personally attended to all the facets of the research, including extensive literature review, field work, analyses of information and writing the report. Furthermore, the research benefitted immensely from the scholarly inputs of Prof. Terrence Madhujith, Professor and Department Chair, Department of Food Science and Technology, Faculty of Agriculture University of Peradeniya, who was the research consultant on food science and food technology and a constant guide and advisor. He contributed many

leads to orient the study for a rational output. Mr. Shantha Emitiyagoda, Extension Agronomist, was continuously with the research, shouldering the extensive field situation analysis component. Professionally he acquired information from the agriculture community of farmers, officers, private sector, in several districts and regions. Research profited by his years of field experiences and skills in field discussions.

Infotechs IDEAS (Pvt.) Ltd. wishes to thank Dr. Canute De Silva, for his untiring dedication, which steered the study to a whole new level. We also express our gratitude to all the members of the research team for their concerted efforts and commitment in making the study a success.

Infotechs IDEAS (Pvt.) Ltd. gratefully acknowledge the assistance from staff of ASMP and express sincere appreciation to Dr. Rohan Wijekoon, Project Director for his support during the course of the research. In particular, we wish to put on record a debt of gratitude to Ms. Asoka Jayakody, the Policy Specialist of the ASMP for her continuous guidance and encouragement throughout the study period. The Policy Specialist and the panel of external reviewers rendered assistive navigation to the research, advising critical mid-course trajectory refinements. We exceedingly value the learned comments from Dr. Ilmi Hewajulige and Dr. Chathura Rodrigo, the external reviewers, which inspired us to achieve this accomplishment.

Throughout the endeavor, Ms. Nimanthi Karandagoda, Senior Program Officer of Infotechs IDEAS, functioned as the research coordinator and context monitor, performing as the focal point of coordination among client, ASMP and consultants. She also partnered with the research team with specific literature survey and editing early drafts. We appreciate and thank her for her committed support.

This research could not have been completed without the backing of stakeholders of the public sector, private sector and the people sector comprising widely spread farming and trading community, who earnestly cooperated with the research team during information collection. We appreciate and thank them for their openness, participation and support.

Mr. Tissa Warnasuriya
General Manager, Corporate Affairs
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October 14, 2020

The Research Team

1. Dr. Canute De Silva - Agricultural Economist, Principal Researcher & Team Leader

2. Prof. Terrence Madhujith - Professor and Department Chair, Department of Food Science & Technology, Faculty of Agriculture, University of Peradeniya

3. Mr. Shantha Emitiyagoda - Extension Agronomy Specialist

4. Mr. Tissa Warnasuriya - Institutional Development Specialist

5. Ms. Nimanthi Karandagoda - Senior Program Officer, Research Coordinator & Context Monitor

Abbreviations

ASMP:	Agriculture Sector Modernization Project, of Ministry of Agriculture
CAA:	Consumer Affairs Authority.
CAC:	Codex Alimentarius Commission
CFU:	Colony Forming Units (of bacteria)
CODEX:	Codex Alimentarius
CBRP:	Contamination Based Regulatory Programmes
CWE:	Cooperative Wholesale Establishment
DOA:	Department of Agriculture
DG:	Director General
DGHS:	Director General of Health Services
Es:	Environmental Sustainability
EU:	European Union
FAC:	Food Advisory Committee
FAO:	Food and Agriculture Organization
FBO:	Food Business Operators
FCAU:	The Food Control Administration Unit
FCRDI:	Field Crop Research & Development Institute
FCSNA:	Food Control System Need Assessment
FCSRIA:	Food Control System Regulatory Impact Assessment
FDI:	Food and Drug Inspector
FFG:	Farmer-Focus-Group (discussions)
FFS:	Farmer Field Schools
FG:	Focus-Groups (discussions)
FSA:	Food Safety Authority
FSEC:	Food Safety Enabling Capacity
GAP:	Good Agricultural Practice
GLOCRDI:	Grain Legume & Oil Crops Research and Development Centre

GLV:	Green Leafy Vegetables
GM:	Genetically Modified
GMF:	Genetically Modified Food
HACCP:	Hazard Analysis Critical Control Points
HARTI:	Hector Kobbekaduwa Agrarian Research and Training Institute
HORDI:	Horticultural Crop Research and Development Institute
IDI:	In-depth Individual (interviews)
IPM:	Integrated Pest Management
KII:	Key Informant Interviews
MAL:	Maximum Allowable Level (Limit)
MRL:	Maximum Residue Level (Limit)
MOH:	Ministry of Health
MOA:	Ministry of Agriculture
NATCOL:	Natural Food Colours Association, Brussels, Belgium
NFCS:	National Food Control System
NFSP:	National Food Safety Policy
NIPHT:	National Institute of Postharvest Technology
NPQS:	National Plant Quarantine Service
NWP:	North Western Province
PDA:	Provincial Director of Agriculture
PHI:	Public Health Inspector
QARP:	Qualitative Analysis Research Procedure
ROP:	Registrar of the Pesticide
RRDI:	Rice Research & Development Institute
SAA:	Situation Analysis Approach
SLSI:	Sri Lanka Standards Institution
SPS:	Sanitary and Phytosanitary (measures)
SWOT:	Strengths, Weaknesses, Opportunities, and Threats; as in SWOT analysis
TBT:	Technical Barriers to Trade
UNIDO:	United Nations Industrial Development Organization
WHO:	World Health Organization

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Chapter 1

Policy Research for Modernization of Food Safety Assurance System in Sri Lanka

Background

The '**Policy Research for Modernization of Food Safety Assurance System in Sri Lanka**[1]' is an obligatory project activity of Agriculture Sector Modernization Project of the Ministry of Agriculture. It is one of nine policy research themes the project is accomplishing through outsourced consultancy services.

1.0 The Agriculture Sector Modernization Project

1. The Agriculture Sector Modernization Project (ASMP) is a World Bank funded development oriented project in Sri Lanka, jointly implemented by two complementary Ministries; the Ministry of Agriculture (MOA) and the Ministry of Primary Industries. The Project has two major technical components, of which the Component 2; 'Productivity Enhancement and Diversification Demonstrations', is implemented by the MOA in seven districts within five provinces. It aims to support smallholder farmers to produce competitive high value agricultural products, improve their ability to respond to market needs and access domestic and international markets and become efficient and sustainable market participants.
2. A subcomponent of component 2 is: *'analytical and policy advisory support, aims at developing evidence-based policy, legal and regulatory frameworks needed for agriculture modernization'*. This subcomponent specifies several research agendas to accomplish through outsourced proficient consultancy institutions. The 'Policy Research for Modernization of Food Safety Control System in Sri Lanka' is one such outsourced[2] research assignment.

[1] The Agriculture Sector Modernization Project Report names this research as 'Policy Research in the Area of Food Safety'. As this original title lacks rigor, as observed during key stakeholder discussions, the title was reworded to be expressive of the research output. Thus the 'Policy Research in the Area of Food Safety' was reworded as 'Policy Research for Modernization of Food Safety Assurance System in Sri Lanka'

[2] Awarded to InfotechsIDEAS (Pvt.) Ltd.- Consultants

2.0 Definition of food safety and explanation of related terms

3. Food safety has an all-inclusive and ever widening interpretation. Food safety is interpreted as *'producing, handling, storing and preparing food in such a way as to prevent infection and contamination of food in the food value chain* (World Health Organization, 2015)*'*. Food safety is also defined as; *'food safety is the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use* (Codex Alimentarius Commission, 2009)*'*. Safe food is devoid of contaminants to a harmful level.
4. Different countries stress on realizing food safety in value chains depending pertinent to their economy and lifestyle of consumers. Thus great emphasis is given to prepared food hygiene in developed economies than in developing economies. Developing economies give a greater scrutiny to safety of food coming from developing economies than consumers in the exporting countries. Livestock based economies are concerned on safety of livestock feed more than in countries where livestock is a less significant husbandry. However, in general, all countries whether for domestic consumption, exports or imports are apprehensive about the safety of food and take suitable and country-relevant remedial actions to modernize the domestic food safety control system. Only the depth and extent of actions differ among countries.

3.0 Contamination and adulteration of food

5. The presence of substance that is not intended to be an ingredient of the food product could be due to contamination or adulteration. In common usage, the phrase 'food contamination' often means both, without distinguishing the classification. Specifically stating, contamination is unintentional and could arise from natural causes, implicitly from the food producing process, or as a result of lapse in quality control. Many contaminations are predictable, and risks from contamination are generally manageable as the contamination process is openly evident, provided there is a strong food safety enforcing system.
6. Adulteration, on the other hand, is economically motivated. It is the intentional replacement of the intended ingredient of a product with an adulterant, or dilution of the intended ingredient with a less expensive, not as-good-as substitute. Adulteration always results in the introduction of unknown hazards and hence unknown risks into the food product. Except for the adulterator, no one knows what was added, and whether the adulterator knows the toxicity of the element cannot be known. If the substance is an unknown or

unexpected element, it will bypass the routine detection process. For food scientists and food safety enforcers, it is a technically challenging situation.

3.1 Food contaminants

7. The tangible element of contamination or adulteration is termed as contaminant. Contaminants are broadly categorized as Chemical, Biological and Physical. Chemical and biological contaminants are the main concerns for the food safety in the agro food chain.
8. Chemical contamination happens when food gets tainted with a natural or artificial chemical substance. Chemical contaminants can be unintentionally or incidentally added chemicals[3], as well as intentionally added chemicals (adulterants)[4]. There are several common paths for chemical contamination. The primary stage of food chain where agrochemicals could be used indiscriminately is the main path, where carryover chemical toxins can harm human health depending on the chemical specificity, residue level on food and their injurious consequences.
9. Environmental sources such as irrigation water, produce cleaning water at collecting and sorting points and even at way side markets and soil polluted with heavy metals is another source. Air polluted with industrial and farm waste chemicals also can make way to the food chain. Other possibilities are; cross-contamination during food processing, chemical migration from food packaging materials, and fraudulent actions at value addition process.
10. Biological contamination occurs when food becomes contaminated by living organisms, mostly the microorganisms, or the substances they produce. They includes bacterial, viral and fungal contaminations, or parasitic contamination[5] originating from unhygienic storage and storage pests. Biological contamination is the leading cause of food-borne illness and food poisoning. Microbial toxins are extremely potent toxins. Mycotoxins such as aflatoxin from mold infection of both raw and processed food pose a serious carcinogenic threat. Molds could invade food at any stage, especially when moist while in transit or storage.
11. Physical contaminants are any kind of undesirable matter foreign to the food and mixed in the food. In fraudulent food trade, look-alike foreign matter are often intentionally mixed as bulking agents, in the processing segment. This action among other things constitute

[3] Such as agricultural chemicals (pesticides, fungicides, herbicides, fertilizer, antibiotics, growth hormones), toxic elements (lead, zinc, arsenic, mercury, cyanide).
[4] Such as unapproved colour additives, over the limit preservatives (nitrites, sulfating agents), several substances prohibited by food laws.
[5] Common bacterial contaminants are: E. coli, Salmonella spp. Common viruses are Hepatitis A. Common parasites are roundworms, tapeworms and flukes.

food fraud. Solid matter from the surrounding or from handlers' belongings may unwittingly mix up during processing and packaging.

4.0 Dishonest operations affecting food safety

12. Food Fraud is another issue related to food safety. It is the deliberate and intentional substitution, addition, tampering, or misrepresentation of food, food ingredients, or food packaging; or false or misleading statements made about a product, for economic gain (Spink et al 2011). It is deception of consumers using food products, ingredients and packaging for economic gain and includes substitution, unapproved enhancements, misbranding, and counterfeiting. Though it is often regarded as deceiving the consumer on food quality, intentional distortion of contents lead to deceiving on food safety.
13. Trans-boundary traffic of food sometimes creates devious entry points for food unsafety, as witnessed in recent years. This is due to significant increase in quantity and variety of food moving across boarders in international food trade. Almost all countries compete to enhance their stake in world food commerce. The food importing countries having their lucrative markets make regulatory requirements more and more stringent. The food exporting developing countries while strive hard to match the high food safety standards of importing countries, often struggle to prevent unsafe food deviously entering the country.
14. Food Dumping[6] is another concern. It is considered as a form of price discrimination. While the World Trade Organization reserves judgment on whether dumping is an unfair competitive practice, most nations are not in favor of dumping. Devoid of complete food labeling, developing countries can become favorite dumping ground for unsafe food.
15. Food science and food technology innovations had inspired the expansion of food industry but has paved way for new health concerns as well. In the field of food chemistry, more and more food additives are continuously being developed, some with potential health hazards. In the field of biotechnology, modification or alteration of natural food is rapidly advancing. Such elements infiltrate the domestic food chain circuitously through imports; as contaminated dried primary foods, variously processed food, food processing ingredients and seed for domestic cultivation.
16. WHO and FAO recognize that modern biotechnologies have potential to raise agricultural productivity, reduce dependence on harmful chemicals and increase the nutritional value

[6] It occurs when a manufacturer lowers the price of an item entering a foreign market to a level that is less than the price paid by domestic customers in the originating country. The practice is considered intentional with the goal of obtaining a competitive advantage in the importing market

of foods. A specific concern in biotechnology is the genetically modified (GM) crops and food. Most of the scientific community views GM foods are safe. However, public are concerned on its long term health effects, especially on its allergenicity and antibiotic effect. Whether processed food use properly tested and approved GM crop ingredients, whether the label information on GM are genuine are issues for food safety control systems.

17. Radioactivity[7] in food, especially in imported food with incomplete disclosure of contents and origin, is an intermittent threat, but looming all the time. Radioactive heavy metals occur naturally and may get transferred into crops from rocks and minerals present in the soil. Other sources are artificial radioactivity from nuclear accidents and civil or military nuclear operations. Radioactivity in food in general is not disclosed.

5.0 Global progression of food safety statutes and guidelines

18. The evolution of food safety regulations in many developed economies goes back to several years; and if the fledgling regulations were also to consider, the span would extend to over hundred years. In the early period, food safety regulations were enacted piecemeal, from time to time, to address specific hazards a country had encountered. The first formal food safety regulation in the U.S. for example, was enacted in1906 as Pure Food and Drugs Act. Subsequent additions came along with major food born disease outbreaks.
19. Sri Lanka also had a somewhat similar beginning. Sri Lanka enacted several Ordinances and Acts from as far back as 1862 on the prevention of contamination of food. However, it was in 1949 that the first specific legislation on food was enacted as the Food and Drugs Act. The main features of all outdated Acts were: (a) prevention of chemical contamination and, (b) prevention of sale of unhygienic food.
20. The Food and Drugs Act was replaced in 1980 by the still in force Food Act No. 26 of 1980, which addresses a wider range of facets of food safety. It was amended in 1991 and in 2011. Between 1989 and 2013, twenty five Regulations had been legislated to the Food Act to regulate various spheres of food commerce in Sri Lanka.

[7] While radioactivity is harmful, irradiation is considered as an acceptable technology that improves the safety by reducing or eliminating microorganisms and insects by using FDA approved irradiation methods

Chapter 2

Research Objectives and Methodology

1.0 Rationale for the Research

1. An effective food safety assurance system is to protect and improve the public health by ensuring that foods meet science-based safety standards through the integrated activities of the public and private sectors (Institute of Medicine (US) and National Research Council (US), 1998). Food safety assurance systems in most developing countries are hampered by gaps, outmoded and ineffective policy frameworks and intricate challenges to improve the system. For example, a SWOT analysis on technical gaps in food safety regulatory system in Pacific Island Countries, had listed 26 weaknesses and 12 threats for rectification (FAO, 2018). They are applicable elsewhere as well. While the national food safety systems are often sluggish, the colossal global food industry was advancing in product forms, product volumes and networked global trading. This has compelled the international food safety standards and food safety strategy setters to continuously review the food industry, update the safety standards, procedures of implementation and evaluation. The WHO and the FAO of UN are the global organizations spearheading food safety systems worldwide through various commissions[8].
2. Public awareness and attentiveness to food safety has increased rapidly over the years and governments are striving to modify and develop comprehensive food safety policies and establish effective implementation strategies. The developing economies are obligated to comprehensively review and revive their national food safety policy systems and specific legislation periodically. Already several developing economies had revived their food control systems with robust policies, strict enforcements and prosecutions; among them China, India, Maldives, Thailand, and Malaysia are good examples.
3. Food production, processing, and marketing system in Sri Lanka ranges widely from small to large scale, with products passing through multiple tiers of producers, handlers and middlemen. Likewise food imports arrive through multiple importers and from numerous

[8] The most important global body for food standards, the Codex Alimentarius Commission (CAC), is the global reference point for food producers, processors, consumers, national food safety agencies and the international food trade. Since inception in 1963, CAC has produced: 223 food safety standards, 78 food safety guidelines, 53 food safety codes of practice, and numerous maximum levels, based on scientific principles.

countries of origin. Within the domestic trading network, food pass through warehouses, wholesaler storage and retailer storage network, some of which may be of unsanitary condition. Currently the responsibility to ensure food safety is resting on a multi-institution system evolved over historical or political reasons, but lacking proper inter coordination. In addition, an explicit food safety policy is nonexistent, and Acts and Regulations may be inadequate or of low practicability. This situation is further compounded by the resource competing other sectors of national development, which are equally important to the nation.

4. Though periodic reviewing and reviving of specific legislations occur in Sri Lanka, the cyclically reviewing and reviving of the entire national food safety policy framework is still awaiting. Following the advice of international agencies on food safety to revive the food policy framework in developing countries as a science-based discipline, as well as considering the ineffectiveness of the current system often and in pursuing other Asian countries who had modernized their food safety legislations, Sri Lanka is compelled to fall in line with the global trend. An operational national food safety assurance system in Sri Lanka will provide safe food for consumers and competitive food for exporters.
5. In above context, the ASMP of MOA is spearheading a research to review current food safety hazards, policies, strategies and the implementation framework and to propose an operational modernized system. This is the report of the referred research: 'Policy Research for Modernization of Food Safety Assurance System in Sri Lanka'.

2.0 Scope of the Research

6. The food production system spans a vast and diverse spectrum. It embraces several value chains such as; inputs for food production, primary food production, transportation, processing, storage, retail sale, restaurant hygiene and consumer. The food spectrum has many food groups and their explicit commodities, ways of production and preparations. They are in primary or processed form, domestically produced or imported. The major food groups are the agro foods, beverage foods, palm group foods, animal source foods, and fish source foods[9]. Consequently a research on the whole food safety spectrum is unwieldy.
7. An analysis of one major group of the spectrum aligned with the objectives of the ASMP is exercised in this study to expound the food safety situation in general and to develop national level recommendations. Yet the output of the research would complement any

[9] Agro foods are vegetables, fruits, grains, seed, pulses; Beverage foods are tea, coffee, cocoa; Palm group foods are coconut, palmyra, kithul; Animal source foods are meat, eggs, dairy; Fish source foods are marine fish, fresh water fish, and crustaceans.

endeavors in other domains of the food sector (spices, livestock, fisheries, plantation crops) in developing a holistically modernized food safety assurance system in Sri Lanka.

8. Food Safety Assurance System is within the overarching Food Control System. For food safety to be assured, the overarching food control system should be comprehensive, well-articulated, effective and operational. The scope of this research is to modernize the food control system in Sri Lanka.

3.0 Objectives of the Research

9. The General Objective of the research is to formulate and recommend an all-inclusive, effective, policy framework towards achieving an enhanced food safety assurance system in Sri Lanka.

10. The Specific Objectives are;

i) Assess the possibility of prevalence of food safety hazards in various value chains in the agro foods sector. Field elucidation from peripheral stakeholders of misuse of agrochemicals and factors contributing to the misuse. Compare agrochemical usage in Sri Lanka with regional countries. Agrochemical regulations from the point of view of food contamination, including the situation with respect to MRLs. Recommendations with respect to managing the agro chemical misuse.

ii) Capture the views, opinions, suggestions from a wider audience of stakeholders at apex level and field level on gaps and weaknesses in current food control system inclusive of its regulation, implementation scope and institutional coordination.

iii) Assess the gaps and effectiveness of policies, Acts and Regulations, supportive facilities and institutional implementation system currently in place for food safety.

iv) Examine the widely recognized and advocated food safety policies, regulatory, standards, frameworks, strategies advocated by international food safety agencies to suitably adopt in developing the research recommendations.

v) Examine the modernized food control systems in other countries in Asia with a view to adopt them for modernization of the current food control system in Sri Lanka

vi) Review food safety related operational systems such as pesticide control, quarantine, customs, other services to incorporate to research recommendations.

vii) Review the Food Act and other related Laws / Acts /Regulations related to food safety and propose suggestions/recommendations for policy/regulatory changes to improve food safety, with responsible authorities to undertake changes.

viii) Detail the cost effectiveness of food safety improvement and environmental sustainability of food safety strategies.

4.0 Research Procedure

11. The Research was accomplished by means of Qualitative Analysis Research Procedure (QARP). It is the most appropriate approach as the data and information volume assessed to elicit the current situation as well as the procedures, formulations, strategies, policy elements proposed by global authorities on food safety are non-numeric. The procedure involved systematic collection and analysis of contextual information from past research, published documents, numerous interviews and direct observations. Within this procedure Situation Analysis Approach (SAA) was employed comprehensively as the research problem has multifaceted issues, to encompass the range of current and potential future issues and their determinants, system performance and performance gaps in responding to national needs and expectations. It is the basis for setting priorities to be addressed in the policy, strategy or national plans suggested in this report. As multifaceted research are convenient to conduct as multiple themes, the research was conducted within interlinked themes; the thematic approach to qualitative analysis (Vaismoradi et al 2013)[10].
12. The Philosophy of Reasoning in logic, specifically inductive reasoning with triangulation of qualitative analysis interpretations, was the approach employed in field level stakeholder interviews. This is detailed in the introduction section of Chapter 4, on situation analysis based on external evidences.

4.1 The Two -theme Research Methodology

13. The research was conducted under two parallel themes. Contents of each theme was addressed under few subset themes[11]. The sub-setting of themes, adapted from Attride-Stirling (2001) gives a greater flexibility to the researcher. They were as follows:

[10]Qualitative Content Analysis and Qualitative Thematic Analysis are two commonly used approaches within the situation analysis in qualitative research.

[11] In the Inception Report, the segregation was referred to as modules. Reworded to subsets to be distinct.

THEME A: Assessment of Current Situation of Food Safety:

SUBSET 1: Safety Status of Food Items

Tasks in Subset 1: (i) Literature survey (ii) Stakeholder interviews.

SUBSET 2: Food Safety Strategies

Tasks in Subset 2: (i) Examination of renowned food safety strategies

THEME B: Assessment of Regulatory Systems and Standards Relevant To Food Safety:

SUBSET 1: Food Safety regulatory mechanisms in Sri Lanka & other countries.

SUBSET 2: Agrochemical usage & comparison with neighboring countries.

SUBSET 3: Corrective actions suggested by international organizations

4.2 Research Output

14. The research report evaluates the effectiveness and weaknesses of current policies, Acts and Laws towards food safety, as well as shortcomings in implementing and integrating such legislature. Amalgamating all the output from different subsets of two themes, the research recommends new policies, improvements to operational logistics, institutional coordination, institutional mandates, analytical capabilities and effective monitoring, reporting and action arrangements. Procedures to be followed to make the recommendations a reality are proposed. The outcome of the research when implemented would lead to a better and competitive food safety situation in Sri Lanka.

5.0 Confines of the research from an holistic perspective

15. The General Objective of the research was to develop and recommend policy changes towards achieving enhanced food safety status in Sri Lanka, which had been articulated in Chapter 5. Conducting sophisticated laboratory analyses of samples of food for different types of contaminants was not a mandate of the research, hence was not undertaken. The perspective for the research was on possible contamination of agro foods, to align with the objectives of the ASMP. As stated previously, the situation analysis did not pursuit other food sectors (beverage foods, palm crop foods, animal source foods), as well as other extensions of food spectrum (restaurant hygiene, food fortification). These exclusions however, would not change the validity of core policy and implementation recommendations of this research to a notable extent, as they could be amalgamated without friction with food safety policies, strategies, and frameworks recommended by other sectors; when developing a unified national policy.

Chapter 3

Food Safety Situation Analysis based on Secondary Evidence

1.0 Introduction

1. The Chapter 3 analyses the food safety situation in Sri Lanka based on secondary evidence. The analysis is discussed under three categories: a) Review of relevant literature on food safety hazards, appended with citing two cases of interest observed in the field, b) Review of food control regulatory system in Sri Lanka, and c) Review of selected other country food control systems. In the next chapter, the situation analysis based on primary evidence from personnel in the field and from administration is described. Both analyses have guided the formulation of research output of this study.
2. At the onset, it is prudent to clarify food safety health hazards and paths of contamination to avoid misinterpretations. Harmful substances inadvertently entering the food chain from the food production process, are called the unintentional health hazards. There are many entry points for unintentional contaminants. Any agrochemical residue from cultivation practices, any biological pathogen contaminating the produce at harvest, collection, bulk transport, display shelve, and during unhygienic processing are all considered as unintentional contaminations. Harmful substances from locations nearby or far-off entering the food chain elsewhere are also unintentional, but non-point entry health hazards. Any substance deliberately added by the food producer to food in harmful quantities, such as food additives or adulterants with intention of food fraud are the intentional health hazards.

A. The Literature Review

3. A broad based literature review was accomplished on food safety hazards by screening scholarly articles, journal articles, book chapters and e-newsprint. The screened literature are discussed in this section in following order:
    a) Literature on Chemical Hazards of food
    b) Literature on Biological Hazards of food
    c) Literature on Physical Hazards of food

2.0 Review of literature on Chemical Hazards of food

4. Chemical food contaminants are substances not present naturally in raw material used for food production nor added during an acceptable production process. Some examples are environmental pollutants, contaminants derived from agricultural production, contaminants from food processing, heavy metals, and whatever other toxic substances that has entered inadvertently. Literature survey was pursued aiming three noticeable hazard entry points:

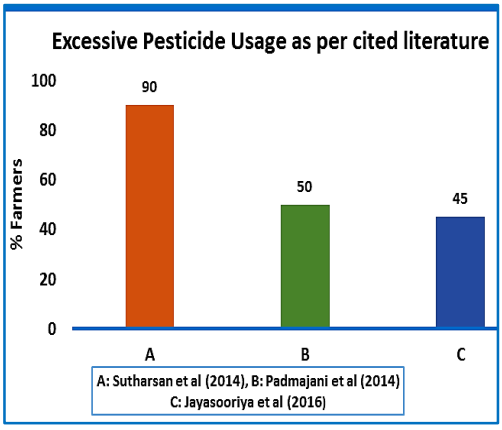
    a) Unintentional chemical hazards at point of origin;
    b) Unintentional chemical hazards at a distance from point of origin (non-point);
    c) Intentional chemical hazards (fraudulent), as additives and adulterants

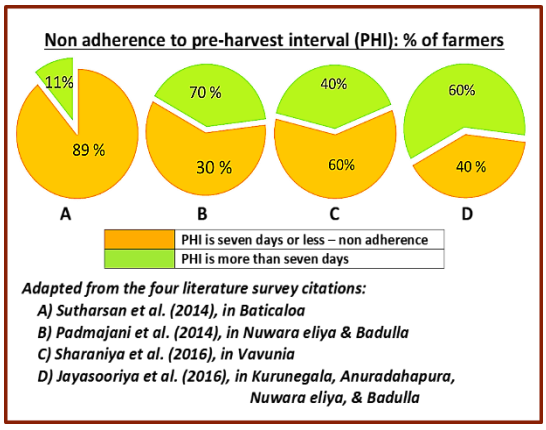
2.1 Abstracts on unintentional chemical hazards at point of origin

5. Excessive use of pesticides and non-adherence to recommended pre-harvest intervals in the primary value chain is commonly observed in the field in Sri Lanka as well as in Asian countries. Of several literature surveyed, following studies sufficiently demonstrates the risk of food getting contaminated by pesticides.
6. Sutharsan et al (2014), in his research on pesticide usage pattern in vegetable cultivation in the Batticaloa district, clearly shows that popular crops, Brinjal and Chilli are heavily pesticide sprayed as 84 percent of Brinjal farmers and 66 percent of Chilli farmers apply pesticides more than 22 times during a cropping season. Moreover 90 percent of them apply excessive dosages and do not adhere to the recommended pre-harvest interval, thereby posing a serious food safety hazard.
7. Somewhat similar results were reported by Padmajani et al (2014) on exotic vegetables in Nuwara elia and Badulla, where they reveal that misuse begins as a preemptive or delaying measure, even before the appearance of pest damage symptoms. Overdoses and disapproved pesticide cocktails had been practiced by 40-50 percent of farmers. One third do not adhere to mandated pesticide free pre-harvesting period.
8. The research by Sharaniya et al (2016) in Vavuniya district, also has comparable results with respect to non-adherence to pre harvest intervals. Around 60 percent of the farmers harvested their products within one week from the pesticide application and 36 percent within two weeks and only 4 percent after two weeks from pesticide spraying.
9. Jayasooriya et al (2016) in their study in Kurunegala, Anuradhapura, Nuwara eliya and Badulla districts also presents the existence of preemptive application of pesticides by 47

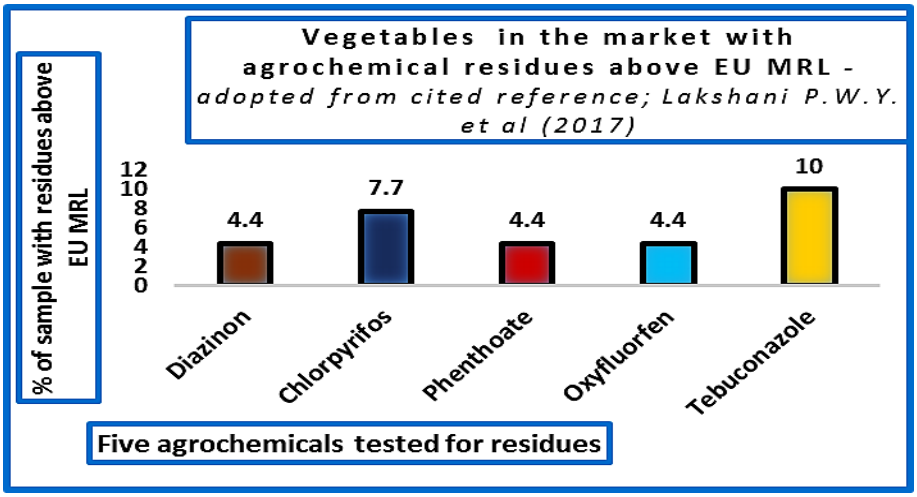
percent of farmers, 40 percent non adhering to recommended dosages and 46 percent of them mixing different agrochemicals.

10. Above broad observations may be illustrated as follows.





11. While above citations (and other similar) were on pesticide usage irregularities, the study by Lakshani et al (2017), analyzes the actual pesticide residue content. Taken as an aggregate, about 25 percent of three popular vegetables; tomato, capsicum, cabbage from Nuwara Eliya, Puttalam and Dambulla markets had residues over the EU MRLs.



12. The results indicates that Tebuconazole[12] has higher possibility to stay as residues, followed by Chlorpyrifos[13].

13. The ROP (2019) has issued an informative and advisory circular on MRLs in agricultural produce, addressed to all relevant officers in the agriculture sector. Accordingly, during the period 2016-2018, an analysis of 700 samples of 30 different fresh fruits and vegetables has revealed that GLVs (Gotukola, Mukunuwenna) have a higher predisposition to have

[12] Tebuconazole is a triazole fungicide used agriculturally to treat plant pathogenic fungi
[13] Chlorpyrifos , profenofos, diazinon are organophosphate pesticides

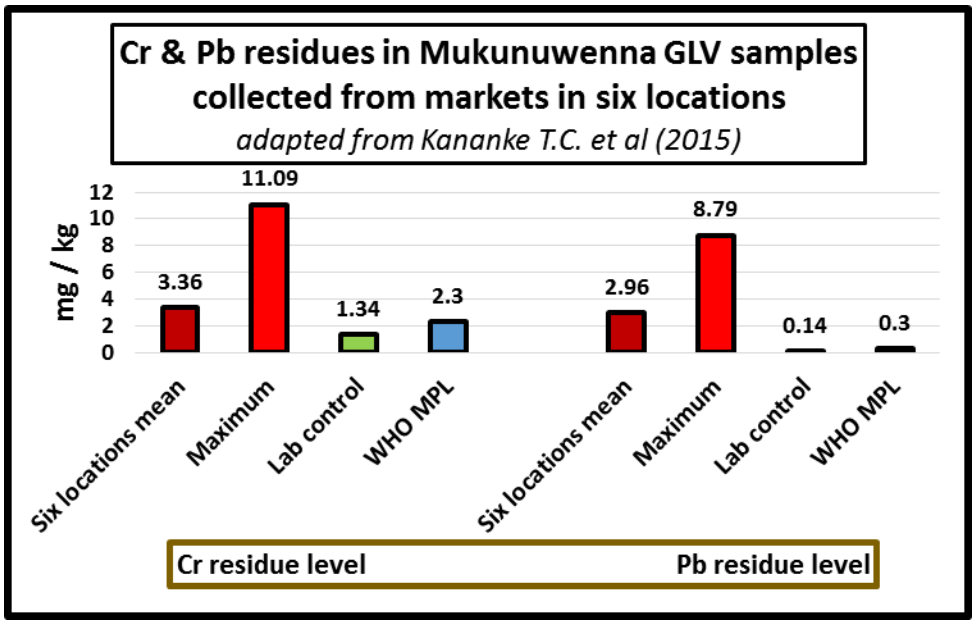
pesticide residues (the citation has not indicated the residue level). Of the 700 samples analyzed, 31 percent are contaminated with some form of agrochemical above 0.001ppm level. In general, a default limit of 0.01 ppm is considered as a reference limit when MRLs are not available for a pesticide. In the above study only 1.7 percent of samples had detectable residues above the default MRL level.

14. A review of earlier research during 2001-2009 period, by Marasinghe et al (2011), shows low incidences of pesticide residues in vegetables. Chlorpyrifos, profenofos and diazinon were the most frequently detected organophosphates, with about one percent of samples having levels above MRLs. GLVs (Mukunuwenna), an un-recommended crop for pesticide usage also had detectable oragnophosphates. Though the detections were low, they could reach unacceptable levels depending on time and various governing factors.
15. The observations in Sri Lanka are not unique. A parallel situation is elicited in several studies in the Asian region especially in China and India. Such studies also focus on factors responsible for the pesticide misuse, which are comparable to field observations conducted by this research. They include farmer's perceptions on necessity of higher dosages, preemptive applications, socio economic factors, economic dependency on pesticide dealers and collectors, respect to peer advice, families cultivating as clusters and taking common decisions, as revealed by Xu et al (2008). The "pesticide retailer factor" is highlighted by Jin et al (2014) in China, which says that pesticide use is a joint result of retailers' information provision strategies and farmers' trust. The lowest pesticide use occurs when accurate information is provided and when farmers highly trust the information provider. Overuse occurs with either information distortion or low levels of trust. Cooperatives have advantages both in terms of information provision and trust, thereby leading to the lowest use of pesticides. The retailer factor is an attribute; 'farmer's trust on retailers determines converting trader information into farming behavior'. This is evident in the absence of an effective extension system. Other studies such as by Schreinemachers et al (2017) on vegetable farmers in Cambodia, Laos, and Vietnam, a study by Nguyen et al (2018), in Vietnam, an extensive study in India by Shetty et al (2010), show parallel situations on how and why food get contaminated at the point of origin.
16. Hybrids are widespread cultivated for high productivity, high net income, and for high consumer demand based on visual traits. However, their ready susceptibility to pests and diseases requiring an array of pesticides is the key reason for this category of hazards. This was confirmed by all farmers interviewed under farmer focus group discussions and by all

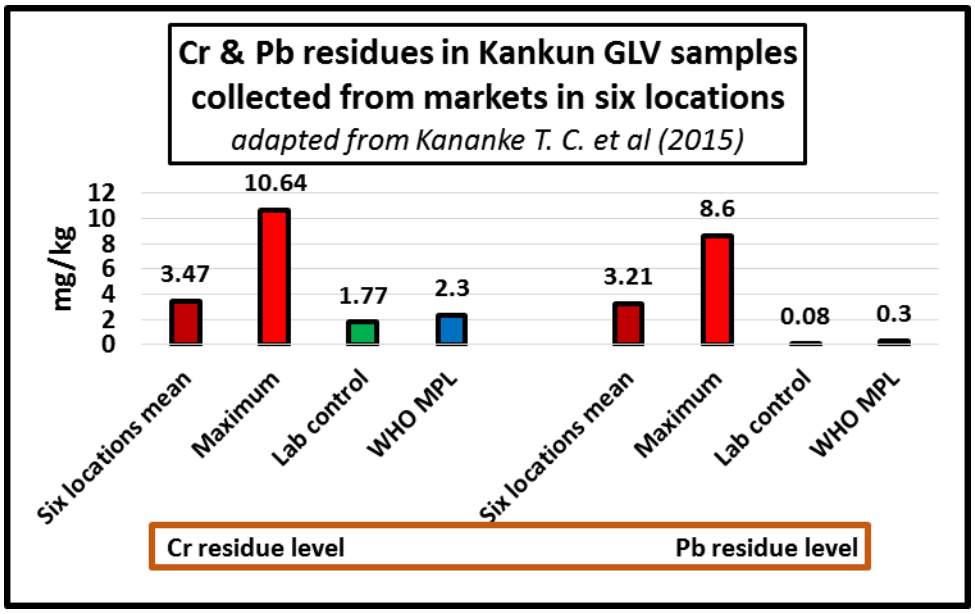
agriculture field personnel, as presented in a subsequent section. This is expressed as 'economical and behavioral lock-in aspect'; which has to be managed.

2.2 Abstracts on unintentional chemical hazards at a distance from origin

17. The non-point contamination[14] of food mostly stress on heavy metal contamination. Kananke et al (2015) in their study to evaluate Pb and Cr contamination in GLVs; "Mukunuwenna" (*Alternanthera sessilis*), "Thampala" (*Amaranthus viridis*), "Nivithi" (*Basella alba*), "Kohila Leaves" (*Lasia spinosa*) and "Kankun" (*Ipomoea aquatica*) in Colombo district have found presence of Pb and Cr in GLVs. The average Pb and Cr concentrations of all the five types of GLVs exceeded the WHO/FAO safe limits. Accumulation of Cr followed the order of Nivithi <Mukunuwenna <Kankun <Thampala <Kohila, while for Pb, it varied as Mukunuwenna <Nivithi <Thampala <Kankun <Kohila. Among the four GLVs, Kohila accumulated significantly higher levels of both Pb and Cr.
18. The Pb and Cr contamination for the two most popular GLV; Mukunuwenna and Kankun is illustrated below.



[14] Origin of contaminants is elsewhere, but carried away to food production site by many means, also incidental within the site as naturally high contents in cultivating soil.



19. An interesting reassessment by Kananke et al (2016) has shown that heavy metal contamination of Mukunuwenna at the field was lower than the levels when they were available in the market, speculating en route tainting from vehicle emissions.
20. A similar study by Wickramaratne et al (2017) on aquatic vegetables had shown that Zn, Cu, Pb, Ni, Mn, Hg, Cr and Cd are in detectable amounts, and Cr and Pb over the permissible levels in Kankun and Kohila yams. Study on heavy metals in nine types of vegetables in Kandy market by Silva et al (2016) also shows presence of six heavy metals in detectable but less than the maximum allowable levels.
21. Though exact source of heavy metals is not traced; the farm or nearby soil, irrigation water, emissions from vehicles, surface drainage from garbage sites, and low quality fertilizer had been discussed as potential contaminant sources. This proposition is important as food safety policy formulations in future should take into account to regulate the place of cultivation, source of irrigation water and manure, to minimize heavy metal related hazards.
22. Though not conclusive, agricultural crop production with unsafe practices has been *suspected* as one of the causative factors for the Chronic Kidney Disease (CKD) of unknown etiology in Sri Lanka. The research by Paranagama (2014*)* on this subject *deduces* a link to unsafe use of pesticides and fertilizers. Such a scenario is also postulated by Wimalawansa (2014) in her research on impact of changing agriculture in Sri Lanka.

2.3 Abstracts on intentional chemical hazards – Food Additives

23. The seven main groups of food additives are *antioxidants, colourants, flavour enhancers, sweeteners, emulsifiers, stabilizers and preservatives*. Colourants are the most misused and less revealed in labeling. Thus literature survey was focused on food colourants. According

to the food act regulations of 2011 only nine synthetic colourants[15] are permitted to be used as colouring substances in foods in Sri Lanka, and it says that proportion of the synthetic colouring shall not exceed 100 mg per 1 kg, of food or beverage ready for consumption.

24. Since the visual aspect of products plays an important role in the selection of food products by modern consumers, colour is a key additive of food and beverages. Permitted synthetic food dyes are widely used in many bakery products, confectioneries, jellies, and beverages. However, some foods and beverages may contain non-permitted synthetic dyes, as well as over addition of permitted synthetic dyes. The use of non-permitted dyes and indiscriminate use of permitted dyes are known to cause adverse health effects.
25. Worldwide research has linked the three most widely used (90 %) dyes; Yellow 5, Yellow 6 and Red 40 with cancer, and with problems in children including allergies, hyperactivity, learning impairment, irritability and aggressiveness. However, the global reaction is controversial. Many countries outside USA recognize the dangers of artificial food coloring and have banned them, including Austria, Finland, France, Norway, and the U.K.
26. Synthetic food colourants may contain azo dyes, the group to which the non-food grade textile dyes also belong. The EU regulations stipulate strict maximum allowed levels of permitted azo-colourings and declaration of E numbers on the label. Though such adherences are observed in reputed brands, most products by second-rate producers in suburbs and villages do not reveal the colour content.
27. A study in Jaffna on identification of food colourants in confectionary by Dilrukshi et al (2019) has shown that 85% of studied samples had permitted synthetic colourants and 8% non-permitted colourantss[16]. An analytical study by Kumudu et al (2015) in Colombo district has shown that 85% of samples contained synthetic colourants; mostly Tartrazine (55.8%). Alarmingly, 5.8% of samples contained a non-permitted industrial dye; Alizarin[17].
28. Use of non-permitted colouraants is widely reported in Asian countries. A study in Karachi City, Pakistan by Saleem et al (2013) revealed that 11% branded and 44% unbranded food items, respectively, with not permitted colors. Similarly, 4% branded and 30% unbranded beverages were found with prohibited colors. In East India, Dixit et al (2013) reveals that 80% of confectionary were adulterated, of which 72% had exceeded prescribed limits (100mg/kg) and 29% had used non-permitted colours. Estimation of non-permitted food

[15] Carmosine (Azorubine)(E122), Ponceau 4R (E124), Erythrosine(E127), Allura Red(E129), Sunset Yellow FCF (E110), Tartrazine (E102), Indigotine (Indigo carmine)(E132), Brilliant Blue FCF(E133), Fast Green FCF (E 143).
[16] Rhodamine B, Fast red, Bromocresol purple, Metanil yellow
[17] Alizarin is a pH based colour changing dye used in paint industry

colourants in chilli and curry powder in India by Singh et al (2017) has shown that 37% of samples had confirmed presence of Sudan and 50% Rhodamine-B dye.

2.31 Natural Food Colours - an alternative to toxic synthetic colourants

29. There are alternatives to synthetic food colourants; the Natural Food Colours. According to Meticulous Research (2020), the demand for natural food colors over synthetic food colors is increasing due to the growing consumer awareness for organic products, health hazards associated with synthetic colors, and health benefits of natural food colors.

30. Natural food colours originate from a wide range of sources; vegetables, fruits, plants, minerals and other edible natural sources as pigments. They are selectively extracted by physical or chemical methods. Pigments are available as liquids, powders, gels, and pastes.

31. Natural food colours also have limitations for industrial use. They do not have a concentrated colour as synthetic dyes, need to use more to get the desired colour saturation which could affect the taste of the product and colour stability is heat sensitive.

32. Following table illustrates the natural colourants available for food industry.

Natural Food Colourants & their Sources		
Anthocyanins	Black Grapes, Blackcurrants, Cherries, Elderberries, Red Cabbage, Strawberries	E163 Red/Blue
Betanin	beetroot	E162 Red/Pink
Carmine	female Cochineal insect	E120 Red
Chlorophylls/ Chlorophyllins	Alfalfa Grass, Nettles, Parsley, Spinach	E140 & E141 Green
Carotenoids	Annatto, Carrots, Oranges, Prawns, Red Peppers, Saffron, Tomatoes, Palm Fruit	E160a - E160g Yellow, Orange, Red
Curcumin	Turmeric	E100 Yellow
Riboflavin	Eggs, Milk, Yeast	E101 Yellow
Carbon black	Carbonized Vegetables	E153 Black

2.4 Abstracts on intentional chemical hazards – Food Adulterants

33. Food Adulteration refers to the process by which the quality or the nature of a given food, is reduced through addition of adulterants or removal of its vital substances. Adulterants are foreign matter and usually inferior chemical substances or substitutable closely similar food material. They are added for economic reasons, to sell cheap manipulated product at a price close to the genuine product. Consumers face an array of health problems from adulterated foods; from immediate effects such as diarrhea, giddiness, to long term effects like cancer and liver problems. For example adulteration of turmeric powder with metanil yellow is highly carcinogenic, prickly poppy seeds added to mustard seeds lead to liver disorders, tamarind husk powder in coffee to giddiness, malachite green textile dye for colouring green peas and vegetables to cancers. Such adulterations are common in India.
34. According to Seneviratne (2018), quoting some examples; spices could be adulterated with flour, paddy husk, coconut meal, sawdust, salt and added colors. Honey often is adulterated with sugar syrup, coconut oil with cheaper palm oil, coconut vinegar with acetic acid.
35. In Sri Lanka, the most commonly noticed adulteration is chilli powder, spices and cooking oil. In 2013, CAA detected an adulterated food manufacturing factory in Colombo, and seized 1 Mt of dyed chilli powder, 500 kg of dyed turmeric powder and 2000 Lt of unsuitable tomato sauce laced with a variety of gums used for chewing gum (Hiru News, 11-12-2013). Every now and then, it is common to hear fraudulent adulteration of poor quality chilli powder with dyed feed-grade ground maize. According to informed sources, cooking oil is also vastly adulterated and an analysis[18] of palm oil in the market has shown that Olein oil being sold in the guise of Palm oil. Concurring, Lukmanjee (2017), quotes, *"Sri Lankans buy and consume adulterated oil unconsciously and some consciously because of the price factor. Coconut oil is now considered an oil with health benefits, but 85% of consumer market has cheap coconut oil adulterated with palm oil".*
36. Adulteration of foods in India is widely acknowledged. The Times of India on 20 Aug 2017 reported how 40 Mt of adulterated chilli powder, turmeric powder and coriander powder were seized in Jaipur. Chilli had been mixed with dyed wheat husk, and coriander powder with ground coriander stalks. Sri Lanka face the adulteration hazard through our imports. A case in point is the newsflash in Ceylon Daily News, 4-01-2013, that CAA had seized 187,500 kilos of brown sugar imported from Brazil, mixed with sand valued at Rs. 10 mn.

[18] Industrial Technology Institute (ITI)

3.0 Review of literature on *Biological* Hazards of food

37. Biological contamination is when pathogenic microorganisms such as bacteria and their toxins, fungi, viruses, and parasites contaminate the food. It is a common cause of food poisoning and food spoilage. Biological contamination can take place anywhere: at the source of primary produce, rough packing (bundling) and transport, bulk breaking, transport within market chain, during food processing, storage and distribution. Also people (infected persons or carriers of pathogens) and the environment (food contact surfaces and facilities) can spread microorganisms on raw or processed food. Almost all biological contaminations are incidental.

3.1 Abstracts on biological hazards of food

38. Biological contamination of food in post-harvest stages[19] is widespread. The collection and bundling of multi-produce from multi locations and transporting the haul long distances to stockpiling warehouses, bulk breaking economic centres, public markets and roadside vendors are the hazardous nodes of the 'agricultural produce collection to marketing value chain'. The pathogen infiltration is due to squashing of fruits and vegetables, as well as widely practiced unhygienic cleaning of produce by market and roadside vendors. Though the immediate effect of food spoilage is the non-marketable quality, they can spuriously enter the consumer chain, and spoilage microorganisms could cause foodborne illnesses.
39. The food spoilage microorganisms are: yeast, moulds and bacteria, and their source is natural (Seema, 2015) from the farm soil, cleaning water at the collection and market places, and from storage surfaces in packing houses and retail markets. Yeasts spoil high sugar foods such as; kitual syrup, pickles, soft fruits and juices with a low pH value, honey, dried fruit, dried vegetables, and jams, making them unsafe. Molds invade shelf-stored vegetables such as brinjal, cabbage, carrots, sweet potatoes; fruits such as papaw, avocado, grapes, strawberries. Molds produce mycotoxins, some of which are toxic compounds like the aflatoxin[20]. Soft-rot bacterial invasion make the produce throwaways, but pathogenic bacteria[21] can linger on even visibly good looking produce. Interestingly a study by Mahagamage (2016) on bacterial contaminants in ground water of Jaffna (40

[19] The literature on this category are not as abundant as in pesticide contamination group. The sources are mainly the newsprints on actual incidents and microbial science articles on scientific foundation. Thus literature contents are pooled for this review.
[20] Two closely related species of fungi are mainly responsible for producing the aflatoxins of public health significance: Aspergillus flavus and A. parasiticus
[21] Ibid.

locations), has shown that entire peninsula was contaminated with total coliform and E. coli bacteria and the parameters recorded were not within the WHO and SLS standards, as well as. 38% of locations were positive for Salmonella spp. Agriculture in Jaffna depends mostly on ground water for irrigation.

40. Biological agents enter plant tissue through mechanical injuries, and some fungal species could produce toxic metabolites in the affected sites. Colonization of microorganisms is rapid when produce surface tissues are damaged (Barth et al, 2010), such as bruising, cracks, and punctures. Such infections could arrive at the bulk breaking facility and could lead to a potential cross-contamination. Raw salad also can harbor pathogens. Analysis of microbiological quality of 8 different raw salad vegetables in India by Mritunjay (2017) has revealed that all were positive for total coliform count, and 16.7% for E. coli count.
41. Another non-point microbial contamination[22] prone group of vegetables is the green leafy vegetables (GLV). Based on a set of criteria, WHO/FAO (2008) had ranks GLV plus herbs group as the *'Level 1: Priority Group' needing attention.* In Sri Lanka GLV cultivation often use unhygienic water for irrigation which may have water from common drains, water from faulty sewers, and inundation water after flash rains and minor floods carrying drain and possibly sewer overflows as well as the cultivations profusely using animal manure which are sources of pathogens (Mritunjay 2015). Moreover, as in other vegetables, the cut leaves are transported as bundles in open trucks, subjecting to leaf and stem damage, favoring entry of pathogens.
42. An analysis of the pathogenic content of GLVs and few other vegetables in Sri Lanka (de Silva et al 2013) collected from roadside markets, retail markets and supermarkets has shown that Mukunuwenna and Gotukola leaves, and Salad leaves have the highest contamination of pathogens[23] and highest number of viable bacterial count (VBC) in comparison with tomato and cabbage. *Although the highest VBC was recorded from the roadside markets, overall analysis did not support the view that vegetables sold in super markets have less pathogens*, Citing similar results from Thailand, authors say the hygienic condition of vegetables purchased in different markets cannot be discriminated. The produce available in supermarkets may as well contaminated as produce available in retail and roadside markets, if they are originating from similar sources.

[22] Mainly the E. coli types and Salmonella spp.
[23] Salmonella spp., L. monocytogenes and suspected colony of E.coli O157

43. Pathogenic contamination of vegetables from three markets in Kandy as revealed in above study can be illustrated as follows.

Average viable bacterial counts of vegetables (prior to washing) sourced from three markets in Kandy District			
	Average viable bacterial count (cfu/g)		
Vegetable	Roadside market	Retail market	Super market
Tomato	$2.7x10^6$	$1.2x10^4$	$1.1x10^6$
Cabbage	$3.1x10^6$	$1.2x10^6$	$1.2x10^6$
Mukunuwenna	$4.3x10^6$	$1.4x10^6$	$3.4x10^6$
Gotukola	$1.7x10^6$	$3.4x10^6$	$3.4x10^6$
Lettuce	$2.9x10^6$	$1.8x10^6$	$1.8x10^6$
Assessed bacteria: Salmonella spp., Listeria monocytogenes and Escherichia coli – as an aggregate			
cfu/g: amount of bacteria in a solid medium, ex. Food, expressed as colony forming units per gram			
Maximum safe count to consume: $1x10^5$ cfu/g			
Adapted from cited reference de Silva et al (2013)			

44. According to Hussain et al (2017), yet another challenge to food scientists is the emergence of antimicrobial resistant (AMR) bacterial strains in foods including fresh produce. This issue has emerged as an important and growing public health concern and an economic problem. It is necessary to understand the pathways of antimicrobial resistant pathogens contamination and act to minimize their introduction and occurrence in fresh produce. Good hygiene practices in agriculture, fundamental in achieving food safety, are also key to addressing antimicrobial resistance.
45. For years, food safety has been studied separately from the prevention of food spoilage. However, from a microbiological-ecological point of view the two areas cannot be separated (Petruzzai 2017). In spite of considerable efforts, microbiological safety assurance seems remote in developing countries, including Sri Lanka. The infrastructural facilities of existing wholesale and retail markets are inadequate for improving the biological safety as evidenced by close proximity heaps of rotting fruits and vegetables. Highest losses occur at the retailer point, as the damage along the trading path is cumulative, and strong sunlight and polluted environments aggravating the spoilage and contamination (APO/FAO 2006).

46. In Sri Lanka, the attention is mainly for food security and sustainable food production, but improper bulk transport and improper bulk storage has not received much attention, leading to food losses of about 20-40 percent[24] of production. Modernizing collection and transport system is an intricate logistical problem, but attending to it indirectly improve food safety.

4.0 Observed 'cases of interest' of large scale food contamination

47. In order to document examples of food contamination in large scale in Sri Lanka, as newscast every now and then, two occurrences are outlined below as cases of interest. Both are organized food frauds, amounting to large volumes posing serious health issues.

4.1 Case of Interest No.1: – Contaminated Stored Potatoes and B. onion

48. A periodic food spoilage in Sri Lanka is the large scale decomposition of imported potatoes and both imported and locally procured B. onion in warehouses. They are sometimes covertly sorted for slightly rotten produce, to sell by roadside vendors, second-rate boutiques, eating houses and canteens and for ingredients in fried snacks.
49. An example to quote (Hiru News, 01-01-2013); in Dambulla, a container stock of potatoes unsuitable for consumption, valued at Rs. 1.8 ml was seized by CAA. Yet again in Dambulla, in March 2019, Officers of the Health Section of Municipal Council discovered 5,000 kilos of potatoes unsuitable for consumption (Daily Mirror 11-03-2019). The decomposed potatoes were scheduled to be destroyed within the port premises in Colombo, and somehow had ended at the Dambulla Economic Centre. This scenario got repeated in Dambulla, in Dec. 2019, with a large stock of refuse potato being secretly sorting to resend to the market (Hiru News, 09-12-2019.
50. Somewhat parallel situations were reported on rotting B. onions. In Jan. 2015, Officers from the Office of Director of Health, Anuradhapura discovered a stock of 130 Mt of rotten B. onions purchased locally, which was originally to be destroyed, stored secretly in a warehouse in the Shravasthipura, Anuradhapura. During the same period, stock of rotten B. onions belonging to Sathosa was discovered in Oyamaduwa in Anuradhapura, and in Bulnewa in Anuradhapura. In Dec. 2019, the Health Unit of the Dambulla Municipal Council found a large quantity of rotten B.onion imported from Egypt and placed in a container for sale on the main road behind the Dambulla Economic Center.

[24] Personal communication with NIPHT

51. Both rotten potatoes and B. onions pose a huge health problem. The rotten potatoes can cause acute Solanine toxin poisoning, gastrointestinal disorders and several side effects. The fungal pathogens produce specific toxic mycotoxins (Ellner 2002, Lenc 2011) which cannot be eliminated by removing the rotten part and consuming the rest of the tuber. Rotting onions is considered a reservoir of pathogens (Orpin 2017). Both food poisoning bacteria and mycotoxin producing fungi are present in rotting onions. Removing the spoiled sheaths and cooking the rest, as often do in cheap eateries cannot eliminate the toxins.
52. These two situations, as in case of spoiled rice discussed below, bring to focus that food safety cannot be achieved without considering certain decisive external governing factors. Potato and B. onion going waste, causes foreign exchange losses, food security losses and food hygiene losses. They could have been avoided if food imports, warehousing, and distribution was foresightedly planned. *This is a case of food safety policies interdependent on agriculture and trade policies.*

4.2 Case of Interest No.2: – Contaminated Stored Rice

53. The newsflashes about spoiled stored rice has several elements to reflect. Foremost is the sporadic nature of incidents, from one or two isolated places, limited to a specific quantity of bagged rice. Second significant observation is; the incidents are not related to primary production value chain, but to the end nodes of marketing chain. A closer look reveals other weaknesses in the food control system precipitating this situation as well The bulk of the rice food fraud was the spoiled rice being fraudulently reprocessing to release to the market. The minor detections in retail outlets were unsuitable rice for retailing. Following narration is composed from regular newsflashes.
54. In August 2016, a rice mill at Minneriya was raided when it was on contract reprocessing a stock of unsuitable rice belonging to CWE. The rice was from India; ‘mfg date Sep. 2014 and exp. date Sep 2016’, with only one month more for the expiry. In January 2017, 35 Mt of spoiled rice brought from Colombo was detected in Kekeirawa when reprocessing to send back. They were Grade 11, Ponni Samba rice from India in original bags, with the mfg. date Jan 2015 and exp. date as Jan or Feb 2017. This is two-year old rice (if mfg. date is correct) having only one more month for expiry, and already spoiled. In May 2019, 80 Mt of rice unsuitable for consumption was detected in Hambantota.. In March 2018, a 1.5 MT of spoiled rice reprocessing with adulterated colour was detected in Ambalantota (possibly local rice). Some reporting of spoiled rice in wholesale storage were; substandard

14 Mt of rice in various points in Colombo 17 Mt of unsuitable rice at rice and rice flour repacking centre at Mawanella.

55. The above incidents could very well be a result of unplanned and uncontrolled rice imports in terms of imported amounts, batches, non-consumer preferred types, and non-estimating properly the locally available stock or forecast buffers. It can be safely assumed that the spoiled rice had mould infection leading to off-colouration. The re-polishing of off coloured rice grains results a better than before looking grains, but if the mycotoxins, and the aflatoxin are already infiltrated to the grain it would not be removed by polishing. These reprocessed rice still could be carcinogenic. They (probably) enter the second-rate markets and food preparation entities like canteens, as alleged by The All Island Canteen Owners' Association and the Lanka Self Employees' Association (Daily Mirror, 2017).

5.0 Review of literature on *Physical* Hazards of food

56. Physical hazards are either foreign materials unintentionally introduced to food products or naturally occurring objects in food that are hazardous to the consumer. A physical contamination of a food product can happen at any stage of production, but value added processing stage is the most vulnerable. Common physical hazards are pieces of glass, metal, plastics, wood, fine pieces from jewelry, and natural components of food such as shells, stalks, bones, pits (seeds). Such hazards can cause cuts to the mouth or throat, damage to the intestines, damage to teeth or gums. The presence of physical hazards in food can trigger a food recall. In Sri Lanka, such incidences are very sporadic and mostly in restaurants and snack outlets. This field has not many significant literature to review, except ones advocating risk management strategies for food processors.

B. The Food Control Regulatory System in Sri Lanka

57. It is reasonable to assume that references to 'food policy' in Sri Lanka, in effect refer to food production policies/programmes or food pricing policies, whilst a food control policy focusing on food safety is a different matter altogether. The importance of a National Food Control Policy addressing food safety issues having the legal muscle to institute operational management systems was extensively examined and observations are briefed as follows.

6.0 Food Legislations (Acts) and Regulations

58. Food control in Sri Lanka is founded on Legislations (Acts) and Regulations as well as Directions under a law. The situation analysis with respect to the regulatory aspect of food control system is deliberated below.

InfotechsIDEAS — Legislations & Regulations on Food Safety *

Legislation / Regulation	Scope	Regulatory Agency
1. Food Act No 26 of 1980; Amendments No 20 of 1991; No 29 of 2011 & several Regulations	Re: food import, manufacture, sale, transport, catering etc.	FCAU/ MOH
2. Pesticide Act 33 of 1980 Amendment No 6 of 1994. Pesticide Act 31 of 2011	Re: entry of pesticides, marketing, testing formulations & residues & advising on use of pesticides	ROP/ DOA
3. Regulations on pesticide MRLs Gazette No 2023/34, Food Act	Re: MRLs of pesticides & pre-harvest withholding periods	ROP/ DOA
4. Plant protection Act 35 of 1999	Re: foreign entry of any organism harmful, or destructive to plants	NPQO/ DOA
5. Atomic Energy Board Act No 40 of 2014	Re: protection from irradiation from any source including food	SLAEB
6. Sri Lanka Standards Institution Act of 1964	Re: framing & promoting standards for diverse items, including food	SLSI
7. Consumer Affairs Authority Act No 9 of 2003	RE: protect consumers against hazardous food, unfair trade,	CAA
8. Sri Lanka Standard 1523/ 1:2016 on Good Agriculture Practices	Re: Sustainable agricultural production with food safety	DOA
9. EDB Regulations 2014 SLS 1324:2018 Organic Agriculture production and Processing	Re: Sri Lanka Organic Standards for producers, processors, exporters of organic agricultural products	EDB
10. Fertilizer Act 1988	Re: Regulate importation, formulation, & distribution	NFS
11. Food Storage Directions under CAA Act No. 09 or 2003	Re: Prohibiting Imports, manufacturing, & trading unfit food	CAA

** (excluding fisheries, livestock, tea, coconut, spices: -only for agro-food chain)*

59. The central legislation is the Food Act No. 26 of 1980, amended by Food (Amendment) Act No. 20 0f 1991 and Food (Amendment) Act No. 29 of 2011. The Part I of the Act provides prohibitions in respect of additives, fitness for human consumption, cleanliness, adulteration and sanitary conditions. The Part 11, includes provisions for establishment of a Food Advisory Committee (FAC), designating DG of Health services as the chief Food Authority (CFA), and providing authorities to DG of Customs for imported foods, to Chief Medical Officer of Health for Colombo Municipal Area and to Medical Officers of Health under Urban Councils and Provincial Councils. Part III is on nature of offences.

60. There are 29 (+) Regulations under the Food Act, declared through a legal process by the subject Minister relevant to the problem needing attention, in consultation with the FAC.
61. Above Table examines all laws and regulations intended to serve the food control system in Sri Lanka (excluding fisheries, livestock, tea, coconut, and spices).

6.1 'Policy-Matching-Analyses' of the regulatory system

62. The above presented composed table may portray a misinforming impression of existence of a holistically well taken-care-of food control system in Sri Lanka, as there are several legislations. *However, if same legislations are pitched against segments of the food chain, the depiction is different.* Such a scrutiny of legislation was accomplished for three broad composite segments, as presented below. They show inadequate representations, field level gaps in implementation and undue skewedness towards certain segments of value chain.
63. Following three "Policy Matching Analysis" Boxes scrutinizes; i*) Primary Produce Production Segment, ii) Collection, Transport and Storage Segment, and iii) Food Processing and Marketing Segments.* Presentation is assumed as self-explanatory.

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Policy Matching Analysis-Box 1

Primary Produce Production Segment –
Scrutiny of Legislation, Regulatory Agencies & Lapses

Hazards in Primary Produce Segment	Legislation to focus on Hazards	Objective of Legislation	Regulatory Agency for Legislation	Observed Lapses in Implementation
1. Misuse of Agrochemicals 2. Higher pesticide residues	1. Pesticide Act No 33 of 1980 ; Amendment Act No 6 of 1984, Act No. 31 of 2011, and Extraordinary Gazettes	- provisions to regulate the import, formulation, packing, labeling, storage, transport, sale and use of pesticides - to specify MRLs suitable to local conditions	ROP / DOA ROP / DOA	- No market surveillance, low farmer know how on agro chemicals, Inadequate extension network, - MRLs only for few produce No regular testing for MRLs, few labs. High cost.
3. Non-adherence to pre-harvest interval 4. Non GAP practices opening many hazards	2. Sri Lanka Standard 1523 Part 1:2016 requirements of GAP 3. Sri Lanka Standard 1523 Part 1:2016 requirements of GAP	- series of norms to follow for food safety - series of norms to follow for food safety	DOA DOA	- SL-GAP coverage is minimal - Inadequate extension network - Scheme not yet accredited; independency, impartiality & competency to operate GAP cannot be assured.
5. Excessive use of fertilizer, poor quality	4. Regulation of Fertilizer Act 1988	- Imports, manufacture, formulation, and distribution of fertilizer	NFS, DOA	- Inadequate extension network to train farmers, adulterations reported
6. Unreliable 'organic' farming	5. EDB Act No 40 of 1979– NOC Unit 6. EDB Org. Products Regulations 2014 7. SLS 1324:2018 on organic agriculture	- All segments in organic agriculture to adhere to Sri Lanka Organic Standards - All to obtain a certificate from registered certification body to claim organic - Methods from production to storage of organic products	- EDB / NOC Unit DOA	- Focused on promoting exports. - Lack of attention for local consumers. - Lack of coordination with DOA - No proper monitoring of organic farming, promoting fake products

64. The policy-matching-analysis Box 1, on first segment of the value chain as presented above, highlights about six statutes to regulate the safety of primary produce at production stage. All regulations having inadequacies. The national primary produce production segment is the mandate of DOA as well as it is the regulatory agency for the legislations.
65. The second policy-matching-analysis in Box 2, box covers three important nodes, the collection of primary produce from farmers from multi locations, transporting them to local markets or to distant wholesale bulk breaking economic centres and re-transporting, and storage. Apart from gaps in implementation, absence of legislation is glaringly evident. The activities at the market node is very important to maintain food safety of produce just before leaving to consumer. This node is not guided or protected by a significant legislation. Ripening of fruits using chemicals is a common topic of impression in the society.

Policy Matching Analysis-Box 2

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Collection, Transport & Storage Segment –

Scrutiny of Legislation, Regulatory Agencies & Lapses

Hazards in Collection to Storage Segment	Legislation to focus on Hazards	Objective of Legislation	Regulatory Agency for Legislation	Observed Lapses in Implementation
1. Drain / unclean water washing of vegetables at farm	**1. Sri Lanka Standard 1523 Part 1:2016 on GAP**	- Series of general norms on food safety	DOA	- SL-GAP coverage is minimal - Inadequate extension network - Scheme not yet accredited.
2. Post-harvest spraying of chemicals	**2. No definitive regulation, may consider GAP**	- Series of general norms on food safety	DOA	- Inadequate extension network to train farmers; adulterations reported
3. Unapproved packaging & haulage	**3. Direction No 39 under section 10 of CAA Act**	- Norms on packaging collection & transportation of vegetables and fruits	CAA	- Regulation ineffective, difficult to enforce, widely unapproved packaging & haulage.
4. Unclean water - washing at market	**4. *(non-existing or non-accessible)***	----------	----------	----------
5. Toxic to food, storage pest control	**5. *(non-existing or non-accessible), One chemical in DOA-Pest Mgmt. booklet***	----------	----------	- Widely assumed warehouses spray chemicals, extent unknown
6. Unhygienic storage ambience promoting moulds	**6 *(non-existing or non-accessible)***	----------	----------	----------
7. Storing expired & unfit to eat produce	**7. Direction Nos. 51, 52 under Section 10 of CAA Act**	- Shall not store any expired or unfit /unsuitable food for human consumption	CAA	- Frequent newsflashes on storage of & sale of unfit for consumption food
8. Artificial ripening of fruits	**8. *(non-existing or non-accessible)***	- Only a Direction by MOH to use Ethral for banana, papaw, avocado & mango	----------	- Artificial ripening is widespread

66. The third policy-matching-analysis in Box 3, is on food processing, marketing and importing segments. In this vast segment of food value chain, MOH and CAA is undoubtedly conspicuous. It should be noted that these segments deal with end products and influence of MOH and Food Act is predominantly on the end products. In complex and ever changing global trade, safety of food produced off-shore is of paramount importance.

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Policy Matching Analysis-Box 3

Food Processing, Marketing & Importing Segments –
Scrutiny of Legislation, Regulatory Agencies & Lapses

Hazards in Processing, Marketing, Importing Segments	Legislation to focus on Hazards	Objective of Legislation	Regulatory Agency for Legislation	Observed Lapses in Implementation
1. Unapproved or excessive colorants,	**1. Food Act -food coloring substances regulation -2006**	- Only approved colorings for food processing	MOH / CAA	- Use of unapproved additives or over use of approved additives is evident, often with highly toxic substances. Labelling does not reveal the truth about additives in the product. Difficult process to sample & analyze contents.
2. Unapproved or excessive flavorings	**2. Food Act -food flavorings substances regulation -2013**	- Only approved flavorings for food processing	MOH / CAA	
3. Unapproved or excessive antioxidants	**3. Food Act - antioxidant regulation -2009**	- Only approved antioxidants for food processing	MOH / CAA	
4. Unapproved or excessive preservatives	**4. Food Act-preservatives regulation -1991**	- Only approved preservatives for food processing	MOH / CAA	
5. Food adulteration	**5. Food Act Part 1, section 2(d)(e)**	-Ban of adulterated food or having added substances	MOH / CAA	
6. Non adoption food standards	**6. Food Act- standards regulation -2009**	- The SLS standard of 158 food items adopted under food Act	MOH / CAA	- Standards are mostly non-mandatory
7. Fraudulent labelling	**7. Food Act- labelling & advertising regulation - 2005, Section 10 CAA Act**	- Norms for labeling and advertising	MOH / CAA	- Most labels do not reveal true contents, may have mislead consumers
8. Labelling of imported food	**8. Regulations, section 10 of CAA Act on entry point food labelling**	- Name, address of manufacturer, importer, distributor, MRP	MOH / CAA	- Most labels do not reveal true contents, may have mislead consumers
9. Shelf life - imported food	**9. Food Act -shelf life of regulation - 2011**	- minimum of 60% unexpired shell life	MOH / CAA	- Often replace labels
10.Aflatoxin on imported food – chilli, turmeric, condiments, onions, potato	**10. FCAU Import Food Inspection Mechanism**	- If no analytical & SPS certificates, inspect each consignment	MOH / CAA	-Many news on aflatoxin tainted imported chilli, potatoes, onions
11.Pesticides on imported fruits	**11. ---- do -----**	- If no SPS certificate, if & when checks only		- No evident program to test for residues
12.Pesticides on imported chilli, potato, onion	**12. ---- do -----**	- Random checks only		- No evident program to test for residues
13. Importing GM Food	**13. Food Act- GM foods Regulation - 2006**	- Prohibits import & sale of any GM foods		- No evident program to test for GM foods

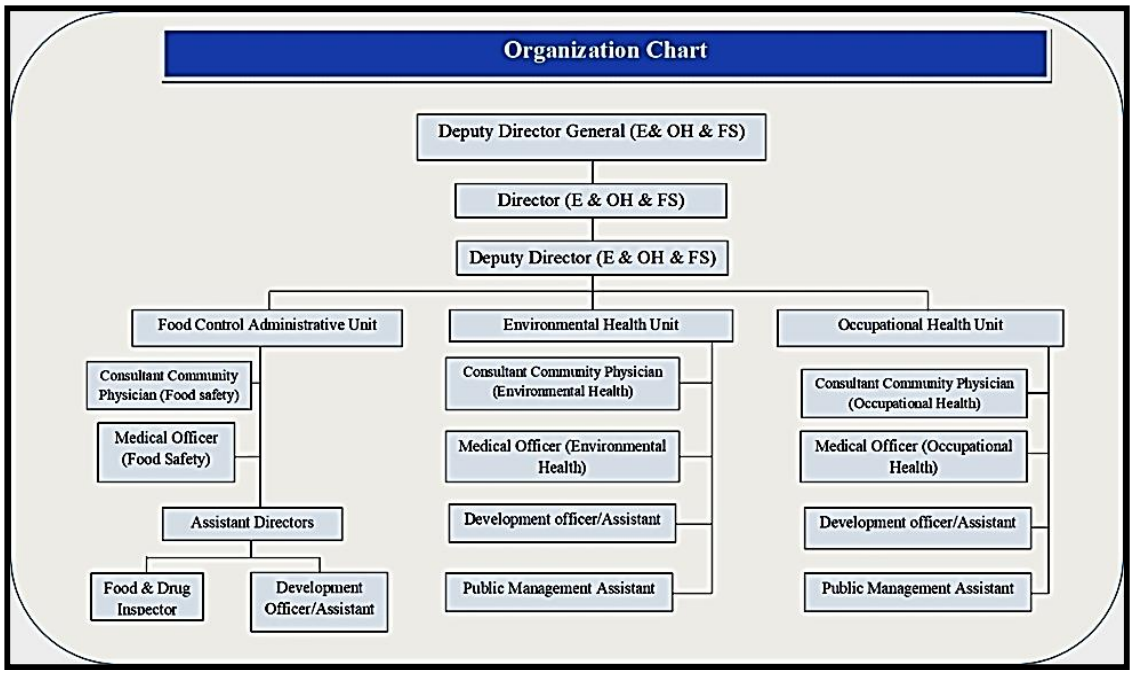
67. By assimilating the three policy-matching-analyses it is convincing that Food Act is drafted for end-point food products and not for primary point agricultural produces. The food Act does not address the food safety issues occurring in production or primary processing supply chain. Therefore the Act does not cover the whole spectrum of farm to table continuum. This is a crucial lapse in the legislation
68. The Food Act does not address modern day food safety hazards, which are the main concerns in cross boundary spread of food borne diseases. Though there are standards of SLSI followed under the Food Act, they are on conformity of product to formulation and its quality. Though some countries have their own standards, CODEX standards endorsed by FAO & WHO are used by many to develop national standards in par with global standards. Sri Lanka has 14 Codex Committees to develop standards and (according to FAO) only the spice committee is active.
69. By drawing on the deductions of all three analyses, it can be safely said that the present regulatory system is not effectively integrated and not efficiently operational. This confirms the observations of the expert consultative workshop as well. It also sends a message, for a food control policy, food safety authority and a comprehensive management system.

7.0 The Food Control Management in Sri Lanka

70. The Food Control Management is a mandated responsibility of the Ministry of Health, to accomplish clauses and regulations of Food Act No.26 of 1980 and amendments. To this end, the Director General of Health Services (DGHS) is the Chief Food Authority, and the Deputy Director General (Environmental health, occupational health and food safety), DDG (E&OH&FS) the Head of Food Control. The Food Control Administration Unit (FCAU) is managed by the Director (E&OH&FS). FCAU is responsible for i) import control of food, ii) domestic control of food and iii) issuing export certificates for food items. Following flow-diagram[25] illustrates the organizational setup at MOH.
71. The FACU is a composite of several committees. The Food Advisory Committee (FAC) is the most *Central Committee* within FACU. Other associated sub-committees are*: i) Amendments to the Food Act, ii) Food Advisory (Regulation Development), iii) Food Advisory (Technical), iv) Laboratory Support, v) Food Advisory (Health claims).* All the committees have a predefined number of members representing a wide array of scientific fields and general public. The food control management system, *though seemingly*

[25] www.health.gov.lk

comprehensive, has several grey areas needing attention, which have been further stressed while developing the research recommendations.



72. The FAC is a group of 22 members representing the MOH Senior officers, MOH-CMB Municipality, MRI, Government Analyst, Department of Animal Production and Health City Analyst, Chief Food & Drugs Inspector, Customs, Ministries of Justice, Food, Trade, Local Government, SLSI, Food Technologist, Food Science Experts, and Representatives of Commercial Interest, Industry, Consumers. Inconsistently, while the livestock sector is represented, the foremost sector, agriculture is not represented properly (as well as fisheries sector). The Deputy Director (National Plant Quarantine services) of DOA attend the council sessions, but he cannot voice on behalf of total responsibilities of the DOA, and as NPQS has no mandate on food safety *(see functions of NPQS in a subsequent section)*, his presence is irrelevant. In this research, various paths and nature of food safety hazards in the primary production, primary produce packing, transport, warehousing and marketing of agro foods has been mentioned. Thus, this lapse negates the intention of food safety in the most important food sector.
73. The FAC is burdened with large number of Ministries, often with ever changing obligations, as well as shifting of departments and institutions under them. Each of the departments and institutions is more concerned with overall obligations to their parent ministry and food safety matters may never be a priority. Harnessing and harmonizing contributions of each entity for the common goal of national food safety is an unworkable

task for a national committee. A commanding apex establishment in the nature of a Food safety authority is thus recommended to rectify this situation.

74. The other important units of the FAC are: *i) Regional Peripheral Food Control Administration, ii) Import Food Control System through DG Customs, and iii) the Analytical Services.* Their functions are focused on testing of end-product-foods at processing points, marketing points, food serving points (on hygiene), and at food importing points. Though the principles and procedures of risk analysis is the most recommended way forward, such principles are not emphasized by the FAC.

7.1 Regional Peripheral Food Control Administration

75. Peripheral Food Control Administration is the food control programme in provinces. The Provincial Directors of Health Services is overall in-charge as instructed by the FACU. The Medical Officer of Health (MOH) assisted by Public Health Inspectors (PHIs), Food and Drug Inspectors (FDIs) and Food Inspectors (FIs) implement the programme in the field. There are Local Government bylaws to complement the Food Act.
76. Inspection and classification of food serving places is undertaken by local government authorities, as guided by the FAC. However it is only an assessment of prevailing visible conditions of the place. FACU need to influence local governments to support the food preparation and serving places to acquire essential restaurant utilities such as clean water, waste disposal, strict and safe pest elimination, pathogen / rust free cooking apparatuses and quality ambiance within the restaurant. The inspection of ingredients used for food preparation is limited to organoleptic testing. Whether unapproved additives and adulterants are used in food preparation, whether biological contaminants or hazards are present in vegetables (and fish, meat) are not investigated.
77. There are close to 1800 PHIs and about 100 FDIs and FIs. For them attending to random food safety checks is only one of the duties of their long list of commitments. Thus the field level food safety management is compromised. Also their authority to inspect is limited to food at storage, processing, marketing, and eating places; but no legal authority to oversee primary food production. This observation again supports the recommendation to have an independent Food safety authority in Sri Lanka. With such an institutional setup, an exclusive cadre of field officers only for food safety could be developed, trained on hazards, hazard detection, and mitigating principles.

8.0 Imports & Exports (Control) Act of 1969

78. Sri Lanka import food products from several countries, among them the leading partners are India, Brazil, China, United States, Thailand, Indonesia, United Kingdom, Singapore, Malaysia and Pakistan, accounting for about 80 percent of food imports. The remaining may come from many other countries in small quantities. Thus the risk for trans-border food hazards entering Sri Lanka is high. Sri Lanka has a well-integrated customs clearance system for food imports aiming at managing the food control system at point of entry.

8.1 Food Control System at Customs

79. The Director General of Customs is the control authority for imports empowered by the Department of Customs and the FCAU of MOH. The inspection of imported food may be undertaken by any of four competent authorities: i) FCAU, ii) SLSI, iii) the NPQS, and iv) the Animal Quarantine and Inspection Service within their specialties. Food and drug inspectors of FCAU are empowered to inspect all imported food items under the Food (Standards) Regulations of 1989 and Food (Adoption of Standards) Regulations of 2008.
80. All food importers are registered with Sri Lanka Customs with a dossier of their information in an electronic database; *Automated System for Customs Data (ASYCUDA),* as per Imports and Exports (Control) Act of 1969. It is updated with each consignment, to check the reliability of the importer at any given time.
81. Inspection of a consignment is based on pre identified high-medium-low risk profile of the goods as classified according to the Act. To facilitate the on-arrival clearance process, Sri Lanka has pre-border control agreements with some exporting countries to accept their pre-export certification of compliance. When such a certification is absent, consignments are subject to inspection. The country of origin and health certificate issued by a competent authority of the exporting country, are mandatory requirements. Some other certificates such as an analytical certificate, GMO-free certificate may be required depending on the food item. If the food inspector is not entirely convinced with the condition of contents, samples are sent to applicable laboratories, such as at Industrial Technology Institute, National Institute of Health Sciences, Kalutara, Government Analyst Department, Medical Research Institute, SGS-Sri Lanka (inspection, verification, testing and certification company), or to the Atomic Energy Authority.
82. Customs formally recommend to release imported goods only when the related agencies issue positive clearance documents. When more time is needed for inspection and analysis,

goods may be moved to the importers' warehouses under customs control, pending further analyses repots prior to release.

83. In spite of having a sophisticated system, it is common to hear now-and-then that imported food not fit for consumption such as rotten potatoes, onions, mouldy chilli and occasionally mouldy rice being stored in warehouses for sorting and re-selling. Almost all of those are consignments assigned to importers' warehouses with instructions to hold until receiving results of further testing, but unscrupulously let-out to the market by the importer. Likewise some consignments are what had been ordered by customs to destroy, but instead brought to market warehouses by third party traders. This brings to attention the loopholes in management of suspicious food consignments; assigned quarantined in importers' stores which are outside of port premises. This is an issue in the external control of the customs clearance process, possibly in connivance with devious personnel. It is a serious food fraud and to control it a powerful food safety authority having better enforcing capability than MOH is recommended in this report.

9.0 Sri Lanka Standards Institution Act, No. 6 of 1984

84. Food control standards play an important role in global food trade, contributing to technology upgrading and adoption, protecting consumers and the environment. They enhance competitiveness by offering proof that food products adhere to the requirements of the marketplace. Standards mostly address the specificity of the product. Thus they are more on quality of the product than on food safety. Nevertheless, to comprehend this Chapter, a brief on Sri Lankan food standards follows.

9.1 Standards and Technical Regulations in food control management

85. The Sri Lanka Standards Institution (SLSI) is the "National Standards Body (NSB) of Sri Lanka", established under the Sri Lanka Standards Institution Act, No. 6 of 1984. The SLSI is a member of the International Organization for Standardization (ISO) and the International Electro-Technical Commission (IEC), and is responsible for disseminating information on standards, technical regulations and standards-related activities to the industry. SLSI standards are developed with codex standards as a guidance through a consensus-based process of discussions among working groups on SLSI Standards.
86. Currently, 101 'Sri Lanka Standards' are mandatory and adopted under the Food Act. In addition, seven (7) Sri Lanka Standards are mandatory under the Consumer Affairs

Authority Act, fifty (50) under the Import Inspection Scheme of the Customs Department. SLSI has initiated the process for adoption of Codex Maximum Residue Limit (MRL) standard (SLS 910-2013), to introduce to Food Act in future.

87. Technical regulations are most effective when focus is on manufacturing process conformity than product conformity. Some food products are already being certified with SLS logo under the Sri Lanka standards product certification scheme. The SLS mark is widely used by the local food industry and there is customer preference for food marketed with the SLS mark. For the food processing industry, SLSI has issued food safety management certificates for more than 500 industries. It is mandatory for all tea processing factories and desiccated coconut processing factories to get HACCP certification. GMP certification is mandatory to all coconut oil expelling mills by CDA. CAA has also made GMP mandatory for all catering businesses granting exemptions to businesses who possess a HACCP, FSSC 22000 or ISO 22000 certificate from an accredited certification body.

10.0 Sri Lanka Accreditation Board for Conformity Assessment Act No. 32, 2005

88. Accreditation is defined as *'a third party attestation related to a conformity assessment body, conveying formal demonstration of its competence to carry out the tasks'*. Accreditation assures impartiality, credibility and transparency in conformity assessments.

10.1 The Sri Lanka Accreditation Board

89. The Sri Lanka Accreditation Board for Conformity Assessment (SLAB) is the 'National Accreditation Body' as directed by the Sri Lanka Accreditation Board for Conformity Assessment Act, No. 32 of 2005. SLAB functions under the purview of the Ministry of Science, Technology and Research. SLAB has the responsibility to promote accreditation activities and provide the necessary accreditation services to facilitate conformity assessments of goods for domestic and export markets.
90. SLAB is a full member of ILAC and a signatory[26], for testing, calibration and inspection. SLAB is also a full member of APAC and a signatory[27] in the above fields. SLAB is also a full member of the International Accreditation Forum (IAF) and a signatory to the

[26] The International Laboratory Accreditation Co-operation (ILAC) and signatory to the Mutual Recognition Arrangement (MRA) of ILAC.
[27] The Asia Pacific Accreditation Co-operation (APAC) and signatory to the MRA of APAC

Multilateral Recognition Arrangement (MLA) for food safety management systems (FSMS) and product certification.

91. The IAF and ILAC endorse the single system "one test, inspection, or certification, accepted everywhere" and "accredited once, accepted everywhere" principle. SLAB complies with international requirements and has guaranteed the credibility of domestic certificates and test reports in importing and exporting countries. These arrangements have paved way for Sri Lankan products to enter freely into regional and international markets.
92. Accreditation of food safety laboratories by SLAB has many advantages. By going through the accreditation process, the laboratory gains a "credential" that designates the laboratory as qualified and competent to provide food safety analytical services. It also gains international recognition of its competence that is often mandatory in cross-border trade. Food business operators have greater confidence in the accuracy of the test report they are purchasing. Government food safety regulators and implementers, recognize the genuineness of test results of SLAB accredited laboratories.
93. The food safety management system in Sri Lanka by default has to depend on analytical services to test the suitability of food they inspect for human consumption. In this process accreditation of laboratories is undertaken by SLAB, as the National Accreditation Body.

11.0 Analytical Services of food control management – Food Safety Laboratories

94. The Food Act specifies the need of food safety analysis and certification of food, seized on suspicion[28]of food fraud or unsafety. Additionally food exporters need analytical and food safety conformity certifications. This section focuses on food testing laboratories in Sri Lanka and their limitations affecting the food control management system.
95. The SLAB classifies laboratories in Sri Lanka as biological, chemical and mechanical testing laboratories. Food and agricultural products are tested in both biological and chemical testing laboratories. Food testing laboratories are also grouped as government and private. The government laboratories can be observed as accredited laboratories and non-accredited laboratories. It is noteworthy that only 8 of the 15 government laboratories had been accredited to ISO 17025, while 2 of them are currently on temporary suspension.

[28] Part II, section 16 of Food Act

96. An overview of the Accredited Food Testing Laboratories and Non-accredited Food Testing Laboratories in Sri Lanka is given in the following two Boxes.

Accredited Food Testing Laboratories in Sri Lanka		
Laboratory	**Field of testing**	**Accredited parameters**
1. Food laboratory of Government Analyst Dept.	i. Chemical	i. Chemical parameters of black tea
2. Laboratories at Industrial Technology Institute	i. Chemical ii. Microbiological iii. Residual iv. Trace metals	i. Chemical parameters of cashew, tea, margarine, cereal products ii. Microbial parameters of tea, spices, sea foods, herbal, coconut, wheat, meat & milk products iii. Chemical residues & trace metals, in food
3. Laboratories at Sri Lanka Standards Institute	i. Chemical ii. Microbiological	i. Chemical parameters of products of milk, edible oil, sugar and tea ii. Microbial parameters of fruit drinks, fruit juice, meat, milk products
4. Food Safety & Quality Assurance Laboratory, UOP	i. Veterinary group of drugs	i. Antimicrobial residues in poultry products, fish, milk, animal feeds
5. Low-level-counting lab, Atomic Energy Authority	i. Nuclear - Analytical	i. Radioactivity on water, milk products, tea, coconut, fish, processed food
6. Biological Lab. of NARA	i. Toxicology	i. Histamine in fish, fish products

Non-Accredited Food Testing Laboratories in Sri Lanka			
Laboratory	**Field of testing**	**Laboratory**	**Field of testing**
1. City Analyst, Colombo	i. Chemical	**5.** Provincial Food Quality Laboratory, Kurunegala	i. . Chemical ii. Microbiological
2. City Microbiologist, Colombo	i. Microbiological	**6.** Food Quality Control Laboratory, MOH, Anuradapura	i. . Chemical ii. Microbiological
3. City Analyst, Kandy	i. Chemical ii. Microbiological	**7.** NIHS, Kalutara (testing & research)	i. Chemical ii. Microbiological
4. Laboratory of Registrar of Pesticides, Kandy	i. Pesticides formulations		

97. Almost all laboratories are undermined with inadequacies. Summing up the literature reviews on laboratories in Sri Lanka, the most notable shortcomings were as follows.

a) *Inadequate or outdated equipment*: While the ITI, SLSI and SGS are equipped with modern equipment and instruments, regular calibration; most others have basic conventional equipment or outdated equipment and instruments; and chemicals spilled and corroded working environments. The consumables in such laboratories are often inadequate. Dearth of modern equipment, instruments and consumables could constraint conducting certain advanced tests required by the Sri Lankan importers and exporters to comply with international food safety requirements.

b) Lack of maintenance and calibration: The ISO 17025 requires to maintain and calibrate laboratory equipment. While the ISO accredited laboratories have a proper maintenance and calibration system with maintained records, non-accredited laboratories fall short in this requirement. Periodic calibration is critical to ensure accuracy of the food safety tests, hence the effectiveness of total food control management system.

c) *Lack of reference materials and standards*: According to ISO 17025, reference materials are required to confirm the accuracy of results, maintain lab performance, etc. and is encouraged to be used by all laboratories. However, the non-accredited laboratories do not have these reference materials and required standards. This could prevent them to provide accurate services in food hazard analysis.

d) *Lack of external training for human resources:* Often the laboratory personnel are not up-to-date trained. Due to budget constraints most trainings are in-service in nature which could undermine competence of the technicians. Competence is a critical factor for certain food tests required by the exporters.

e) As the Food Act attention is on end products, the food safety laboratory services are also currently utilized for test reports of end products, for legal actions on violators. It is also heavily focused on food quality than on food safety issues. With expected change of emphasizing the full value chain in future, tests in other segments would be required.

98. Due to resource constraints most laboratories cannot acquire the technical capacity to perform all tests related to food safety. Therefore, it is necessary to identify the test parameters that could be tested best in each laboratory operating throughout the country. Through continuous analysis of a given parameter, technicians can gain the competencies necessary to generate reliable test results. A planned specialization laboratories programme has to be identified by the food control management.
99. In order to improve the food control system and to utilize laboratory services in an effective manner it is necessary to develop a database of information on food hazard health incidences and results of laboratory tests. This data bank could be used in preventive planning of food hazards. The proposed Food Safety Authority should consider such a an arrangement. A standard fee structure for food testing needs to be developed, which could benefit all laboratories in general in covering their cost of instruments and chemicals; at least to supplement their institutional budget.

12.0 Plant Protection Act No. 35 of 1999 - National Plant Quarantine Service

100. The National Plant Quarantine Service (NPQS) is an institute of the Seed Certification & Plant Protection Centre (SCPC) of DOA. This service institute has the responsibility of enforcing and implementing the relevant clauses of the Plant Protection Act No.35 of 1999, its Regulations made thereunder, as well as still enforceable Regulations of the Plant Protection Ordinance No. 10 of 1924, with respect to plant quarantine activities[29]. The NPQS also conducts related research and development activities. NPQS is a signatory[30] to IPPC and APPPC.

101. The objectives of NPQS are; *i) prevention of introduction, establishment and spread of dangerous alien pests within the country, ii) involvement in domestic pest control programmes, iii) development of treatment technologies to eradicate pests of quarantine importance, and iv) promotion of export of healthy plants and plant products.*

102. Therefore, broadly speaking, it has two goals; i) Protection of Sri Lankan agriculture, environment and economy from alien pest invasions through imports and ii) Protection of Sri Lankan economy by assuring phytosanitary quality of plant of exports. Thus the main responsibility is Bio-security from imported planting materials, plant-meal based animal feeds, and few consumption plant food items, along with bio-security of exports.

103. As often misinformed even at highest food safety regulatory forums, NPQS has no mandate on food safety and no routine work programme on food safety inspection of imported foods, unless called upon to do so, which otherwise is handled by inspection officers of MOH at customs. NPQS singularly is unqualified to voice on total programmes of DOA at the FAC. Considering the advantage of existence of NPQS at points of entry, NPQS should be beefed up to have an operational arm to inspect and approve imported food alongside customs inspection. This could be achieved under a food safety authority.

13.0 Control of Pesticides Act No. 33 of 1980

104. The Control of Pesticides Act No. 33 was enacted in 1980 to manage the pesticide usage in Sri Lanka, in order to uphold the safety of foods, safety of agricultural farmers and to sustain the environment and public health. Prior to the Act, pesticides had been liberally imported, including banned pesticides. DOA was foremost in instituting the Pesticides Act.

[29] Good to know: "In 1869, a rust disease Hemileia vastatrix wiped out the coffee plantation in Ceylon. Subsequently Indonesia passed legislation banning coffee imports including sacs used for packing coffee from Sri Lanka and it was the first plant quarantine law in the Asian region". Quote from doa.gov.lk/SCPPC/NPQS/ accessed on 10-04-2020

[30] International Plant Protection Convention of WTO & Asia & Pacific Plant Protection Commission of FAO

105. The Act is primarily to manage the pesticide *supply sector*, and as observed in the field, it is weak in managing the *demand sector* of farmers' use or misuse at farmer level. Though the Act has laid down norms for trading of pesticides, yet it is weak in regulating the traders and the trade. In general the Act focus on importation of pesticides active ingredients, local formulation, packing, and allowing to sell, among others.

13.1 The Office of Registrar of Pesticides (ROP)

106. The Office of Registrar of Pesticides (ROP) is administered by SCPPC of DOA. It has the national responsibility to ensure quality pesticides which are least hazardous to human health and environment enter the market. The Pesticides Technical and Advisory Committee of DOA, with 15 member representations from agricultural, health, environmental, analytical, product standards and legal sectors assist ROP on technical issues related to enforcement of the Act. The Office of ROP maintains an across-the-board pesticide control procedure, which includes the registration of producers, risk/benefit analysis, field monitoring and enforcement, laboratory testing and import regulations.

107. Since 1995, Sri Lanka has not permitted any pesticide of WHO toxicity Class 1-a (extremely hazardous)[31] and Class 1-b (highly hazardous)[32] to enter the country. Office of ROP allows pesticides of Class II: moderately hazardous and Class III: slightly hazardous, to be imported, formulated and to trade. Currently 41 pesticides had been banned and their use is prohibited and another 11 are restricted. However there is common consensus that some banned pesticides may be arriving through illegal sea routes.

13.2 Comparison of pesticide usage in Sri Lanka with other countries

108. The *Total Pesticide Volume* in use in Sri Lanka was stagnant, but shows a decline in very recent years[33], standing around 1700 MT per year. Likewise the *Annual Per-cultivated Area Application Rate* was constant over the years, around 0.8 kg/ha. They are illustrated as follows.

[31] Such as endosulfan, chlorpyrifos, carbosulfan, and quinalphos

[32] Persistent organic pollutants (POPs); pesticides with potential for long-range transport, persistence in the environment, ability to bio-magnify and bio-accumulate in ecosystem

[33] However, a firm conclusion cannot be made without an academic exercise of relating it to cultivated extents, crop types and pest thresholds in the reporting years

Pesticide Volume & Application Rate in Sri Lanka
- selected years for comparison -

Year	Volume MT	Appln. kg/ha
2000	1696	0.89
2001	1705	0.89
2016	1924	0.84
2017	1682	0.73

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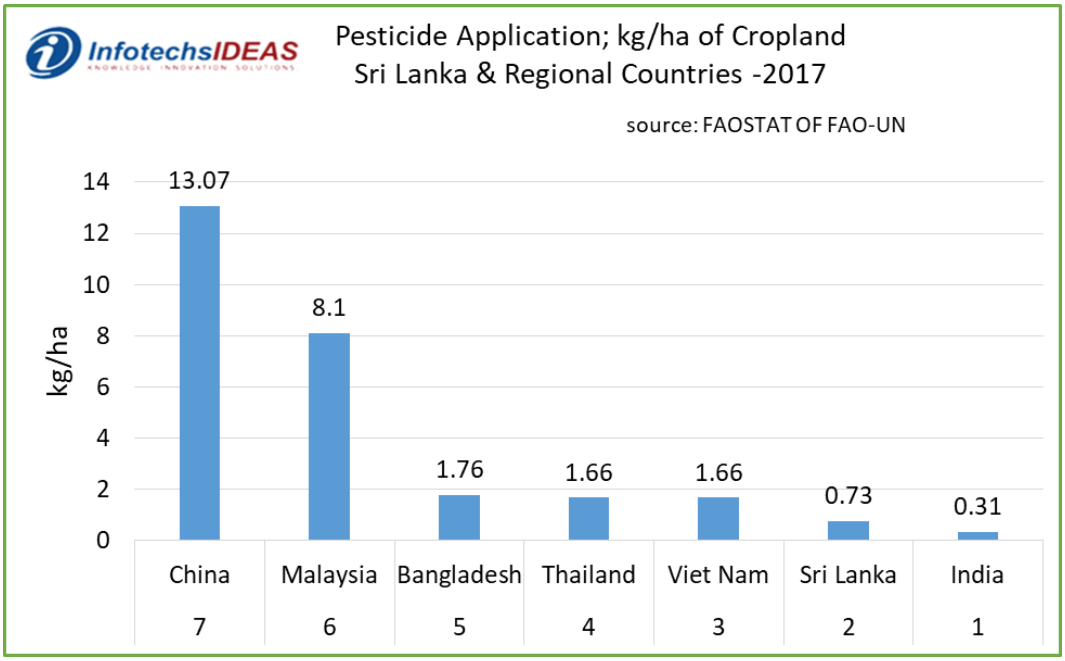
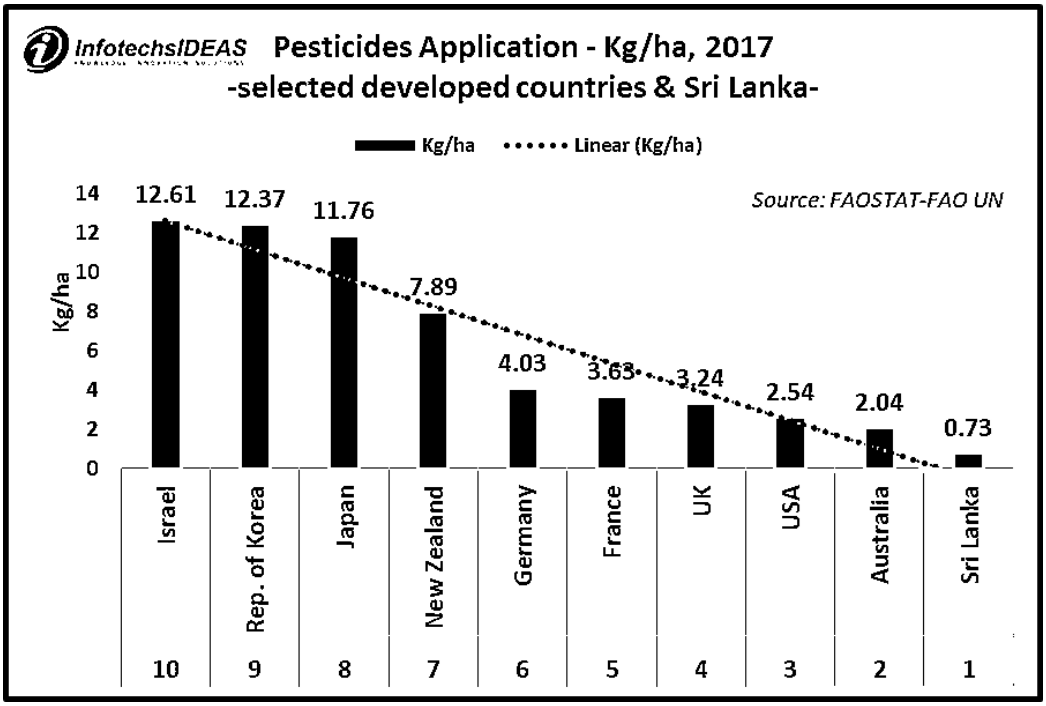
Source: FAOSTAT of FAO-UN

109. In order to appraise the Sri Lankan standing with respect to the Annual Per-cultivated Area Application, among Regional Countries and Developed Countries, data from the same source were plotted as clustered column charts, as illustrated.



110. It is notable that within the regional countries, Sri Lanka is one of the lowest pesticide applying countries. While India is on the average using less than half of Sri Lankan application rate, Bangladesh, Thailand, Viet Nam are applying little over twice the Sri Lankan rate, and China a staggering eighteen times more.

111. The low pesticide application *per hectare of cropped land* in Sri Lanka is more prominent when compared with some developed countries. All selected developed countries have a larger per hectare usage than Sri Lanka; Israel, R.O. Korea, Japan having the application rate close to China and about 16 times more than Sri Lanka; and UK, USA, and Australia about three times more.



112. Nonetheless, it is crucial to assess the segmented global comparison presented above focused with respect to food safety. Undeniably the *overall* pesticide application rate in Sri Lanka is very satisfactory, in spite of the Office of ROP having certain concerns with pesticide traders. *Yet seemingly convincing and non-alarming depiction is actually misleading and could pave way for speculative policy judgments. The hazard of pesticide on food indisputably lies with toxicity of what is applying by farmers and subsequently of what is coming to the table as residues.* Thus, the safety is not exclusively, though important, from lower per unit rates of applications. That is why the food in developed countries are considered relatively safer due to their proper pesticide management, in spite of higher pesticide application rates.

113. In Sri Lanka, many farmers, as discussed in the previous Chapter, boost the toxicity of pesticides by mixing cocktails, use non-recommended application timings, frequencies and concentrations; use for non-recommended crops (GLV) and more hazardously non-adhere to the required pre-harvest pesticide free intervals. Therefor while the Act has the ultimate control on the pesticide supply side, on the demand side many farmers by their own

formulations nullify the 'pesticide free safe food for consumers' ambition, even though the national per unit pesticide usage is less.

114. As Office of ROP and the district agriculture offices are less effectual in field control of misuse of pesticides, an independent enforcing squad of monitors may have to be engaged directly assigned to the Food Safety authority outlined in next Chapter.

C. Review of Food Control Systems in Selected Other Countries

115. As a guidance exercise to develop research recommendations, a literature survey on modernized food control systems or models in neighbouring countries was undertaken. *Among them, a synopsis of food control systems in India, Bangladesh, China and Thailand are presented below.* Their core constituents were adopted in formulating the recommendations of this research.

116. The models vary in framework but similar in principles; India has a food safety authority system; Bangladesh has spelled out modern strategies to include under a FAO guidance programme; China modernized the system comprehensively with co-governance and co-compensation, and Thailand modernized food control with a multi-agency system.

14.0 Food Control System in India

117. The food control system in India is more appropriate and applicable to modify and adopt in Sri Lanka. In India, the implementation and enforcement of food safety regulations are by an apex body; the Food Safety and Standards Authority of India (FSSAI). In this research too, a similar institute with different stress roles are recommended. Prior to FSSAI (2011), India had number of food legislations, without an effective system to coordinate their implementation. In 2011 all individual legislations were consolidated into a homogenous act; the Food Safety and Standards Act, 2006 (FSS Act), spelling out the food control policy and instituting FSSAI as the regulatory body for the FSS Act. Since then the FSS Act had continued to evolve with several updating.

118. The FSSAI regulations categorize food products into standardized products and none, with different ways of addressing their approvals. It is continually standardizing more foods in harmonization with Codex Alimentarius and assimilating to some extent other international standards of the European Food Safety Authority, Food Standards Australia

New Zealand, and the USFDA. Some native products also had been harmonized into FSSAI standards.

119. The FSSAI has stringent regulations for packaging and labeling of imported food, including stipulation of all ingredients and additives in descending order of their composition by weight and volume. However, the FSS Act, 2006 does not apply to foods being exported out of India. This affects cross-border food safety of the imported country. It is mentioned in many forums that processed food imported to Sri Lanka either to be consumed as-it-is or as ingredients for further processing may have chemical and pathological contaminants.

15.0 Food Control System in Bangladesh

120. The Bangladesh food safety administration system and to formulate a food safety policy is still in early stages. Food safety is governed by the national food and nutrition policy, and is the responsibility of Ministry of Health and Family Welfare (MOHFW). As in other Asian countries, several ministries have spread-out roles in food safety implementation.

121. There are several laws in Bangladesh for maintaining health and safety standards. Among them; the Bangladesh Pure Food Ordinance, 1959 is to provide better control of the manufacture and sale of food. This Ordinance is being revised to an Act to form a National Food Safety Council and to establish Food Courts. The Bangladesh Standards and Testing Institution (Amendment) Act, 2003, relates to standardization, testing, metrology, quality control, grading and marking of goods. The Pesticide Ordinance, 1971 and the Agricultural Products Market Act, 1950 are for plant quarantine and market product safety. Cabinet is the universal coordinating and controlling entity on food.

122. The government of Netherlands and FAO are having a 'Food Safety Programme (FSP)' to upscale the food safety system, from which some inspirations were drawn to formulate the recommendations of this research. It prescribes (i) establishing a National Food Safety Policy, (ii) a Food Safety Action Plan and (iii) a Food Control System, and need of a strong food inspection services and enhanced laboratory analytical capabilities.

16.0 Food Control System in China

123. The food control system in China is rigorous and may not be an exact model for Sri Lankan conditions due to the vastness and variations in its food producing, processing, exporting and importing sector and its heavy competitive stake in world food trade. The

country has a huge network of small food production and processing companies, which could multiply the hazardousness. Yet the changes made recently to the regulatory system moved China from the traditional regulatory system to a governance system.

124. In 2008, after the scandal of tainted milk, a series of reforms and new laws had been enacted. Some of which are: Food Safety Law in 2009, then considerably revised in 2015; creation of a Risk Assessment Authority in 2011, creation of the China Food and Drug Administration in 2013, and reassigning of administration of important organizations.

125. As in other countries, laws on food safety in China had been a reactive stopgap legislative approach and was not effective for modern day food safety problems. For this reason, after the 2008 milk scandal, China introduced a basic law: "Food Safety Law of the People's Republic of China" ("Food Safety Law"), which provided a basis to constitute legislations at different levels. The basic law clearly emphasizes the perspective of risk management, risk assessment and risk communication mechanisms. This research also has recommended implementation of risk management in Sri Lanka food sector.

126. In addition, the food safety laws enforce the principles of social co-governance. The aim of social co-governance is social sharing of responsibility for food safety by all social subjects in the food field, and all paying shared compensations. Food producers and distributors are charged to bear a larger chunk of compensations.

17.0 Food Control System in Thailand

127. Thailand has a multi-agency system of food control with authority for food management spread among three institutions; the Ministry of Public Health (MPH), Ministry of Agriculture and Cooperatives (MAC) and the National Food Commission. The Food and Drug Administration and Department of Health under the MOPH are responsible for safety of imported food, standard settings for food, labelling, advertisement and packaging. The MAC has Departments of livestock, agriculture and fisheries and is responsible for safety of food at farm production segment. The National Food Commission is responsible for formulation of food policies, directions and strategies.

128. The foremost law governing food control in Thailand is the Food Act of B.E.2522 (1979), with the focus on 'protecting and preventing consumers from health hazards arising from consumption of tainted food'. The MPH is in charge of administering the Food Act. The Act also empowers MPH to promulgate Ministerial Regulations, to appoint the Food Committee and Competent Officers, and to set up other activities to carry out the provisions

of the Act. The Food Committee functions as an advisory board to the Minister or the competent officers on matters related food control administration.

129. The Food Act classifies foods into three main categories as: Specially Controlled Foods, Standardized Foods and General foods with different need of compliances. The restructured food safety administration is based on sound concepts. It builds the principle of prevention throughout the food chain rather than only inspection and rejection at the final stage, comprehensive programs to encourage GAP, GMP, GHP, and the HACCP system.

130. It also aims to improve the food control risk management process to be based on science and transparency. Efforts had been made to separate the food safety enforcement agencies from the standard and regulation development agencies to avoid conflicts of interests Similar concepts were adopted and recommended in this research as well. There are comprehensive programs to train and upgrade the expertise and skills of food inspectors, on certification and accreditation for GAP, GMP, and HACCP programs, performance of laboratories, accreditation schemes and to increase the number of basic food inspection laboratories to make sample analysis more accessible.

131. Yet another important element in food safety framework in Thailand is its emphasis on risk communication among the food business operators and among the general public. Food traders are briefed on food safety hazards in produce they sell and consumers are cautioned on food they buy especially in public markets through numerous programmes.

Chapter 4

Food Safety Situation Analysis based on Primary Evidence

1.0 Introduction

1. The Chapter 4 supplements the secondary evidences based situation analysis discoursed in Chapter 3, with primary evidences and opinions collected from the field and officers. This endeavor was accomplished by conducting; A) Focus-Groups discussions (FGD), and B) Key Informant interviews (KII).
2. FGDs were conducted with farmers as Farmer-Focus-Groups. KII interviews were conducted as; i) Implementer consultations ii) Scientist consultations, iii) Private Sector consultations, and iv) Expert Consultations and Workshop at apex level.
3. The layout and output of all such activities are presented in following sections. To clear the way, a brief note is given below on the philosophy of reasoning and triangulation; the approach to infer interview discussions.

1.1 Reasoning, Inductive Reasoning and Triangulation

4. The results of field level qualitative research is based on sound reasoning, for which the research has to be conducted in its natural setting. Thus the researchers visited pre-selected areas to interview the stakeholders in their own setting. The researcher was the instrument for data collection who gathered the words of the participants and analyzed them carefully, understanding the meaning of their expressive and persuasive language (Creswell J.W. 2005). The field experiences and subject matter knowledge of the researchers aided immensely to comprehend the participant expressions, explanations, externalities and their dilemmas in agriculture. This is also advocated by Trochim M.K. (2006), as; “for the qualitative researcher, the best way to understand any phenomenon is to view it in context. The qualitative researcher, immerse in the culture of the subjects he is interviewing and do not use any already formulated set of questions, but instead allow the questions to emerge and themes to change as the interview proceeds”. The ability to quantify this type of research is limited. The larger portion of participant’s experience cannot be split or unitized without losing its phenomenon. The discussions has to be reasoned out.
5. The outcome of such discussions therefore were the carefully reasoned out logic. Reasoning is the process of using existing knowledge to draw conclusions, make predictions, or construct explanations. Logic refers to two broad methods of reasoning in

qualitative research as; the deductive reasoning and inductive reasoning approaches (Trochim M.K. 2006).

6. In this research for situation analysis, inductive reasoning was adopted to understand across-the-board existing field situation. Inductive reasoning begins with observations that are specific and limited in scope, and proceeds to a generalized conclusion that is likely, in light of accumulated evidences. All forms of inductive reasoning, are based on finding a conclusion that is most likely to fit the premises and is used when making predictions, creating generalizations, and analyzing cause and effect (Wilson R. 2016).
7. The inductive reasoning has to be made stronger. Researchers made the inductive reasoning stronger by: i) conducting the research in representative locations, and by ii) different ways of triangulation.
8. For the research to be in representative locations, four distinct cultivation zones[34] and within them suitable districts were identified as study areas. The recognition of zones was based on characteristics of cultivation system, such as; types of vegetables and fruits cultivated, intensity of cultivation, area specific agronomic practices, and marketing arrangements. All field work was accomplished within this zonal framework in order to perceive a cross sectional and spatially represented situation.
9. Triangulation[35] refers to the use of multiple methods or data sources in qualitative research to arrive at a comprehensive understanding of a phenomena (Patton, 1999). In this research on situation analysis; 'method triangulation' and 'investigator triangulation' approaches were used to make inductive reasoning stronger. Under the method triangulation approach, outcome of discussions of one method (mostly the farmer focus group discussions) were triangulated with field level officers, who are agricultural programme implementers having broader perception on the field situation. Also farmer's' cultivation fields were simultaneously observed and practices and hazards were deliberated in-situ as an extension of method triangulation. Under the investigator triangulation approach (Patton, 1999, Pine, 2014), two researchers having field experiences corroborated in analyzing the field investigation. All conclusive and suggestive statements in this chapter are triangulated.

[34] The four zones are; (i) Upcountry, (ii) Jaffna peninsula, (iii) Kalpitiya peninsula, (iv) extensive cultivation dry zone area. These demarcations were for this research field work purpose only & not a national agronomic demarcation

[35] It is often misunderstood that triangulation should yield same results as from different sources. Triangulation is undertaken to enhance the understanding or interpretation of participant's views, and to strengthen the inductive reasoning.

10. Information was gathered with carefully conducted probing discussions, prompting more questions to emerge and change of focus as the interview was proceeding. An accepted social science practice of a key moderator conducting the entire discussion with a co-moderator aiding him was followed in farmer focus group discussions. Key moderator and the co-moderator corroborated in the investigator triangulation described previously.

A. Focus Group Discussions

2.0 Farmer-Focus-Group discussions

11. The Box 1: Farmer-Focus-Group discussions; overviews the coverage of Farmer-Focus-Group (FFG) discussions. It covered the distinct cultivation zones, cultivation practices such as trellised agriculture, GLVs, controlled environment, and common crops and ways of cultivation. The key themes of FFG discussions were: use and misuse of chemicals, food safety precautionary steps taken if any, what determines farming practices, what influence farming decisions, source of technical information and trustworthiness, binding economic factors, binding marketing factors and what could be done to improve the situation.

Box 1: Farmer-Focus-Group discussions

i. Upcountry zone: Nuwara eliya – 8 farmers & Hanguranketha - 5 farmers
ii. Jaffna zone: Jaffna peninsula – 8 farmers
iii. Kalpitiya zone: Norochchole – 8 farmers
iv. Dry zone: Killinochchi – 4 farmers, Thellulla, Wellawaya – 5 farmers,
Handapanagala, Wellawaya – 2 farmers,
System H, MASL – 7 farmers,
Trellised vegetables: Netolpitiya, Hambantota – 2 farmers
v. Controlled Environment Agriculture: Upcountry Agric Producers (Pvt) Ltd.
Bandarawela – 8 farmers
vi. Green Leafy Vegetables (GLV) cultivators: Labuduuwa, Galle - 5 farmers
vii. Banana cultivators: Embilipitiya, Walawa – 3 farmers, Jaffna – 3 farmers
viii. Guava cultivators: Norochchole, Kalpitiya – 1 farmer

12. The information from farmer discussions were method triangulated by interviewing field implementation officers under KII. Officers thus interviewed are listed in Box 2, in KII discussions section. Interpreting broadly, the outcome of FFG can be presented as follows.
13. Without exception all farmers in all zones use agrochemicals. The intensity of pesticides and fungicides application depends on the susceptibility of the crop to pests and diseases,

widespread of diseases and pests, cash outlay to cultivate the crop and its payback as well as strong binding external factors from agrochemical traders, produce collectors. Thus the agronomic-economic environment overshadow any sensitivity towards food safety. It is also a trapped situation tied to the fact that most cultivated varieties are hybrids lacking their natural vigour to resist pests and diseases, more of soft tissue vulnerable to pests. To gain the end product visual quality, farmers are compelled to use pesticides. Often they overuse or misuse chemical combinations to hedge against the incurred high capital cost of hybrid seed farming, and to safeguard thigh net incomes possible from hybrid cultivation.

14. The locked-in situation of consumers preferences, cultivation of varieties having preferred traits and crop management with profuse chemical applications; was amply evidenced by cultivators, field officers and produce collectors. Sometimes, the local varieties are nearly nonexistent as they may not be collected by traders forwarding produce to distant markets, but may trade in local weekly markets. This view was also shared by implementer level key informants consulted in Jaffna, Nuwara eliya, Kalpitiya, Bandarawela and Wellwaya. The consumer bias for visual attraction of the vegetables was strongly confirmed by all private sector collecting centers, including supermarket chains, even further elaborating the hybrid variety by name having the demand and hence their focus in collecting sometimes only that variety. In such a binding external factor situation, farmers have to cultivate the 'asking variety' only, and safeguard the crop with profuse chemical applications. The vegetable collector-truckers have the same view and bulk breakers offer blemished vegetables to non-stringent markets.
15. Although cultivation of some hybrid cultivars are prohibitively expensive they give an enormous pay back[36] compelling the farmers to take heavy prophylactic measures to save the crop. Another unique obstacle for food safety in vegetable cultivation is the fact that most vegetables are of 'continuous harvesting type' preventing any prospect to maintain the recommended pesticide free pre-harvesting intervals. The pre-harvest interval can be followed only for single harvest crops or harvest space-out possible crops. For susceptible crops an early prophylactic application of pesticides is a must, as chemicals now available in the market are of low toxicity to pests (no red band chemicals).
16. It is dismaying to note that even for green leafy vegetables (GLV) farmers apply heavy dosages of vegetative growth fertilizer, livestock manure and fungicides. Traders do not

[36] 0.5 acre hybrid capsicum needs a Rs. 400,000 investment; gross income is about Rs 1.2 mn. in six months, single farmer data at Handapanagala, Wellawaya

collect GLV lacking intense green colour and / or with insect damaged leaf edges. After every cut of GLV, the field is fertilized and sprayed with fungicides and pesticides.

17. Thus disregarding the fact that pesticides are harmful if misused, farmers justify it to match the way the assured marketing arrangement needs the product, in order to hang-on to their main income source.
18. Though literature uphold GAP farming, for farmers in remote areas, it is a hard to adopt concept. In reality active GAP farms sparingly exist, even among the registered farms supplying to supermarket collection centres. Farmers in general are least interested. The prime reason is the lack of sufficient farm-gate observable demand and lack of or marginal incremental price for such produce. According to DOA, the initial high investment cost is discouraging farmers, when an incremental price and marketing arrangement is not firm. It was very clear that in present context, extensively changing the farming system to GAP farms is ineffectual. Sweeping changes in consumer demand and food marketing chains are needed before such a realization. The situation analysis on GAP is further detailed under KII with implementer consultations and with scientist consultations, in subsequent sections.
19. The reviewed controlled environment agriculture in Bandarawela is run by a 26 member-administered private company. The company has 300 registered 'polytunnel farmers', and the combined ground area of all polytunnels is 300,000 sq. ft., with individual farmer tunnel areas varying from 1000 sq. ft. to 80,000 sq. ft. It is a very lucrative[37] industry for the progressive members. salad cucumber, bell pepper, tomato, zucchini, "Ho Miris" are the types of vegetable grown. The produce are of very high quality standard and are currently supplied to Sri Lankan Air Catering services, and previously to two supermarket chains. Even in this sophisticated high returns setup, of the 300 farmers only 6 have obtained the GAP certifications, throwing light again, that GAP is not demand driven.
20. Contrary to expectations, use of agrochemicals in polytunnel agriculture is too common. Frequent spraying of fungicides is very apparent as polytunnel crops are highly susceptible to fungal diseases due to high humidity. Widespread pests observed were white fly and aphids for which to control, heavy pesticide spraying is needed. As in open field agriculture, foliar growth sprays and agrochemicals are promoted by chemical dealers.
21. The controlled environment agriculture is a huge money spinner. One intentions of closed environment was protecting the crop from insects and diseases. But in reality, fungi and

[37] One farmer having poly tunnels in ten locations gets a gross income of around about Rs. 750,000 per month.

difficult to control insects like white fly, mites and aphids are profuse in polytunnels than in open fields. This necessitates frequent use of fungicides and pesticides.

B. Key informant interviews

22. Key informant interviews (KII) are qualitative in-depth interviews with people who know what is going-on in their community due to their professional interactions. The purpose of KII in this study was to collect information from a wide range of people who had firsthand observations on agriculture based food safety issues and obtain insight on the nature of problems and solutions. KII and discussions were accomplished under 4 broad categories: i) Implementer consultations, ii) Scientist consultations, iii) Private Sector consultations, and iv) Expert Consultations and Workshop at apex level.

3.0 Key Informant Interviews with implementer level stakeholders

23. KII with implementing officers, as listed in Box 2 below, was used to method triangulate the FFG discussions, as mentioned earlier. Additionally, specifics of the discussions are presented below.

Box 2: Implementer level key informant consultations

i. Director Extension - Extension & Training Centre, DOA
ii. Provincial Directors of Agriculture – NCP, NP, CP, NWP
iii. Agric. Director - Nuwara eliya
iv. Dy Director of Agric., Inter Provincial – Anuradhapura, Polonnaruwa
v. Dy. Resident Project Manager - MASL – Thambuththegama
vi. Provincial Director Training - ISTI, DOA, Bindunuwewa
vii. Agri. Instructor - Norochchole, Labuduwa, Netolpitiya
viii. Agronomist - MASL, Walawa
ix. Agriculture Development Officer, Sri Lanka Hadabima Authority

24. Agriculture Extension service is managed by 9 provincial councils, 6 interprovincial areas of DOA, and 10 irrigation system of Mahaweli Authority of Sri Lanka. KII of varying depth were conducted with relevant officers in all zones PDA of NP, NCP, NWP and CP and; field officers of interprovincial area of Anuradhapura, and System H (Thambuthegama). During discussions following observation were made.

25. Extension officers are aware of the threat to food safety from excessive applications of fertilizer and agrochemicals by farmers to obtain a higher productivity. Over use is very often due to incorrect advices of the agrochemical dealers, as the state extension service is thinly spread and not readily available. The capacity of the state extension service is severely inadequate to provide an effective extension service to the all farmers. The consumer preferences for visually appealing quality of fresh produce and disregard to its safety also compel farmers to apply over doses of chemicals.
26. GAP is one of the strategies available to assure food safety, but its acceptance is sluggish, as farmers do not get a higher price for GAP products. Many agencies advice the extension service to promote GAP, but it's acceptance ultimately depends on its worthiness, as farming is a money earing venture. Rational thinking of farmers is to earn a living out of agriculture, to get a higher productivity, higher farm gate price with low cost of production. This is not realizable with GAP under the current context, as marketing and farm-gate pricing structure is not conducive yet.
27. Provincial Director of Agriculture NWP and NP and some other provinces promote to a limited extent ecological farming and organic agriculture, but its expansion and long term sustainability are constrained by limited demand and marketing facilities, limited input supply services, low productivity and low profitability of the organic agriculture.
28. Leafy vegetables, okra, brinjals, cabbage, green cob of maize, onion, and green chili are the most vulnerable vegetables to food unsafety. Due to many reasons IPM is not practiced. Agronomic recommendations are obsolete and need to reorient to incorporate the preset day farmer expectations while improving the food safety status as well.

4.0 Key Informant Interviews with scientist level stakeholders

29. KII was conducted with scientific officers concerned with food safety, either as a main or minor mandate. Box 3: Scientist level key informant consultations; as presented below list the participants and their opinions are summarized in following sections.

Box 3: Scientist level key informant consultations

i. ROP & senior staff - Registrar of Pesticides Office
ii. Head, Chemical & Microbiological Analysis Division - ITI
iii. Senior Lecturer Food Science - University of Peradeniya
iv. Curricular Development Specialist on food safety - GAP Office, DOA
v. Senior research officer - Food Research Unit, DOA
vi. Panel of scientists - Nat. Ins. of Post-Harvest Management, Anuradhapura
vii. Director & research officers - HORDI, RRDI, FCRDI, GLOCRDI

30. Registrar of the Pesticide (ROP) and ROP office of the DOA, is the pesticides regulatory authority in Sri Lanka established under the Control of Pesticides Act No. 33 of 1980. Good Agriculture Practice (GAP) Office at the Extension & Training Centre of the DOA is responsible for promoting GAP while Seed Certification Service is responsible for issuing GAP certificates. Following issues were surfaced during the consultation process.
31. At present there is a food act and has some provisions for food safety regulations managed by Ministry of Health and indigenous medicine. But there is no formal linkage with the DOA or with ROP. ROP has analyzed 700 fruit & vegetable samples for 60 chemicals and had observed detectable amounts of pesticides not exceeding MRLs. Only 2% had hazardous level of chemicals. ROP is of opinion that fruits and vegetables in Sri Lanka are not contaminated to the extent presumed by some people. However, some documented literature and field observations by the research team reason out considerable application of chemicals to vegetables and GLV, even without adhering to pre-harvest intervals. The research gaps needing attention are; updating MRLs for new chemicals and updating SLSI standards. The enforcement officers are reluctant to enforce any legal actions in accordance to the act, as they are concerned about damaging the rapport with farmers. Provincial councils are not lending a priority attention to the work of ROP.
32. There are 1500 agrochemical shops in the country but only 50% are registered. Chemical agencies supply pesticides to non-registered shops as well, but they are not trained for selling of pesticides. There is a great possibility of disseminating wrong information and advice through them.
33. RRDI is of the view that in the food safety regulatory mechanism, rice is not considered as a threat as during processing, husks and bran are removed along with any residue chemicals, if any. As the processing facilities are modernized, physical quality of the rice

has improved tremendously. However, some of the recent practices such as combine harvesters and wet paddy can cause fungal infections. Improper storage also leads to fungal infection of rice. RRDI has never been contacted or participated any food safety meeting of the ministry of health.

34. The interviews at other research stations yielded in general comparable views with respect to crops other than rice. By nature of the crop susceptibility, many crops need to be nurtured with artificial fertilizers and profuse applications of agrochemicals. Also most of the low-country vegetables are continuous harvesting crops and a pre-harvest intervals between harvests cannot be maintained. Judicious application of lowest toxic but effective pesticides in correct dilution need to be practiced. However, the rationalization by farmers is different; as the crop is their sole income, they take extra precautionary acts to save it by profuse application of chemicals. Educating the chemical traders, to be a scientific source of information is recommended.
35. The importance of effectively promulgating the GAP programme was stressed by DOA GAP office. SL-GAP standards have been established by the SLSI and are mostly IPM practices and ecologically friendly crop production practices. Currently only a negligible number of farmers practice GAP procedures due to marketing issues. The officers are of the opinion on the need of a mass scale popularizing campaign for GAP while establishing market facilities for GAP products.

Status of SL-GAP Programme

Year	Issuance of GAP Certificate - Farms	Total Farms With GAP certificate	Farms Abiding GAP
2016	7	7	7
2017	163	170	170
2018	206	376	NA
2019	172	548	302 (55%)
2020	311	859	348 (40%)
2021	4141*	5000*	

* The targets of the long term plan

Source: SL-GAP office, DOA

36. SL-GAP Certification programme of DOA is administered by two separate divisions; implementation division and certification division. In the field, GAP programme officers

are stationed in Provincial DOA offices and IP offices. The SL-GAP was officially launched in 2016. Above table shows that achievements over the years from national perspective is insignificant. Adherence to GAP after certification is around 50 percent, and DOA target aspirations are too ambitious. They reason out that currently GAP is supply driven, meaning it is the administration whowants to push it and not demand driven by farmers. Farmers do not demand it as there is no firm price and marketing advantage.

37. Attending to all food safety hazards in all segments of the food chain were stressed by the food scientists. The biological hazards due to unhygienic practices in food processing, cross border trade of contaminated food, and from inappropriate storage is currently not tackled sufficiently and effectively.
38. IPHT views that food unsafety can originate due to post harvest operations such as improper transport and unapproved ripening methods. Imported food items such as chill have Aflatoxin as well as heavy metals and high level of chemical residues. Unacceptable producer practices in post-harvest treatments, processors practices in using unhygienic products and ways of processing, leads to food unsafety. PHI are not inspecting the fruit and vegetable sanitation as there are no standards developed yet. A food safety council or authority should be established.

5.0 Key Informant Interviews with privates sector stakeholders

39. Last category of KII was the consultation of private sector. It included produce collectors, a bulk breaker, a fruit processor, rice mill managers and agrochemical dealers. The list of participants interviewed under private sector KII is given in Box 4: below.
40. The most noteworthy consultations in this category were the vegetables and fruits collecting centres; specifically the Cargills Collection Centers in Jaffna and Norachchele, the Keels Collection Center in Jaffna, Vegetable Collection Centre at Haali ela, vegetable collection and bulk breaking hub at public market, Padiyapelella, and the Dedicated Economic Centre at Dambulla. Following are salient features of collection system.
41. The supermarket collection centres have a well-defined procedure to obtain high quality produce, which are either sorted at the centre according to visual criteria; fruit size, colour, appearance, blemishes and smell of chemicals or as per arrangements. In some centres farmers themselves sort and pack in retail shelf bags and bring them to the centre. In some places fruit ripening chambers are also installed. The centres provide farmers with crates for transport and seed materials of varieties in demand. All procurements are coded for

traceability and nonstandard produce are rejected. Purchases for the next day's requirement are made from registered farmers only as per Colombo head office requirements. Own field technical officers advice and oversee whether the farmers adhere to food hazard precautions. Though GAP certified farmers are few, all registered farmers are expected to follow its principles as much as possible. The feed backs from Colombo on consumer perception on quality and safety of their produce is transmitted to the farmers. Farmers are happy as they get the payments promptly. Corporate Social Responsibility (CSR) programs such as scholarship for children, best farmer awards, use of best farmers to educate other farmers are also successful activities.

Box 4: Private Sector level key informant consultations

i. Manager - Cargills Vegetables and Fruits Collection Centre, Norochchole
ii. Manager - Cargills Vegetables and Fruits Collection Centre, Jaffna
iii. Manager - Keels Vegetables and Fruits Collection Centre, Jaffna
iv. Visiting Agent - Vegetable Collection Centre, Haali ela
v. Traders in Vegetable Collection & Bulk Breaking hub – Padiyapelella
vi. Dedicated Economic Centre,- Dambulla
vii. Manager - Jacushi Food Processing Centre, Uduwil, Jaffna
viii. An agrochemicals dealer, Digana, Kandy
ix. An agrochemicals dealer – Kilinochchi
x. An agrochemicals dealer – Padiyapelella
xi. An agrochemicals dealer – Mandaramnuwara
xii. Manager - "Singhalanka" Rice mill, Diyabeduma, Polonnaruwa
xiii. Secretary - Polonnarwa Rice Producers Association.
xiv. Manager - "Wee Hena" Rice Mill, Kaduruwela, Polonnaruwa

42. The analysis of the supermarket produce collection system revealed that when the total value chain is properly integrated, production and procurement of safe food is possible. This however, needs strong corporate leadership.
43. The observations at the collection and bulk breaking centre, vegetable collecting centre and at the economic dedicated centre, very strongly revealed that bulk collected and traded vegetables are what the consumer demands based on visual traits, and at no stage in the collection – bulk breaking – marketing chain, whether pesticides had been misused was a concern. However, en route spoiled, bruised, crushed vegetables may not be traded, not because of concern on biological food unsafety hazards, but on difficulty to market. Food

safety, as understood by professionals as chemical hazards, biological hazards, physical hazards, is not a factor in the complex collection, bulk breaking remarketing system. Thus right from the primary segments of food chin, food safety is an unattended concern.

44. The interviews with agrochemical dealers were not very revealing. Understandably, non-admitted to advising farmers to use overdoses or agrochemical mixtures. However, as observed by the researchers, they vigorously advise farmers on varieties currently on demand (what are purchased by collectors), their agronomic information, and required fertilizers and chemicals, which are also what is available in their stores. From random interviews of farmers who visited the store, and observing their approach to the dealer for goods and advice, it was clear that agrochemical dealers have a persuasive influence on vegetable cultivation, including advising of pest and disease control, in their locality.

6.0 Expert Group-Consultative Workshop

45. As an essential constituent of the research, a mid-course expert group consultative workshop was conducted with selected apex level participants representing several stakeholder institutions. The list of participants are shown in the following table.

Workshop on "Policy Research in the Area of Food Safety" List of Participants		
A	MINISTRIES	
	Ministry of Agriculture	3
	Ministry of Health	2
	Ministry of Health – special invitees	2
B	DEPARTMENTS & STATUTORY BOARDS	
	Department of Agriculture	5
	Sri Lanka Accreditation Board	1
	Department of Import & Export Control	1
	Institute of Policy Studies	1
	Government Analyst Department	2
	Industrial Technology Institute	1
	National Institute of Post-Harvest Mgt.	2
C	PRIVATE SECTOR	
	National Agribusiness Council	1
	Innovative Pesticide Marketing (Pvt) Ltd	1
D	OTHER PARTICIPANTS	
	Dept. of Crop Science, Univ. of Peradeniya	1
	Free-lance	2
	Research Team	4
	TOTAL	29

46. The objective of the workshop was to gather insights on gaps in the existing system, guiding principles and the strategies for regulatory modernization. Workshop was moderated for three groups of participants to review three broad themes: A) Reinforcing governing policies for food safety, B) Augmenting technology and institutions for food safety, and C) Regulating agro-food value chain for food safety. Summing up of outcome is as follows.

6.1 Outcome of discussion on 'Reinforcing Governing Policies for Food Safety'

47. The consultants of theme 1 reviewed 'Reinforcing Governing Policies for Food Safety'. Following composite synopsizes output of the theme one deliberations.

Box 1: Theme: "Reinforcing Governing Policies for Food Safety" - Outcome of deliberations	
A	Gaps/weaknesses in current food safety policies
1	No established government policy in Sri Lanka on food safety
2	Coordination among stakeholders on food safety is inadequate
3	The existing legislations cannot address food safety from farm to fork
4	Government policies on agriculture, except the EDB National Export Strategy, do not enforce food safety
5	No independent national authority to enforce food safety in all segments of food chains
B	Objectives of the national food safety policy
1	Policy should ensure safety of food in all segments in different food chains
2	Policy should introduce preventive measures, mitigation measures and control measures
3	Policy should formulate, review and update comprehensive regulations
4	Policy should be food producer, seller and consumer friendly by incentivizing compliance of food safety requirements
C	Guiding principles for policy formulation
1	The policy formulation should encompass strategies detailed by WHO - SEARO strategy to framework the food safety policies
2	Policy should promote & enforce modern food safety management principals

48. Consultants identified several gaps, among them the foremost is the non-existence of an instituted food control policy including food safety, no proper coordination among key players, and the food control system not covering farm to fork concept. There is no independent national authority to direct and control issues covering all segments of food safety. The group suggested as guiding principles, an enactment of a holistic food safety policy and to adhere to the guidance of food safety advocating international agencies on strategies and frameworks. The proposed policy should address food safety in all segments of food chain using modern principals in food safety management. It should introduce preventive measures, mitigation measures and control measures. It should create comprehensive legislations, continuous review and update and incentivizing compliance.

6.2 Outcome of discussion on 'Augmenting Technology & Institutions'

49. The consultants reviewing 'Augmenting Technology and Institutions for Food Safety' identified several gaps in the institutional setup. Their deliberations are summarized below.
50. They highlighted lack of proper identification of institutions involved in food safety/food technology development, non-coordination/communication among institutions, and the existence of multiple institutions without specified mandates related to food safety. Also lack of an institution related to risk assessment (including risk management and communication), non-adoption of novel techniques in analytical/ technological field, and lack of nationwide database on food safety are some other gaps in this field. To strengthen Technologies and Institutional Mechanisms, the group suggested a central body such as a food safety authority, to attend to coordination of food safety related activities of a food control policy, capacity building of institutions and technology improvement pertaining food safety related analytical systems.
51. They also suggest that the proposed food control policy should look into enforcement, laboratory services, food technology providers, exports, imports, GMO food, policy implementation and monitoring mechanisms. They recommend risk assessment approach for food safety management, mandatory system certification (GMP, HACCP) based on commodities/sensitivity and identification of R & D as a priority areas.

Box 2: Theme: "Augmenting Technology and Institutions for Food Safety" - Outcome of deliberations	
A	Gaps/weaknesses in Existing Technologies & Institutional Setup
1	Institution involved in food safety/food technology development are not properly and comprehensively identified
2	Weak coordination/communication among food processing institutions and between processors and technology developers
3	Multiple institutions exist without their mandate related to food safety being clearly identified and spelled out
4	Lack of an institution to advocate risk assessment (including risk management and communication) on food safety
5	Slow to take up novel analytical and processing techniques
6	Lack of nationwide database on food safety
B	Objectives to strengthen Technology and Institutions for food safety
1	To coordinate and implement food safety Acts and regulations,
2	To provide advisory and analytical services to food technology providers, exporters, importers
3	To facilitate risk assessment based approach for food safety management
4	To assist in system certification such as GAP, GMP, HACCP, SLS etc
5	To venture on R & D in food safety
C	Guiding principles to Strengthen Technologies and Institutional Mechanisms
1	Create a central body to coordinate food safety related activities and institutions – Food safety authority
2	An overarching food safety policy to address of mandates of institutions and promote development of technologies
3	Capacity building and human resource development of all institutions interlaced to food safety
4	Recognizing food safety technology development by academic and nonacademic research institutions as an acceptable approach

52. The Group 3 expert consultants reviewing 'Regulating Agro-Food Value Chain for Food Safety' points out several gaps, among which are lack of empowerment of a responsible authority for food safety, lack of awareness of each actors of their role in ensuring food safety, poor coordination among relevant regulatory organization/ institution, lack of incentive based well-defined regulatory mechanism. The guiding principles to strengthen regulatory mechanisms on Agro-food value chain, should have mandatory requirements/optimum utilization of step wise certification system which ultimately could lead to global certification; an apex body for coordination of activities to achieve food standards and government facilitation for the formation of consumer protection societies.

53. Group three deliberations can be presented as follows.

Box 3: Outcome of deliberations on the theme: "Regulating Agro-Food Value Chain for Food Safety"	
A	Gaps/weaknesses in existing Regulatory Mechanisms on Agro-food value chain for food safety
1	Nonexistence of an authority to enforce food safety in the agro value chain
2	Vagueness of stakeholder responsibilities and non-awareness of responsibilities of others
3	Poor coordination among relevant regulatory organization/ institutions responsible for the agro-food value chain
4	Lack of incentive based well-defined regulatory mechanism
5	Disorderliness and complexity of agro-food value chain
B	Objectives to strengthen Regulatory Mechanisms on Agro-food value chain for food safety
1	To ensure agro-foods, especially a primary stage are safe for consumption
2	Well controlled production systems safeguard the environment
3	Acceptable to domestic and international markets
4	To ensure the safety of imported food items and raw materials
C	Guiding principles to Strengthen Regulatory Mechanisms on Agro-food value chain for food safety
1	Agro-production should have mandatory requirements/optimum utilization of step wise certification system
2	Establish apex body for coordination of activities to achieve food standard
3	Encourage and provide government facilitation for the formation of consumer protection societies

54. Thus the core outcome of the workshop was: there is no food control (encompassing food safety) policy in Sri Lanka and such a policy is of utmost importance; the existing regulatory legislation, the Food Act and its Regulations have skewedness toward end product regulation without addressing the entire agro food value chain; the food control management system is not properly represented, institutional framework is weak in capacity, coordination and empowerment.

Chapter 5

Research Recommendations

1.0 Introduction

1. As the research recommendations are primarily regulatory and frameworks, the contents of this Chapter should be viewed in conjunction with the previous chapter; the Chapter 4, especially the section B. The Food Control Regulatory System in Sri Lank, pp26-64.
2. Analyses of the food safety situation in Sri Lanka in preceding chapters, established that food control system was undermined by fragmented legislation, multiple jurisdictions, and weaknesses in surveillance, monitoring and enforcement. The infrastructure, equipment, supplies and skilled personnel required for successful operation of a food control system is inadequate. Scientific and technical knowhow among designated personnel and resources for food inspection for compliance need improvement. Due to historical reasons, nearly every country had confronted this situation and in due course had modernized their food control systems to be more efficient and acceptable to international partners. This was exemplified in previous chapters citing selected other country models. Sri Lanka too has initiated modernizing its food control system.
3. As a rule, all countries in their course of food safety modernization, had adopted internationally accepted procedures, which are also recommended in this research. However for the system to be robust to endure unceasing challenges in food trade and in food related health, it should be backed also by a legally binding and enforceable food safety policy. Such a policy needs in conjunction an integrated institutional network for successful implementation.
4. This research strongly recommends as a cascading system, establishment of a:
    i) properly articulated Food Safety Policy,
    ii) a commanding Food Safety Authority and
    iii) an all-encompassing Food Control System.

Their specifics are described in this chapter along with other pertinent recommendations.

2.0 Food Safety Policy, Food Safety Authority and Food Control System

5. The Sri Lanka government has the regulatory responsibility to ensure food being produced and traded within the country or outside its borders is safe for consumption. Various impositions and challenges in the food sector necessitates the government to formulate and

institute a comprehensive and operational *National Food Control System*. To accomplish the national food control system, an explicit *policy commitment* is required from the legislature. Sri Lanka has such policy commitments in various fields of interest expressed as policy documents[38], but lacks a clearly articulated policy document on safety of food.

6. This report convincingly advocate a policy commitment from the executive and supportive laws from legislature to enhance the food safety status in Sri Lanka. It should be the foremost reformation to the existing food control system. The policy commitment should be put forward as a policy document titled: ***The National Food Safety Policy of Sri Lanka***.

3.0 The National Food Safety Policy (NFSP) of Sri Lanka

7. A National Food Safety Policy (NFSP) is required for the government to spell out its obligations towards food safety, food related economy and public health in the country. It is central for an operational food safety programme, as it provides the direction and thrust to the food sector and defines from the national point of view the collective vision for all the actors in the food chain. Absence of a food safety policy[39] is often cited as the leading obstacle to accomplish an effective national food safety control system.

3.1 Why a National Food Safety Policy – rationale

8. There are several reasons to endorse a National Food Safety Policy for Sri Lanka. Following abstract presentation of situation analysis justifies the necessity.
    i. As in other countries, Government of Sri Lanka is obligated to uphold high standards of food safety for domestic consumers and international trading. This can be achieved only from a well-conceived food safety system inspired by a well enacted policy. The present food control system has pressing issues which requires urgent government attention. As the shortcomings had been discussed in previous chapters, only the most evident issues are synopsized below for re-reference and to rationalize the food safety policy requirement.
    ii. Sri Lanka is under pressure to modernize its food control system. The ever demanding global food trade compel Sri Lanka to enforce an acceptable national

[38] For example: National Nutrition Policy of Sri Lanka, 2010; National Policy on Cooperatives, 2019; e-Government Policy, 2009; National Policy on Technical and Vocational Education 2008, etc.

[39] In some countries the term food safety policy is often used to describe the entire processes and procedures followed in implementing their food safety programme. What is emphasized and proposed in this report is an exclusive piece of legislation on national food safety. An equivalent policy, for example, is the National Nutrition Policy of Sri Lanka.

food control system based upon scientific principles and strategies. Such a system could facilitate trade, prevent food adulteration, fraud and deception, and match up to stringent food safety standards demanded by developed economies. At the same time, the requirements of The Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) agreements of World Trade Organization (WTO) create further restrains on the safety of Sri Lankan food traded beyond its borders. The domestic consumers too are increasingly taking interest on the way food is produced, processed and marketed, as well as the safety of food imported to the country either for direct consumption or for reprocessing, as contaminated food or food ingredients are harmful to their health.

iii. The national public health system could be unduly strained from food-borne disease outbreaks demanding more resources and state finances. It could deviate attention and deployment of logistics from other development undertakings. If such expenditure could be avoided, the savings could be used for other pressing sectors. An effective food safety policy would confront such disease outbreaks.

iv. Some major food control issues need a backup policy to rectify. Among them are the legislative gaps, overlaps, inadequate coordination and inadequate representation in food safety functions, non-instituting of science based food control system, inadequate and less recognized research, weak surveillance and epidemiology monitoring systems. Present food legislations address only the end products of the food chain; the processing and marketing segments. Ensuring food safety should be a concern all-along the food chain, from primary production to end marketed product. Without addressing the effects of the preceding nodes, a holistic food safety control cannot be achieved. To that end, there is no clear legal provision or legal commitment, as there is no formal food safety policy. The existing array of legal enactments categorized as Food Act being the primary law and other regulations as secondary laws had originated over time for well-intended reasons, but their broader enforcement suffers from lack of a guiding food safety policy.

v. Different institutions have declared tolerable contaminant levels for materials they are acquainted with, such as MRL of pesticides, veterinary drug residues, and borrowed standards for heavy metals, biological contaminants. They are not comprehensively endorsed in current legislations and usually take excessive length of time to get integrated to laws and regulations. The updating of food safety regulations is far apart, which can be attributed to absence of a persuasive national

policy for food safety. The slow pace of modernization makes the food control system lagging behind other Asian countries and uncompetitive to match the global food safety standards and export market.

vi. Food safety responsibilities are shared among institutions, but coordination may not be effective and holistic to achieve an all-inclusive end result. Some examples to quote are the Ministry of Commerce serving as the focal point to WTO while SLSI and MOH are the focal points for TBT and SPS. Misuse of pesticides resulting in toxic residues is a concern in primary food production which the DOA is entrusted to manage, yet it is not represented in the FAC. The NPQI is a sitting member of the FAC, yet NPQI is mandated with inspection for biological impurities in imported non-processed food and not chemical toxins. MRLs for pesticides are published by DOA, but FAC has not made use of it or updated the regulations. In specific cases such as with pesticide misuse detection, provincial staff may not adhere with central government instructions to avoid field level antagonisms.

vii. Science based food control system is not instituted fully as not promoted by an enforcing food safety policy. Research on food sciences are scattered and limited to the agenda of the researching institutions and universities. The competence of such institutions, their scientists and academics to contribute to food control system is immense, but inadequately harnessed as there is no policy guidance to encourage research and formalize the researchers and research findings in to the food control system. Likewise there are issues in analytical laboratory network, standards formulation and assessment practices, which could be resultant of lack of an enforcing food safety policy.

9. Therefore in order to ensure coherence and circumvent contradictions in activities of public and private entities dealing with food safety and to develop the food safety endeavor devoid of lapses, it is rationalized that a National Food Safety Policy is necessary and should be instituted in Sri Lanka.
10. The essentials of the i) National Food Safety Policy, ii) National Food Control System, iii) National Food Safety Authority, iv) principles of desired in food control management, and v) strategies for critical, focused areas are elaborated in succeeding sections of this chapter.

3.2 National Food Safety Policy – the vision

11. The vision of the NFSP should be to achieve a state-of-the-art National Food Control System (NFCS) in Sri Lanka, through appropriate legislation, science-based principles, national and international standards and agreements governing food safety systems, integrated institutional framework, and public-private sector partnership; aimed at safeguarding human, animal, environmental health and the food based economy of the country.

3.3 National Food Safety Policy – the scope, objectives and principles

12. The scope of the NFSP should be the entire food chain from primary production to consumer and all sectors associated with food safety assurance and control. They are broadly the health of consumers, the food producing agriculture sector comprising crop farming, livestock farming and fishery, the food processing industry and the food trade comprising domestic procuring and marketing, imports, and export of food.
13. The objectives of NFSP should be individually and collectively support implementation of the NFCS. *The pivotal objective of the NFSP should be the establishment of an independent statutory apex body, in the form of a Food Safety Authority of Sri Lanka (FSASL)*[40]. All the other objectives and goals of the NFSP can be underpinned with the establishment of the FSASL. Important, indispensable objectives of NFSP are listed in Box*: Objectives of the proposed NFSP*. If a policy is not well articulated with guiding basic principles it will be merely an unconvincing cosmetic document

[40] Several countries have established Food Safety Authorities with varying levels of mandates to suit their national legislature. Some examples are: i)European Food Safety Authority (EFSA) of the EU, ii) Norwegian Food Safety Authority, iii) UK Food Standards Agency, iv) Canadian Food Inspection Agency, v) Food Standards Australia New Zealand (FSANZ) Authority, vi) Malaysian Competent Authority for Food Safety, vii) Singapore Food Agency and the viii) Food Safety and Standards Authority of India (FSSAI).

14. Basic Principles of the policy put the political intentions into more practical terms by setting a more detailed conceptual framework that supports the overall policy objectives. Thus the NFSP should uphold Basic Principles widely accepted as norms[41] in a national food control system. They may be reviewed periodically for consistency with newly developing perceptions on food safety. The foremost principles need to be incorporated into the NFSP are indicated in: *Basic principles of proposed NFSP*.

Basic Principles of proposed NFSP

a) Integrated 'food chain' approach, which is to consider all aspects of the food production chain as a continuum from and including primary production up to and including sale or supply of food to the consumer

b) Risk based approach, by conducting systematic risk analysis comprising risk assessment, risk management, risk communication as a main focus approach

c) Obligating Food Business Operators at every stage of the food chain to have responsibility for ensuring the safety of their food products

d) Directing the national food control programme to be consistent with the World Trade Organization's Agreements on Sanitary and Phytosanitary Measures and on Technical Barriers to Trade

e) Harmonizing international standards by adoption of internationally accepted standards, guidelines and recommendations and, in particular, those issued by the Codex Alimentarius Commission as the first option

f) Instituting reliable traceability and transparency principle, among others

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15. Once National Food Safety Policy is in place it facilitates the drafting, legislating and adopting an effective National Food Control System (NFCS) in Sri Lanka.

4.0 National Food Control System with a Food Safety Authority of Sri Lanka

16. National Food Safety Policy, short of a system to accomplish its goals would be an inconsequential document. To realize the intended policy outcome, the National Food Safety Policy should be made enforceable by means of a wide-ranging operational system; the ***National Food Control System*** (NFCS). The NFCS is closely alike in most countries, built on internationally accepted models, yet they may differ in addressing country specific problems. Sri Lanka also should sensibly adopt the basic system to suit our requirements.

[41] The Basic Principles are considered necessary in food control system modernization by global institutes advocating high food safety standards. Individual countries add more as required as well as strike a balanced level of adherence based on cost-benefit of the principle. The involvement of academic society in dealing with such analyses from the beginning of the modernization is noteworthy.

4.1 Why a National Food Control System – rationale

17. If Sri Lanka is to develop a modern food safety system, it needs to build up a strong food safety enabling capacity (FSEC). The FSEC typically comprises high levels of: food safety culture among the populace, applicable scientific knowledge and technical skills, operational procedures and resources, food safety policies, laws, regulations, and food safety standards. A well-capacitated FSEC is an asset to food safety stakeholders; the farmers, Food Business Operators[42], consumers, and the relevant organizations; government agencies, official/accredited food control laboratories, and the food firms. It ensures the safety of domestically produced as well as imported food for Sri Lankan citizens, country's ability to export to international markets abiding international food safety standards and regulations, and reduce the incidences of food-borne diseases.
18. In order to accomplish a strong food safety enabling capacity in Sri Lanka, it needs a driving engine; A National Food Control System. Its scope and objectives are discussed below.

4.2 National Food Control System – the scope and objectives

19. The scope of NFCS should cover all types and forms of food as a continuum, from farm-to-table. It should include primary food, processed food, food collection, transportation, distribution and marketing, imported food and ingredients, food exports and prepared food in restaurants, food trucks and vendors.
20. The objectives of NFCS should be better health of the populace and food-linked economic development. Specifically they could be listed as: i) to protect public health by reducing food borne illnesses, ii) to protect consumers from insanitary, contaminated, unwholesome, mislabeled or adulterated food and iii) to maintain consumer confidence in the food system which will give rise to increased domestic and international trade in safe food.
21. The administrative structure and mandate of NFCS are discussed in subsequent sections of this chapter, once the importance a Food Safety Authority is explained.

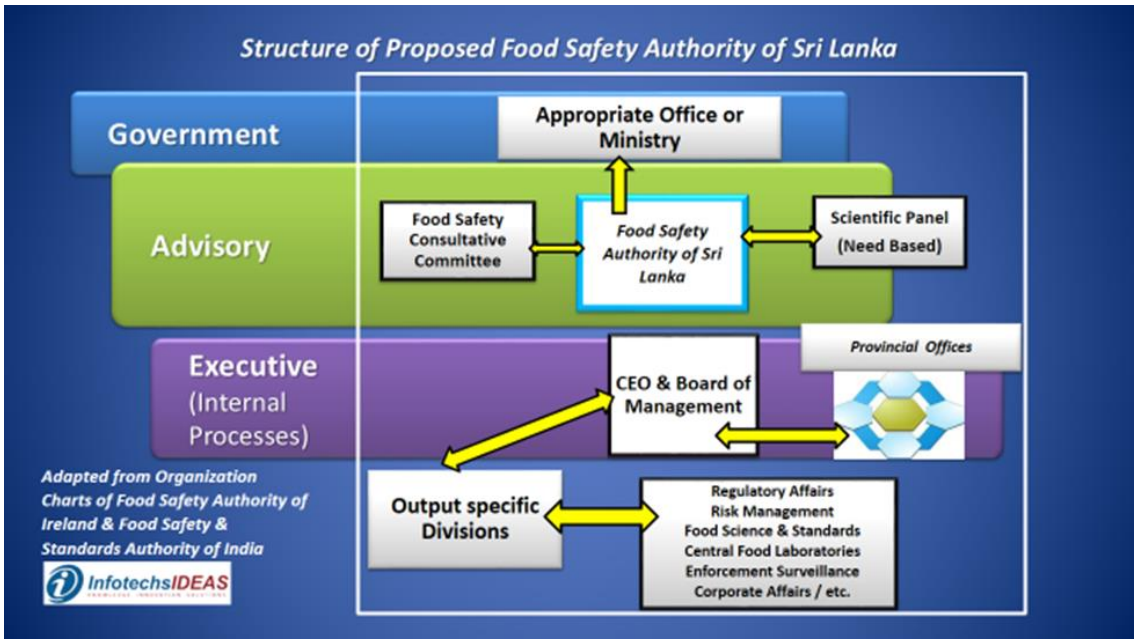
[42] Food business operators (FBO) are any undertaking, whether private or public, for profit or not, carrying out any of the activities related to any stage of manufacture, processing, packaging, storage, transportation, distribution of food, imports and including food services, sale of food, or food ingredients. They have a multitude of roles and responsibilities toward achieving food safety in their business.

5.0 Rationale for a Food Safety Authority

22. As clarified previously, the NFSP is the legislation and NFCS is the integrated system to achieve high standards of food safety. However both in isolation is less effective without a commanding entity linking the policy and the system. The go-between powerful entity is the Food Safety Authority of Sri Lanka, which is firmly recommended in this report. Following layout demonstrates how should the Food Safety Policy, Food Safety Authority and Food Control System be established in Sri Lanka.

6.0 The Food Safety Authority of Sri Lanka

23. The Food Safety Authority (FSA) of Sri Lanka, should be an autonomous body established under the national food safety policy (NFSP). The NFSP should have a policy statement: *"Enhancing national capacity to achieve an efficient and effective food control system in Sri Lanka",* under which the legislature can institute a National Food Safety Authority in Sri Lanka. The FSA, should be detached from any specific Ministry. Being unaffiliated, it can unbiasedly enforce rules, regulations, procedures in all sectors of the food control system. It is realized that deciding under which administrative agency the FSA should be founded is would be a tough political; an exercise beyond the scope of this research.
24. The FSA should be the national reference point with respect to food safety and food standards in the National Food Control System of Sri Lanka. It should be a science-based body, mandated to protecting public health, food based economy, and consumer interests in the area of food safety and hygiene.
25. The Food Safety Authority, being the controlling apex body in the food control system should have a persuasive administrative structure governed by a Board of Management with a Chairperson as head and Directors for subject oriented Divisions. The envisaged structure of the FSA is illustrated below.
26. The board of management should be composed of legally adequate number of members from various Ministries, Departments, Institutions and civil societies. In Sri Lanka context the board should represent sectors of: Health, Agriculture, Commerce, Academics, Scientists, Technologists, Industrialists and Consumers among others. The CEO as the administrative head of the Authority should liaise on one side with the parent administrative agency under which the FSA was instituted, and on other side with all the food control implementing agencies.



27. The Authority should be aided and guided by a Food Safety Consultative Committee or the Central Advisory Committee and need based external Scientific Panels. The Consultative Committee would facilitate consultations with concerned farm-to-table stakeholders. It would provide views and advice to the management board on pertinent issues related to food safety all along the food chain. Furthermore, there should be several specific Divisions, such as on: Regulatory Affairs, Risk Management, Food Science and Standards, Central Food Laboratories, Enforcement Surveillance. It is also necessary to have a separate Scientific Committee to assist and advise the Board in matters of scientific nature. The Scientific Committee could be consulted on matters such as on: Scientific and Technical including risk assessment; Food standards and codes of practices; Food safety related research; Nutritional value and content of food; Food labelling and disclosing; Implementation and administration of food inspection services; and Monitoring and evaluation including regulatory impact assessments.
28. The overall involvement of the Authority is usually termed as **Key Functions of the Authority**. They can be perceived in three broad areas, but not limited to, as follows.

a) Enforcement and Compliance

i. Management Board has wide ranging powers, including the formulation of food control policy and the provision of advice to Government

ii. Adopts a strategic view across the whole food chain and consults widely with all sectors of the food chain and all interest groups to ensure public involvement in in food safety;
iii. Guide and assist food safety regulators for an effective system of enforcement.
iv. Manage risks in the food chain and respond effectively to any food safety crises.
v. Ensure detecting, deterring and preventing breaches of food laws
vi. Effective system to protect consumers.
vii. Identification of legislative needs; monitoring the efficiency and effectiveness of law enforcement and food surveillance activities
viii. Statutory powers to coordinate, monitor and audit local agency and provincial food control activities, including food analysis, inspection, enforcement, and education

b) Science, Expertise and Evidence

i. Support risk assessment practice in food safety system
ii. Support evidence based research, coordinated studies and scientific collaborations
iii. Advance the system to identify emerging risks and threats to the food chain.

c) Engagement and Communication

i. Authentic source for best advice and information to promote food safety and compliance with food law.
ii. Utilizes an open and transparent decision-making process, and able to make public its views on issues related to food safety, public health, and food control
iii. Collaborate with key stakeholders, other state agencies, academia and civil society to promote culture of food safety

35. ***Once the NFSP and the FSA are in place, the recommended NFCS will be manageable.***

7.0 Specifics of the National Food Control System- (*Revisiting)*

36. Revisiting the section 4.0 above, where the National Food Control System was rationalized; following sections continue with its specifics.

37. A national food control system is not a self-contained arrangement, but an array of activities and procedures built upon core components, called the *Building Blocks of the NFCS*[43]. The building blocks are the essential foundations or pillars of the food safety system. The inter-link is illustrated in the graphic.

38. As a rule-of-thumb, all countries have adopted four building blocks, which is also prescribed in this report for the proposed NFCS in Sri Lanka. They are: *Food Legislation; Food Control Management; Food Control Laboratories; Food Inspection and; Information, Education, Training and Communication.* The NFCS is only as strong as its weakest building block. Thus a good understanding of the dynamics of building blocks and commitment to develop the blocks strong and stable is required from the political, scientific and civil community in Sri Lanka. Without this dedication the NFCS would be only partially effective.

7.1 Block 1: Food Legislation

39. Food Legislation is the foremost, of the five building blocks of a modern food control system. In reforming an existing food control system, it is necessary to start with a tough food legislation in place.
40. Food laws in Sri Lanka are more on confiscating unsafe food from commerce and penalizing the liable persons. The outcome has been reactive and enforcement-oriented rather than preventive and holistic to reduce the risks. In today's context, reformed and modern food laws should be more strong, having its influence on every segment of the food chain, and also delegating the Food Safety Authority to continuously improve the system. In addition to legislation, the envisaged system needs updated food standards, either prescriptive or horizontal to address ever evolving issues in food safety objectives. The

[43] The term building blocks was coined by the FAO in their guidelines for designing national food control system. Previously, WHO used the same phrase for the core components of national health system

modern regulatory framework need to satisfy national needs, trading partners and international agreements.

41. Along the above reflections, Sri Lanka should take into account its experiences with the Food Act No. 26 of 1980 and about 18 Regulations enacted under the Act at various times, as well as lessons of modernizations from other countries in order to develop an adoptable food control regulatory framework in Sri Lanka. Prior to embarking on sweeping changes to the existing national food control system, it is only rational to conduct two crucial assessments; ***Food Control System Need Assessment*** **and** ***Food Control System Regulatory Impact Assessment.*** Both could be conducted at commencement of modernizing the existing system as well as at any time during the implementation[44].
42. Food Control System Need Assessment (FCSNA) determines the priority issues and best regulations to strengthen the current food control system in Sri Lanka; more on line with analyzing existing capacities, strengths and weaknesses of the system including legal insufficiencies. Food Control System Regulatory Impact Assessment (FCSRIA) should be conducted to revoke duplicating regulations and obsolete regulations. It is necessary to review all regulations operating along all segments of the food supply chain[45].
43. Following are some food legislations needing attention as foreseen in this study. The need assessment exercise should shed light on many more modifications.

    i) The most crucial piece of legislation should be a directive to establish an autonomous Food Safety Authority. It was detailed previously.

    ii) Technical Regulations on food safety parameters such as food contaminants, additives, MALs, MRLs of pesticides, food labelling, GMF, allergens etc. should be revived in a fixed-frequency time table, to be comprehensive and informed. In today's competitive global trade, partial standards are not permissible. CODEX standards and national requirements should be considered in developing technical regulations.

[44] FAO/WHO has assessment tools, along with guidance on its application, which is primarily intended for self-assessment and monitoring in developing food control systems.

[45] Currently there is a pool of technical regulations introduced time to time by the main food regulator, Ministry of Health and by other regulatory agencies such as Consumer Affairs Authority, Import and Export Control Department, Registrar of Pesticides, Export Development Board, National Fertilizer Secretariat, Sri Lanka Atomic Energy Board and National Plant Quarantine Services etc.

iii) Legislation should ensure consistency with SPS and TBT obligations through a viable SPS-TBT overseeing committee, which also provide policy guidance, discuss cross cutting trade related SPS/TBT and resolve issues in timely manner.

iv) Legislation should persuade compulsory and active participation of nominated stakeholders at Food Safety Advisory Committees, National Codex Contact Points and National Codex Committees by a democratic statutory frame. If the decision making portal is not well attended, food legislation output would be minimal.

7.2 Block 2: Food Control Management

44. Food Control Management essentially aims at developing and implementing a strong operational framework, where roles, responsibilities, and resources of the food control system are clearly defined among the institutions. Present food control management in Sri Lanka is shared among many government ministries, including health, industry, agriculture and commerce. They have overlapping roles with gaps and inconsistencies in coverage.
45. For effective and operational coordination of the food management system, a Food Safety Authority is the most suitable body to establish under the Food Policy. One of the intricate functions of the FSA would be to reexamine the assigned mandates of all departments with respect to food control and reassign specific working areas and enforcing areas, avoiding overlapping, duplication and ambiguity; to come up with a harmonized system.
46. A harmonized system, controlled by FSA could secure treasury funds with least intra-departmental competition and sound resource allocation among the network institutions. It will also facilitate developing an emergency response procedure.

7.3 Block 3: Food Control Analytical Services

47. The laboratory services, also termed as Food Control Laboratories, Analytical Laboratories, in various policy frameworks is the most important ‘service-provider’ type building block in the NFCS. It is the key reference system on adherences to science-based safety standards. It is also the substantiating system for indicting violators of the food law. Laboratory capacity building is crucial for an effective and efficient food safety system.
48. Presently there are 19 accredited food testing laboratories for chemical testing, of which 10 are operating under a government entity while 9 belong to the private sector. In the area of biological testing, there are 13 laboratories accredited for specified products, tests and test

methods. Of these 6 operates under a government entity and 7 operates in the private sector. There are various ways to strengthen or modernize the laboratories in the country, such as regular capacity building, human resource training, accrediting etc. However unplanned and non-networked sophistication would not ease the intended service-providing function, but only enhance the cosmetic of the laboratories. Indiscriminately increasing the number of laboratories will only strain the burden of the treasury without a matching output.

49. It is recommended therefore, the existing food control laboratories to be networked on the same principal as that of Reference Laboratories[46]; and to be called **'National Food Control Reference Laboratories'** of Sri Lanka. Selected laboratories should be upgraded as analytical laboratories for one or more specific need-areas, such as; pesticide residues, mycotoxins, genetically modified organisms, veterinary drugs residues, heavy metals and trace elements, food microbiology, food additives, food contact materials and environmental contaminants. This is a very effective way of rationalizing the limited resources and make the system easily accessible for specific services. Such an arrangement if to be harmonized need direction and control from a hierarchic jurisdiction; thus the strong recommendation of a Food Safety Authority. The FSA will plan, coordinate, and develop the reference laboratories as per national food control system requirements. A National Reference Laboratory system can be easily networked with other international and regional reference laboratories for exchanging technical information and promoting collaboration.

7.4 Block 4: Food Inspection

50. The best food safety regulations are worthless in the absence of proper enforcement. Inspection plays a critical role in food safety as it is essential to the enforcement process. As stated previously, currently inspections focus on sampling and testing of end products to determine their compliance with regulations. To be in par with international consensus inspections should also be on general principles for food hygiene and HACCP based approaches, and an orientation towards this approach is necessary.
51. With the principle of complete value chain based food safety, inspection process also should be introduced in the agro food sector on misuse of agrochemicals in the primary food production chain[47]. To this end, the Food Safety Authority should draw up plans to

[46] For example: National Reference Laboratories (NRLs) of the UK; European Union Reference Laboratories (EURLs) at Wageningen Food Safety Research; ASEAN Food Reference Laboratories (AFRLs), etc.
[47] For example; Regulation Inspection & Enforcement process of Minnesota Department of Agriculture; Enforcement & Inspection of Missouri Bureau of Pesticide Control; Pesticide Compliance and Enforcement activity of Canada

recruit, train, and assign such primary food chain inspectors to minimize the food hazards right from the start of the food chain[48].

52. While food inspection primarily focuses at ensuring compliance of food business operators with regulatory requirements, FSA should also align such data to a monitoring programme aiming at systematic collecting of enforcement information, to build up a perception of the field situation perception map. Such data could be used for risk based planning, focused programming of inspection activities, as well as for non-regulatory strategies such as for training and sensitization of FBOs, consumers, and policy level decision makers.

7.5 Block 5: Information, Education, Training and Communication

53. Information gathering and sharing, educating and training the implementers is the bridge between food safety theory and food safety practice. Even if the food control system has good legislation and management building blocks, if the implementers are unaware of the legislation and the intricacies of the food safety spectrum, the system would be only partially effective[49]. The education and training activity should be for all value chains of the food system and also on inspection and enforcement. The primary food producers: agro-farmers, livestock-farmers, should be educated and trained on avoiding hazards by the line agencies as decreed by the Food Safety Authority. The inspectors and enforcers at end-product inspection as well as (as suggested in this report) under the new scheme inspectors and enforcers for primary producer node also should be educated and trained. The FBOs should orient the skills and knowledge of their staff through education and training.
54. Communicating the information is also an essential element in the food safety management system[50]. Communicating the safety needs within FBOs is the key to ensure the food safety team and HACCP team to be aware of any issues that may affect their food safety management system. This should be achieved within the FBO by orientations, team meetings, bulletin etc.
55. Communication is also important within the general public. The general public have a major role to play in the overall national food control system – they influence the policies that guide the system and the functioning of the system itself. Thus a well-established communication process with the public should be in place within the national food control

[48] This is applicable to the livestock sector as well
[49] 'A chain is only as strong as its weakest link'
[50] Its importance is highlighted in the ISO 22000 standard under parts 5.6.1 and 5.6.2, internal and external communication.

system. Many countries invest in educating and informing the public about food safety as a mean of reducing food-borne illness. This concept should be followed by the Food Safety Authority of Sri Lanka as well.

56. Consumers are the last link in food supply chain. Consumer education and empowerment is necessary for managing food safety. Though not much campaigned in Sri Lankan society, there are internationally accepted consumer rights, of which; 'Right to Satisfaction of Basic Needs' spell out that goods must have the standard of quality (safe food); 'The Right to Safety' means goods bought in marketplace should not be hazardous to health; 'The Right to Information' says that all consumers have a right to be adequately informed about the product or service he is buying, based on the quality, purity, potency, manufacture date, method of use and standard; 'The Right to Consumer Education' says consumers should gain skills they require to make informed consumer decisions in the marketplace. Thus the Food Safety Authority should direct the consumer protection societies and agencies to provide information and educate consumers regularly on all matters of food safety relevant to consumer decisions. Consumer groups and other civil society groups should be encouraged to play a bigger role and voice for safe food.

8.0 Other Food Safety Principles

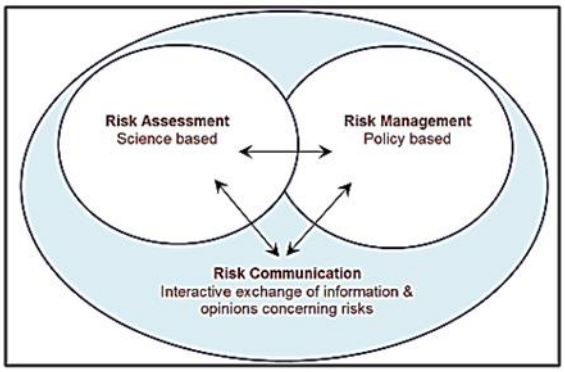
57. The 'five building blocks' expounded above are the pivotal components Sri Lanka food control system should aspire to refine. They are the essentials. In addition to those, there are other indispensable **Food Safety Principles** the Sri Lanka food control system should initiate to be par with food control systems of developed countries. From among many such principles, this report recommends following four to be endorsed in the proposed food control system of Sri Lanka. The Food Safety Authority should be mandated to influence, guide and enforce them in respective chains in the food spectrum.

The proposed four principles are:

1) Principle 1: Integrated 'Food Chain' Approach
2) Principle 2: Systematic Risk Analysis Framework
3) Principle 3: Science-based, Independent Risk Assessment Process
4) Principle 4: Reliable Traceability System

8.1 Principle 1: Integrated 'Food Chain' Approach

58. The integrated food chain or farm-to-table approach refers to safety and quality built into food from primary food production through consumption as a continuum. Food safety can be compromised anywhere in a food supply chain, thus the food supply chain approach to ensure safe food was introduced by FAO to minimize hazards along the entire length of the chain. This co-governance approach places the primary responsibility of food safety on all product producers and suppliers in the food chain; that is, responsibility is shared among all those involved with production, processing, trade, cooking, serving, etc. It is co-governance of responsibility. When primary food is processed, it ensures the safety of products supplied by the preceding chains.



59. Many but not all, potential food hazards can be controlled along the food chain through the application of good practices i.e. good agricultural practices (GAP), good manufacturing practices (GMP), and good hygienic practices (GHP). An important preventative approach that may be applied at all stages in the production, processing and handling of food products involves the Hazard Analysis Critical Control Point system (HACCP).

8.2 Principle 2: Systematic Risk Analysis Framework & Principle 3: Science-based, Independent Risk Assessment Process

60. Measures adopted in controlling food safety by all FBOs, including farmers, should be based on risk analysis framework. The Food Safety Authority should campaign for adoption of risk analysis framework in all food chains. This is an emerging discipline adopted in most developed food control systems in the world. The current process of end-product testing does not guarantee a decline in hazards in the food chains, hence the modern approach to food safety by adopting risk analysis framework.

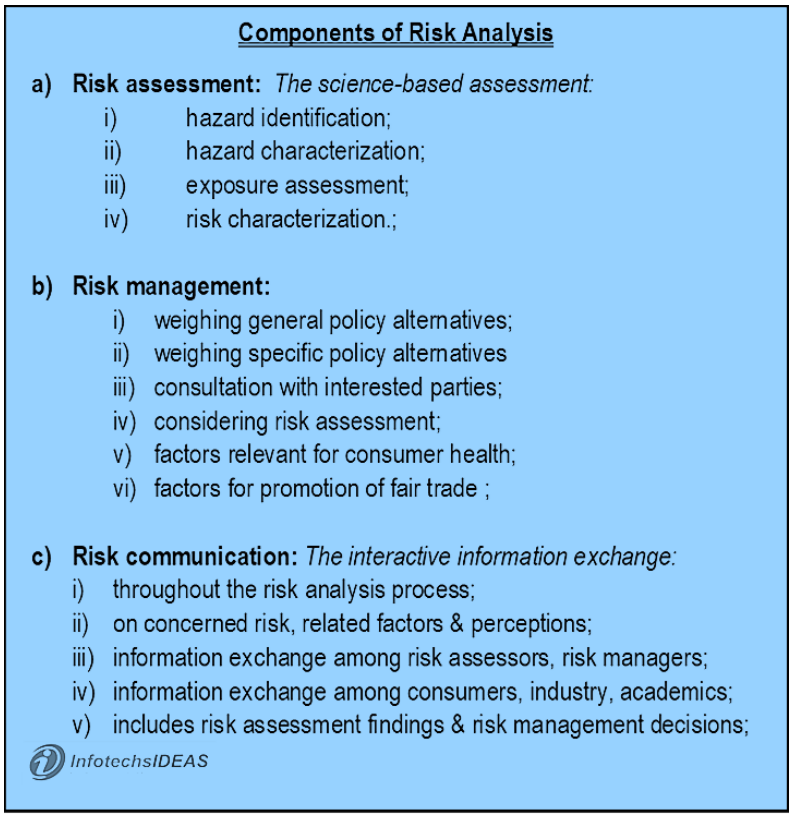
61. Risk analysis is a science-based framework[51], which could systematically and transparently collect, analyze and evaluate relevant scientific and non-scientific information about

[51] Science-based approaches are practiced in all countries such as: good agricultural practices, good hygienic practices, good manufacturing practices and Hazard Analysis and Critical Control Point system (HACCP). What

various hazards. It provides food safety regulators with information and evidence they need for effective decision-making in reducing the hazards along the value chain.

9.0 Process of Risk Analysis

62. As a structured decision-making process, risk analysis includes three distinct but closely connected components defined by Codex. They are: i) Risk Assessment, ii) Risk Management and iii) Risk Communication. Their inter-relationship is depicted in the illustration.



9.1 Risk assessment

63. Risk assessment is a quantitative evaluation of information on potential health hazards from exposure to various agents. It involves four interrelated steps: shown in the Box. The entire risk assessment process requires the use of sound and scientifically derived information and the application of established scientific procedures carried out in a transparent manner. Unfortunately, in Sri Lanka, sound scientific data are not always available for the qualitative and quantitative evaluations necessary for an absolutely sure final decision. Thus the Food Safety Authority in promoting application of risk analysis, should also venture on building-up of data repository. The commonly applicable data from other countries, from codex, as well as by enlisting the academic community, a voluminous data bank could be established.
64. Chemical risk assessment is an established process. It includes assessment of food additives, pesticide residues and other agricultural chemicals, veterinary drug residues, chemical contaminants from any source and natural toxins such as mycotoxin. Biological

is new is the use of risk analysis as a framework is to view and respond to food safety problems in a systematic, structured and scientific way, in order to enhance decision-making throughout the food chain.

hazards from pathogenic strains of bacteria, viruses, helminths, protozoa, algae and certain toxic products they may produce is difficult to assess. Assessment of the risks associated with bacterial pathogens presents complications related to methods used to grow, process and store food. The Food Safety Authority may harness the expertise and resources from academic community and technology research institutes to address this issue.

9.2 Risk management

65. Risk management is the process of weighing policy alternatives in the light of the results of risk assessment and, if required, selecting and implementing appropriate control options including regulatory measures. Goal of the risk management process is to substantiate the estimated risk, to compare the costs of reducing the risk to the benefits gained and to carry out the political and institutional process of reducing such risks.
66. Risk management process has four components: i) Preliminary risk management activities; It includes the establishment of a risk profile to facilitate consideration of the issue within a particular context. It provides as much information as possible to guide further action; ii) Evaluation of risk management options is the weighing of available options for managing a food safety issue in light of scientific information on risks. A cost-benefit analysis could be performed at this stage; iii) Implementation of the risk management decision with regulatory food safety measures, such as HACCP and choice of individual measures applied by the food industry; iv) Monitoring and review give an overview of food safety and consumer health. Where there is evidence that required public health goals are not being achieved, redesign of food safety measures will be needed.
67. The outcome of the risk management process is the development of standards, guidelines and other recommendations for food safety. Risk management decisions can be based on establishing safe handling procedures and practices, even at primary chain such as with pesticides, agro chemicals, veterinary drugs; food safety assurance controls during transport, storage and value-addition processing.
68. The Food Safety Authority should advocate the risk management standards and procedures to all the food chain implementers and as suits best enforce by regulations. It also should periodically evaluate the risk management procedures by monitoring the effectiveness of control measure and its impact on the risk to the exposed consumer population.

9.3 Risk communication

69. Risk communication is the third element of risk analysis. It is the interactive process of exchange of information and opinion among individuals, groups and institutions. Risk communication has positive outcomes. It exposes responsible actions followed by all involved at all stages in the food chain. Consumers will be aware of and would understand food safety control measures advocated by the Food Safety Authority. Risk communication provides the private and public sectors with the necessary information for preventing, reducing or minimizing food risks by mandatory or voluntary means. Proposed Food Safety Authority is thus best institution for dissemination of reliable risk information, and its mandate should have a dedicated administrative division for this activity.

10.0 Principle 4: Reliable Traceability System

70. A reliable traceability[52] system covering relevant stages of production, processing and distribution of food and feed products should be put in place in all sectors of food chain, as advised, guided and enforced by the proposed Food Safety Authority. The traceability system should be able to identify at any relevant stage of the food chain (from production to distribution) from where the food originated (one step back concept) and to where the food went (one step forward concept).
71. Traceability enables corrective actions (such as a product recall) to be implemented quickly and effectively when something goes wrong. When a potential food safety problem is identified, whether by a food business or a government agency, an effective traceability system can help isolate and prevent contaminated products from reaching consumers.
72. In Sri Lanka, ensuring traceability and standards compatibility is necessary more than ever due to increased fragmentation and complexity across multiple food producing enterprises. The unpredictability of supply and perishable nature of food has heightened the need for traceability, particularly when products are found to be unsafe.

11.0 Additional Food Safety Enhancing Strategies

73. In order to make above presented food safety modernization recommendations more productive, five additional food safety enhancing strategies are proposed. They are:
    i. Contamination Based Regulatory Programmes (4 programmes)

[52] The International Organization for Standardization defines traceability as: "ability to follow the movement of a feed or food through specified stage(s) of production, processing and distribution".

ii. An Integrated National Food Safety Surveillance System, and
iii. Food Safety Technology Dissemination under ASMP

12.0 Contamination Based Regulatory Programmes:

74. A strong policy backing alone has no consequences, unless a strong logistical arrangement is in force to implement its clauses. An across-the-board logistical arrangement is undependable as all hazards in the food chain are not the same and cannot be tackled with equal aggression. Certain crucial hazard points need special overarching 'plans-of-attack' based on severity of consequences of the hazard and complexity of their path of entry to the food chain. This research proposes three such areas needing special attention and effort; termed as: *'Contamination Based Regulatory Programmes'* (CBRP). The four CBRPs recommended are:
    i. Restraining Import of Aflatoxin Contaminated Food,
    ii. Restraining Import of Pesticide Contaminated Food, and
    iii. Restraining Misuse of Agrochemicals in Primary Food Production Chain.
    iv. Initiating a widespread program to encourage use of Biopesticides

75. The first two programmes are tied up with processed[53] food imports and the third and fourth are on local primary food production. Only their basic concept is presented below, leaving the food safety authority to develop the plans of attack.

13.0 Case for a Imported Food Safety Policy

76. Accomplishing the safety of food imported to Sri Lanka either as processed food or as food ingredients is challenging. Over time, volume of food imported had increased, food production techniques in exporting countries had advanced and food has become intentionally or unintentionally tainted. Relying on traditional approach of random product inspection at borders, by the food control administrative unit of MOH and Sri Lanka Customs may no longer be effective (Rajapakse 2018).
77. To effectively control the trans-border entry of unsafe food or fraudulent food, all countries need to develop an *Imported Food Safety Policy*, either as a stand-alone policy or as part of a broad based National Food Safety Policy. This report recommends that a well

[53] Food processing is the transformation of agricultural produce into food, or of one form of food into other forms.

composited Imported Food Safety Policy should be incorporated as a vital Chapter in the Sri Lanka National Food Safety Policy. It should be consistent with Codex guidance; 'the objectives of imported food controls should be to protect the health of consumers and facilitate fair practices in food trade while avoiding unjustified technical barriers to trade'.

13.1 CBRP for Restraining Import of Aflatoxin Contaminated Food

78. Time and again, Sri Lankan news media highlights how large quantities of aflatoxin tainted imported food sneaks through the system to the domestic market *(in Sept. 2019, 200 MT of aflatoxin contaminated dried chillies imported from India by 16 importers entered the market,* as disclosed by hirunews, 30-09-2019 *).* Aflatoxins B1, G1, B2 and G2 are the major types found in food, animal feed and spices. Aflatoxins B1 has been categorized as Class 1 human carcinogen. Sri Lanka need to be concerned of possible aflatoxin contaminated imports of dried chillies, peanuts, maize (for animal feed) and chillie based products[54]. Detecting and law enforcing for aflotoxin in imported food is a difficult operation due to problematic sampling and need of specialized laboratories[55], and know-how of law enforcers. Thus the food safety authority should develop a comprehensive 'CBRP for Restraining Import of Aflatoxin Contaminated Food' with collaboration from all concerned stakeholders, including the food and nutrition specialists. This programme should be vigorously implemented by FSA with logistics and skill of participatory agencies.

13.2 CBRP for Restraining Import of Pesticide Contaminated Food

79. The second recommended CBRP is to tackle the suspicion that imported food could be tainted with pesticides. The possible tainted food could be dried food such as pulses (red lentils, green gram, chick pea,), fresh fruits (apples, oranges, grapes) dried spices (chillies, chilli based products) and grains (rice). This category of food is problematic as their point of origin change over the year due to seasonality. Also in case of pulses, authentic evidences for contamination of imported food are scanty, due to inattention of research. However as pulse cultivation needs heavy spraying of pesticides to minimize pod borer damage, it can be tacitly assumed that they could be contaminated. There also exists the possibility of food contaminated with chemicals banned in Sri Lanka, but not in other countries. In Nov. 2018, MOA alerted DOA on suspected monocrotophos residues in dried chillies imported from

[54] Other locally produced foods are coconut oil, rice, desiccated coconut, black pepper
[55] Laboratories of Industrial Technology Institute, for example, has the HPLC method facility.

India (Sri Lanka Mirror, Nov. 21, 2018). In 2018, tests carried out by the Government Analyst's Department confirmed presence of Chlorpyrifos in 50 percent of samples of oranges, apples and grapes collected from various local markets and supermarkets. About 30 percent of grape samples had residues of Profenofos. Both are banned chemicals(Daily News e-paper; March3, 2018). It is assumed that they were probably smuggled goods to the country.

80. The most restricting factor for both aflatoxin and pesticide contamination control[56] is the lack of Sri Lankan MRLs to initiate prosecutions. In this respect there is 'information asymmetry'[57], where exporters can produce and supply unsafe products compromising the health and safety of consumers in importing countries. In the absence of Sri Lankan MRLs, the information asymmetry is real which could pave way for unsafe levels of aflatoxin/pesticide/chemical residue in imported food.

13.3 CBRP for Restraining Misuse of Agrochemicals in Primary Food Chain

81. Farmers in Sri Lanka use pesticides in excess and non-adhere to pre-harvest intervals as amply documented in literature. For very pest susceptible crops, application of pesticides commence even before the appearance of symptoms; as a preemptive measure. Frequent rounds of spraying of potent chemicals as well as mixing different types as pesticide cocktails escalate the toxicity of the application and the safety of primary food. Often social personalities of the farmer, influence of farmer peer groups, advice of pesticide trader, visual quality demand from produce collector and other external controls decides this situation. This has led to varying amounts of pesticide residues in fresh food or primary food. The role and involvement of several decisive elements listed above had made disciplining of pesticide usage arena extremely complex. Field extension personnel prescribing pesticides cannot prosecute his clients for pesticide misuse. The farmer-pesticide dealer bond and farmer-produce collector bond are based on mutual survival and economic gains, hence cannot be broken by mildly addressing policy or programme. The GAP principle in current Sri Lanka context, has no economic gain to farmers, hence its Codex defined GAP principle on use of pesticides is ineffective. Besides, GAP cannot cover the entire farmer community. What is needed for 'Restraining Misuse of Agrochemicals in Primary Food Production Chain, is muscle, a strong overarching

[56] To a lesser extent also applicable to foods contaminated with radioactive materials
[57] In the presence of information asymmetry one set of agents to an economic transaction possess an informational advantage over others.

answerable programme operated by the FSA. As this CBRP is different from previous two due to the conflict of prescriber and prosecutor, FSA should design and operate on its own, an effective programme addressing farmer-collector-trader as an economic entity. A pesticide residue surveillance programme in all districts also may be considered.

13.4 CBRP for Initiating a widespread program to encourage use of Biopesticides

82. Biopesticides are crop protection agents based on living micro-organisms or natural products. They are of several types; bacterial, insect pathogenic fungi, specialized viruses, botanicals,[58] and semiochemicals.[59] Biopesticides are a tiny segment of the pesticide market for now – but their use is projected to grow in future. Globally, biopesticides amount to only 4.5 percent of the total pesticides produced; 6 percent of the USA pesticide market and 3 percent of the Indian pesticide market. Neem based, Bacillus based, nuclear polyhedrosis virus (NPV) based and Trichoderma based are the major biopesticides produced and used in India.
83. Biopesticides have own downsides as well. They can be expensive compared to synthetic pesticides, does not work quickly, needs more frequent applications, sensitive to environmental conditions, including relative humidity and temperature and exposure to UV radiation, difficult to convince farmers.
84. In Sri Lanka, (Galanihe, 2013) all pesticide products used in the country are required to be registered under the Control of Pesticide Act. Biopesticides, including botanicals are also regulated under the Act. However, the locally produced botanical extracts (without adjuvants and formulation types) are exempted from registration and hence do not carry a label approved by the pesticides regulatory authority. If a local producer needs to get a registration for bio-pesticide, the production procedure and the product are required to meet the criteria for registration of other pesticides. Importation and registration of bio-pesticides with bio control agents and microorganisms manufactured elsewhere will not be granted registration until rules and regulations are in place.
85. Current bio pesticides available in Sri Lanka are mainly the neem based products in various forms. Additionally Azotobacter and Pseudomonas in liquid formulation, Pseudomonas

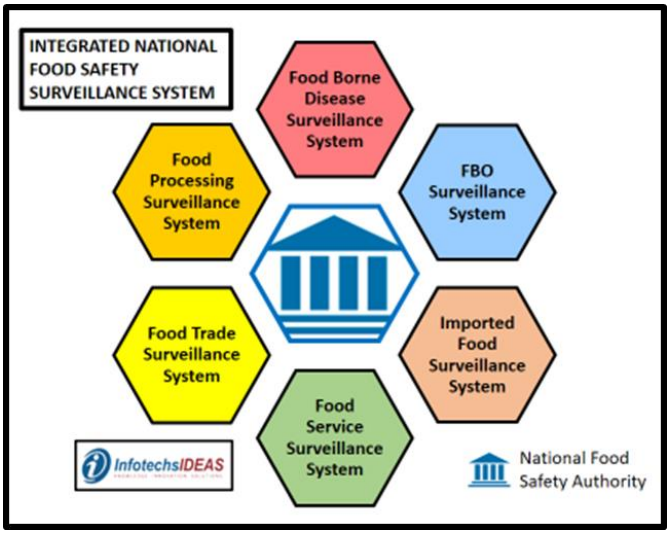
[58] Neem based products are the most widely used
[59] Semiochemicals are chemical compounds produced by an organism which induce a behavioral change in organisms of the same species or a different species. The most widely used semiochemicals are insect sex pheromones

baits, Trichoderma viridae formulations, and pheromone formulations has been introduced to the market, but their continuity and quantity are unknown.

86. The research situation analysis abundantly revealed the locked-in state of commercial food agriculture with toxic agrochemicals that could lead to chemical food safety hazards. A CBRP on advocating and encouraging use of biopesticides at least for vegetables of short interval harvesting, in order to eliminate the heavy chemical pesticide spraying, encouraging manufacture and convenient regulation of biopesticides, among other things is strongly recommended. A CBRP of this magnitude needs complex logistical arrangements and extensive planning, The FSA is the most suitable institution for such a broad based national programme.

13.5 Integrated National Food Safety Surveillance System

87. The research proposes establishing an 'Integrated National Food Safety Surveillance System', as a holistic vigilance system which can simultaneously integrate situation analyses of six key food safety areas. It would be a national surveillance blanket, which needs a powerful single entity to cohere activities of all areas of the system. The proposed Food Safety Authority is the befitting entity to blueprint the system, acquire needed resources and logistics and to execute as a major constituent of the NFCS.
88. The perceived six surveillance areas are illustrated. Much work has to be done (by Food Safety Authority) to work out the concept to a singularly integrated implementable framework. In the current context all six areas intermittently get surveyed, but within the area insufficient coverage. The most noteworthy lapse is the non-surveillance of the primary produce segment in the agro-food chain, which should come under FBO area of surveillance. Likewise the quarantine surveillance for the imported goods does not include the food safety hazards, unless specifically requested. Market surveillance system is on visible spoilage and not linked to their biological toxins.



89. The proposed integrated surveillance system will upgrade requirements

and performance in all six areas under the singular direction of the authority to come up with a blanket coverage of underperformances in total food safety spectrum.

13.6 Food Safety Technology Dissemination under ASMP

90. The situation analysis presented in this research report amply demonstrated that food safety hazards take place starting from the primary food production chain. This has been documented in reviewed academic literature as well as in the peripheral level stakeholder discussions and farmer group interviews conducted by the research team. This situation is closely similar in most Asian and African countries. Yet as highlighted in the report, the primary food chain is currently not in the food control system. The critical importance of controlling food hazards in the primary food chain is emphasized in this report (in other literature as well) through the recommended farm-to-fork strategy together with a food authority to implement it. Nevertheless, any modifications to legislation, administration and logistics take their own path of resistance, before being implemented. The good intention is lapsed by several years.
91. The analysis and recommendations of this report are on a broader perspective. However considering the specifics, in agriculture sector the endeavor to modernize agriculture by MOA need not wait till the legislation and administration are in place. MOA should act immediately and on a continuous perusing manner to influence the primary chain towards safe food production. This research detailed that among possible contaminants and contamination paths in primary chain, misuse of pesticides is the most noticeable. The misuse comprise several aspects; high frequency application, high single and total dosage, unsuitable chemical of choice, most toxic chemical first, cocktailing chemicals, panic application, non-symptomatic application, non-adherence to pre-harvest intervals; among others. Likewise several peripheral dynamics influence the misuse; peer pressure, collector pressure for quality, own adamantine on self-knowledge, and more gravely the two-way dependence on chemical dealers; asking for chemical advice in good intention and getting hazardous recommendations.
92. In such a context, enhancing food safety at primary level needs a mechanism for attitude change of farmers and chemical dealers. As other country experiences show, the pathways in agricultural extension for such an achievement are limited. The most difficult aspire would be the rectifying and regulating the chemical dealer segment as it is nearly impossible to bring them for any instructional programme.

93. This research recommends that MOA should embark on two pronged pathway to tackle the pesticide misuse problem at farmer level to improve primary food safety, as a contained (by the MOA, vs. national) food safety policy. They may name a programme as 'Strengthening capacity of farmers and agrochemical dealers for proper use of agrochemicals for food safety at primary production value chain'. The two pathways available are the *Farmer Field Schools* (FFS) and *Plant Health Clinics*. The FFS has a wider farming knowledge enhancement and attitude change ability (FAO 2010). It is most effective as it is performed in community groups. Since it is an organized activity for farmers, large numbers attend. The agenda could include food safety at primary level and all determinants of pesticide misuse. The plant health clinics are specific to chemical advice when there are pests and diseases. It is not strong to change the attitudes en masse as few people come voluntarily. Still it can give more focused advice on chemical misuse and attend to individual attentions. Both pathways are necessary to improve the food safety situation at primary food processing level targeting the farmers. The lessening of knowledge gaps, building of confidence on scientific approaches, in the community through these programmes would filter into the chemical dealer segment eventually. They would be bent to advise farmers on acceptable chemicals and proper ways of applications.

14.0 Impact of National Food Control System on Environmental Sustainability

94. The proposed national food control system (NFCS) has specific objectives as described in a preceding section. However, national food control systems do have beneficial spillovers, such as trade, industry and economic spillovers which are tangible as well as perceptible beneficial spillovers such as its impact on sustainability of the environment (ES). Following discourse on impact of NFCS on ES is an extension to main theme of the research[60].
95. Environmental Sustainability is defined as the responsible interaction with the environment avoiding its depletion or degradation. It is the concern, whether environmental resources (soil, water, air, biodiversity) are managed satisfactorily for future generations, while undertaking the national food production. Though concerns of ES are mostly global[61], this discussion is location-specific, explicitly on benefits to local ES from the proposed NFCS.
96. The food control system recommended in this report has several key principles, which have beneficial impact on the ES. Among them, the principles of: 'Farm to table' approach, Risk Analysis Framework with GMP, HACCP, and two of the CBRPs: restraining import of

[60] As required by the research TOR
[61] Such as greenhouse gases, climate change, non-renewable energy

food tainted with pesticide residues, and restraining misuse of agrochemicals in primary food production chain, are beneficial to ES. The activities of the NPQS also has safeguarding impact on the local biodiversity.

97. The farm-to-table principle refers to safety built into food chain from point of food production through consumption as a continuum. For this reason, it includes mitigation of all hazards in the primary food production[62] segment, followed by mitigation of all hazards in collecting to marketing segment[63]. Likewise it also includes all activities in industrial processing of primary produce to a value added product in the processing segment.
98. One of the mitigations expected to be enforced by the Food safety authority would be compulsory adherences to responsible usage of pesticides, fertilizers and GAP principles[64]. Usage of agrochemicals in the approved and responsible manner would benefit the ES remarkably by negating detrimental effects of misuse of pesticides on water, soil and air. The detrimental effects negated on water are the surface and ground water contaminations. Surface water gets contaminated through runoffs from pesticide treated farms and ground water contaminates with pesticides and their transformation products (TP). Once ground water is polluted with toxic chemicals, it may take many years for the contamination to dissipate. Soil contamination is more hazardous from TPs. The pesticides and their TPs are retained by soils if the organic matter content is large. Many farms in upcountry zone and Jaffna zone are rich in organic matter and prone to this hazard. Soil contamination cause populations of beneficial soil microorganisms to decline, such as the earthworms, nitrogen-fixing bacteria and nutrient uptake aiding mycorrhizal fungi. Misuse, improper discarding and volatilizing of sprays harm non-targeted organisms such as beneficial insects, non-targeted plants fish, algae, birds and other wild life.
99. Another important approach the food safety authority would implement is encouraging or enforcing GAP in agriculture. The principle of GAP is essentially sustainable agriculture, and in doing so strictly control the excessive use of pesticides and fertilizers. Thus GAP effectually enhance the ES as well, by mitigating negative impacts excessive pesticides (as detailed above) and fertilizers. When fertilizers enter surface water, they stimulate growth of aquatic plants, algae and some microbes. Their unbalanced enhanced growth reduces the dissolved oxygen in water leading to suffocation of fish and other aquatic species. The resulting putrefying fish and other aquatic species severely degrade the water quality and

[62] Use/misuse of fertilizer, agro chemicals, disposal of agro chemical containers to the environment in extensive open field, intensive open field, and controlled environment manners of cultivation
[63] collecting, transporting, bulk breaking, warehousing, retail storing and the marketing
[64] Even without GAP certificate

cause unpleasant odors. Thus through GAP, the NFCS prevents the degradation of ES in water bodies from irresponsible use of fertilizers. Additionally the indiscriminate application of large amounts of chemical fertilizers may result in increase of heavy metals in soil, particularly cadmium, lead and arsenic. Phosphate fertilizer carry as trace constituents; cadmium and arsenic, and farm manure may contain arsenic. NFCS and GAP would rationalize use of fertilizers.

100. With the enforcement of rationalization of pesticide use and GAP, invariably a pesticide waste governance scheme will come into effect. Currently farmers dispose empty containers in ways convenient to them, such as; releasing leftover sprays and application rinses near or into irrigation canals and streams, burning empty containers in open fire, throwing in to common waste places irrigation canals and streams or burying in a wasteland. The foreseen pesticide waste governance scheme prohibiting and preventing such misuses would avert all the environmental hazards associated with it.

101. In the food processing segment, the food safety authority would recommend that most food processing operations should follow GMP and HACCP to process food safely. Though HACCP is built on standard principles, it is flexible to include any other principle. The food safety authority may impose environmental friendly production and waste disposal as an additional principle, which has been suggested as Green HACCP (Zarid 2019). It combines food safety controls with good practices for environmental protection, to have a safe food production that respects the environment. Due to the highly diversified nature of the food industry, various food processing, handling and packaging operations create wastes of different quality and quantity, which, if not treated, could lead to increasing disposal problems and severe environmental pollution problems. There are also waste by-products and effluents from the food processing industry and their impact on the environment if let free could be harmful. Additionally, they represent a loss of valuable biomass that may be recovered by appropriate methods and technologies for reutilization. Thus a properly focused and advocated food control strategy in the processing sector that will be enforced by the FSA would enhance the environment sustainability.

102. Though NPQS has no significant role in food safety maintenance; being limited to biosafety of imported planting materials, yet it plays an important role in preventing entry of noxious weeds, agricultural pests and organisms, some of which could be alien to this country. If such harmful organisms enter the domestic biosphere, their eradication would need unwarranted use of chemicals harming the environment. Thus their role contributes positively towards ES.

15.0 Cost effectiveness of food safety strategies

103. Economic analyses of food safety strategies are highly arduous academic exercises. They depend on the focus of the researcher on what strategies he wishes to analyze, whether at macro level with aggregated costs and benefits to the economy, food chain level, specific principles level such as HACCP and for what products producing or processing. Thus it is an integrated complexity. Such exercises are exclusive academic topics and way tangent from the objective of this research, hence not endeavored. However, a brief examination of issues in undertaking such exercises, are listed below for comprehension[65].

104. Costs and benefits are two dimensions for the economic evaluation of food safety systems. Assessing costs of the food safety strategies and assessing accrued benefits from them is complicated and unyielding, paving way for many approximations as an alternative. Costs and benefits include not only elements that could be directly attributed to the food safety system (direct costs and benefits), but also elements where the relationship is not exclusive (indirect costs and benefits). Furthermore, costs and benefits could involve monetary elements, quantifiable non-monetary elements and non- quantifiable non-monetary elements (qualitative elements), making the system analysis ever more challenging. Benefits, in particular, could be mostly non-monetary and qualitative elements. This is one of the reasons why common approaches for the estimation of costs and those for the estimation of benefits differ.

105. In this situation, methods for the comparison of costs and benefits could be distinguished according to the consideration of benefits in terms of monetary values (*cost-benefit analysis*), a single indicator (*cost-effectiveness analysis*) or an integrated utility criteria (*cost-utility analysis*). Cost-benefit analysis requires monetary values for both costs and benefits. The results might be presented as a benefit-cost ratio. Cost -effectiveness analysis sets monetary costs in relation to physical benefits, in a variety of ways.

106. UNIDO has completed an extensive socio-economic costs and benefits analysis of food safety reforms in Sri Lanka (Goulding 2020). It is a macro economic analysis, considering expected reduction in the loss of income associated with reduced morbidity and mortality due to foodborne diseases, value of enhanced trade and the costs falling on the state and on food business operators (FBOs). The model focuses exclusively on the additional costs and benefits estimates derived from investments in food safety by government and FBOs for a 10-year period. The results, among others, reveal a healthy Benefit-Cost ratio of 2.6 and a

[65] As this topic is mentioned in the TOR

Return on Investment of 184 percent. The analysis "provides a clear economic rationale for investment in the national food safety system and it is therefore recommended to proceed with the reform process and establish a National Food Safety Authority as the means of delivering the benefits"

16.0 Implementation of Research Recommendations

107. The plausible follow-up step to the research is to implement its recommendations, subject to scrutiny and amendments by a panel of experts and legislators. Such panel deliberations should result in sequencing the implementing components, activities and the time frame for universal implementation. This is beyond the scope of the research. Sequencing the activities and time framing need to be attended at the time of implementation of the recommendations, by those who are assigned to the responsibility.

108. It should be emphasized that the procedure recommended for Modernization of Food Safety Assurance System in Sri Lanka is perceived as a 'cascading system'; commencing from i) instituting a National Food Safety Policy, which should trigger the next important step; ii) the establishment of the Food Safety Authority, which would then trigger; iii) all forms of regulations, strategies, mandating the institutions, reviewing procedures etc.. Thus the research recommendations are not a set of patches to the existing food safety system, but an entirely different modification. The initiation of the cascading system to adopt the recommendations, can be briefly described as follows.

109. Since the farm to fork principle recommended runs across the total food spectrum, a multidisciplinary team is needed to draft the national food safety policy. Recalling the situation analysis of the research, it has already conducted a multidisciplinary team situation analysis at apex level. The WHO (2012) indorses that multidisciplinary team(s) consulted during the situation analysis could be convened to draft the national food safety policy. Technical committees or smaller working groups may assist them.

110. The succeeding step would be further consultations from relevant government ministries, departments, institutions, academia, consumers etc. for supplementary inputs to the draft policy and expression of concerns. The supplemented draft is then ratified by the state legal draftsman. The final step is for the policy is to obtain formal approval from the government.

111. Following endorsement of the national food safety policy, the second and third stages of the cascade is instituting the food safety authority and enacting a new food control Act and regulations. The policy would identify a ministry to implement the recommendations.

112. The plausible chain of events for implementation of research recommendations is illustrated below, as a five stage paradigm.

Work plan to adopt The Research Recommendations as a National Policy by the Executive and as Laws of the State by the Legislature		
Stages of work plan	Procedure	Explanations
Stage 1	Instituting a National Food Control Policy	This is the starting point of research recommendations
	1. Task Force: An independent Ministerial office (say President's office or Prime Minister's office) appoint a Task Force (TF) for Modernization of Food Safety Assurance System in Sri Lanka, based on / guided by the recommendations of the research report.	As suggested in the report, when entirely new policy is enacted, its design stage should be unbiased
	2. Multidisciplinary drafting: TF mobilizes multidisciplinary drafting teams to draft the recommended National Food Safety Policy. Technical committees or smaller working groups are formed to assist the multidisciplinary teams	Multidisciplinary teams consulted during the situation analysis can be a starting point, to mobilize
	3. Green Papers: TF prepares several Green Papers on the proposing draft policy. They are circulated widely for additional consultations.	For each food sub sector, ministries, departments, institutions, academia, consumers may be consulted.
	4. White Paper: TF and legal arm of the government prepares the White Paper on the proposed policy, based on revised, updated Green Papers.	1. The White Paper is a statement of intent and a detailed policy plan. Its scope is given in research recommendations. 2. White Paper among other things, will also designate a Ministry, (say 'A'), that will be accountable for policy implementation. 3. Policy will also endorse instituting a National Food Safety Authority.
	5. Endorsement: The White Paper is approved by Cabinet and debated in the parliament for adoption. The National Food Safety Policy, becomes an endorsed national policy of the state.	

Stage 2	Instituting Laws to implement the policy	Policy is an endorsed statement of objectives and procedures. To achieve it, Laws are required
	1. Draft Bill: Ministry 'A' to which the policy has bestowed the responsibility to implement the national food control system, will prepare a draft Bill to table in parliament on establishing a Food Safety Authority	Research has very strongly recommended the FSA, to implement the policy. Report details, the vision, scope, structure of the FSA.
	2. Legal Approval: Draft Bill goes to the relevant Cabinet sub-committee for review and for public comments. Revised Bill is sent to the State legal advisors for legal approval	
	3. An Act: Draft Bill is presented by the Minister 'A" in Parliament, and in due course approved. The Bill becomes the Law on National Food Control System enforced by Food Safety Authority of Sri Lanka	

Stage 3	Establishing the Food Safety Authority	As detailed in research report, FSA is the apex body to attend to all aspects of food control system
	1. Establishing FSA: Ministry 'A' would establish the FSA, as provided by the Act under the National Food Safety Policy	
	2. Logistics for FSA: Ministry 'A' would channel state funds from Treasury, recruit staff for functioning of FSA	
Stage 4	Implementing Food Control Strategies	
	1. Food Control Regulations: FSA would institute relevant technical committees and draft required Regulations to implement the Modernization of Food Safety Assurance System in Sri Lanka, based on enabling provisions of the Act, guided by the recommendations of the research report.	
Stage 5	Subordinating legislation	
	1. Provincial legislation: It is up to national and provincial ministries and departments to implement the law and/or policy, as directed by the FSA.	If necessary provincial legislatures can pass subordinate legislation to complement the national law

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