Biosecurity Status of Food and Agriculture in Nepal

Food and Agriculture Organization of the United Nations

In collaboration with
Ministry of Agricultural Development
Government of Nepal

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KRISHNA PRASAD PANT, SHASHI SAREEN AND RAMESH P. SHARMA (EDITORS)

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25 November 2014

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This report is compiled under the overall technical guidance and supervision of Ms. Shashi Sareen, Senior Food Safety and Nutrition Officer and Lead Technical Officer of the project, FAO RAP, Thailand. The contribution of Ms. Yabuki Nanae, Policy Officer, FAO RAP in the cost of compliance study is duly acknowledged. Help of Dr. Ramesh P. Sharma, former Senior Economist, FAO in editing the papers is highly appreciated. Dr. Binod Saha, Assistant FAO Representative (programme) and Ms. Sonam Dhakhwa-Genpo, Assistant FAOR (administration), provided encouragement and full support to project implementation and their assistance is very much acknowledged. Likewise, FAO Programme Officers Mr. Arjun Singh Thapa and Mr. Shrawan Adhikary helped in many different ways in completing this work. Support of all staffs in FAO Nepal office is also duly acknowledged. Hard work of Dr. Krishna Prasad Pant, Lead Consultant, in leading the study team, compiling the papers and editing them to this form is appreciated.

I hope this report will be useful to government agencies, development partners and researchers who are interested to work in the area of biosecurity in Nepal.

Dr. Somsak Pipoppinyo
FAO Representative in Nepal

FOREWORD

Government of Nepal
Ministry of Agricultural Development

4211639
4211808
4211932
4211665
4211687
4211915
4211940
Fax: 4211935

Ref.:

Singha Durbar,
Kathmandu, Nepal.

I am glad to write few words about the report "Biosecurity Status of Food and Agriculture in Nepal" produced from over half a dozen studies conducted under the Technical Cooperation Project "*Policy assistance for biosecure agro-food supply chain for enhanced market access and food security for the small holding rural sector*" supported by Food and Agriculture Organization of the United Nations.

This report has assessed the status of biosecurity in Nepal and identified ways for solving the problems through an integrated approach. This report has developed a commendable knowledge base in the areas of biosecurity. The recommendations and knowledge base of this report will guide Ministry of Agricultural Development and departments under it in formulating suitable policies, plans and programmes for achieving biosecurity in the country. Other ministries particularly Ministry of Forest and Soil Conservation, Ministry of Health and Population, Ministry of Commerce and Supply and Ministry of Science, Technology and Environment can also benefit from this status report. The implementation will be instrumental for producing safe food in the country, protecting public health and increasing export of agricultural products to high income countries in the world. This complements to the Outcome 4 (Increased Competitiveness) of Agricultural Development Strategy (ADS).

I would highly appreciate development partners and well-wishers to Nepal coming forward and helping us in implementing the recommendations of this report and contributing to biosecurity in this country.

I fully appreciate the support of Food and Agriculture Organization of the United Nations for supporting Nepal as usual to assess the status of biosecurity. I appreciate the hard work done by the study team and editors.

Jaya M Khanal
Secretary
Ministry of Agricultural Development
Singha Durbar, Kathmandu, Nepal

EXECUTIVE SUMMARY

Problems: Nepal has been making efforts to improve food safety and quality, control diseases and pests, chemical pesticides, quality of medicines (including veterinary medicines), strengthen quarantine capacity and manage genetically modified organisms. About a dozen policies, over two dozens of legal acts and government eight departments are directly or indirectly geared towards these efforts. However, the efforts are found scattered with many gaps and overlaps. In the meantime, the country suffers from health risks emanating from food products, leading to public health problems, limited ability to meet sanitary and phytosanitary requirements for agricultural exports, and increased food import dependency, notably in the high income segments which includes the tourism sector. These problems are also responsible for the weak linkages of the smallholder production to high income food markets, thus compromising their livelihood.

Tool: Biosecurity is a strategic and integrated approach to analyzing and managing relevant risks to human, animal and plant life and health, and associated risks to environment, based on the recognition of critical linkages among them. Biosecurity brings together policy and regulatory frameworks for risk management across the sectors of food safety, animal health and plant health to manage risks collectively. Biosecurity comprises of a set of measures designed to protect agriculture, the environment and people from exotic or emerging pests and pathogens, pesticide and antibiotic residues and genetically modified organisms. The measures are applicable at the national, regional and individual firm or farm levels.

Contents of the report: This report presents the findings of seven studies that assessed biosecurity status in Nepal which were conducted under a technical assistance project, "Policy assistance for biosecure agro-food supply chain for enhanced market access and food security for the smallholding rural sector (TCP/NEP/3402)", supported by the Food and Agriculture Organization of the United Nations. After presenting a synthesis in Chapter I, Chapter II scans biosecurity related policies, legislations and institutions in Nepal. The subsequent five Chapters present major findings on the biosecurity status in crops and high value crops, livestock and poultry, fisheries, food products of forest origin and food supply chain in that order. Chapter VIII finally reports on some estimates of costs of compliance of small farms to biosecurity.

Major Findings: Policies, legislations and institutions relating to biosecurity are scattered and not effective enough at minimising the risks of many natural and anthropogenic hazards to different stages of the agro-food supply chain. Major natural hazards include diseases and pests in crops, forests, livestock, poultry, fisheries, many of which can transmit to humans also. Some common examples of natural biosecurity hazards are poisonous mushrooms, grayanotoxin contaminated wild honey and mycotoxins in food and feed. Risks from anthropogenic hazards are still higher. Such hazards range from well known high residues of pesticides and veterinary drugs in food products, use of unsafe ripening agents, colouring materials, adulterants, preservatives and polluted water. Compliance to biosecurity increases the costs of production. Estimates in this study showed, for example, that such costs amounted to be 26%, 38% and 30% higher farm gate price for ginger, tomato and milk, respectively than the present price. The issue is how public policy can be used to create an environment whereby producers are able to recover the extra cost from the market by selling safer and quality products.

Conclusions and recommendations: Nepal's agriculture needs to be biosecure for improving and sustaining human health and life, animal and plant health, overall environment, as well as for exports of agricultural goods and tourism services. Nepal has no choice but to work hard towards for biosecure agriculture. Towards this goal, a number

of suggestions are made in various chapters in this volume. The major recommendations are summarized here.

1. Nepal needs to formulate a national biosecurity policy and a biosecurity act in order to effectively respond to emerging biosecurity challenges.
2. Nepal should consider formulating essential standards for biosecurity through a NepalGAP for certification, labelling and traceability. This should drive and sustain the market-driven model of agricultural transformation that the government is seeking to promote. This is also the core thrust of the Agricultural Development Strategy that will be the main policy framework for Nepal's agriculture in the years to come.
3. Making biosecurity standards incentive compatible helps in their adoption. For this purpose, returns to producers can be raised through linking their safe products to high income markets including export markets, and costs of compliance can be reduced through investment in infrastructure and technology.
4. A robust and multidisciplinary research and analysis programme is essential on key components of biosecurity such as the governance (policy, legislations and institutions), role and strengths of public and private biosecurity service providers, risks of existing and new hazards, their probable impacts and risks and exposure pathways, the economics of the adoption by private actors of the biosecurity measures, and the role of public support including targeted subsidies.
5. Emergency preparedness and response planning are necessary for biosecurity. This requires collection, sharing and analysis of information on biosecurity risks at every stage of the agro-food supply chain from input supply, production to final consumption. The response also includes control and eradication of animal and plant pests and diseases and assurance of food safety. It should include the establishment of a coordination mechanism through a multi-agency coordination group or other similar means. Other aspects include surveillance of food borne diseases, laboratory analysis of food samples, and developing mitigation strategies for early detection, prevention and control.
6. A risk analysis system needs to be installed for quarantine, food quality control and pesticide control on imports. It is also needed for domestic decision making on use of pesticides, hormones, antibiotics, other veterinary drugs, food additives, contaminants and food production and processing technology, for example.
7. Awareness creation is crucial among the farmers and other agro-food supply chain actors. Farmers and private sector actors need awareness in a number of areas - safe production technology, safe harvesting techniques, safe collection points, importance of clean water for washing and cleaning, suitable packaging materials, ice facility and cold chain for perishable products, suitable transport vehicles, and sanitation in retailing. In addition, consumers need information on safe storage and cooking practices and understanding labels for appropriate consumption of safe food.
8. Technological and other supports are also necessary during the initial stages. The type of supports can be different for smallholder farms and firms than for large commercial farmers and firms. The former need technology, physical inputs and quality control support whereas the latter are capable enough to adopt biosecurity measures on their own but require liability rules and supports such as certification.

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LIST OF CONTRIBUTORS

Bhim Nath Acharya, Freelance Consultant, Kathmandu. (bhimnath@gmail.com)

Narendra Chand, Under Secretary, Ministry of Forest and Soil Conservation, Kathmandu. (narendrachand@gmail.com)

Ganga Prasad Kharel, Professor, Tribhuvan Univesrity, Kathmandu. (gangapkharel@yahoo.com)

Rama Nanda Mishra, Programme Director, Fisheries Development Directorate, Balaju, Kathmandu. (aryanmishra017@gmail.com)

Krishna Prasad Pant, Lead Consultant, Agriculture Policy and Trade Expert, FAO Nepal. (kppant@yahoo.com)

Damodar Sedai, Deputy Director General, Department of Livestock Services, Harharbhawan. (dsedai56@gmail.com)

Shashi Sareen, Senior Food Safety & Nutrition Officer, FAO RAP, Bangkok and Lead Technical Officer of this Biosecurity project. (shashi.sareen@fao.org)

Ramesh Sharma, Economist, Kathmandu, formerly Senior Economist with FAO. (rsharma2556@gmail.com)

ABBREVIATIONS AND ACRONYMS

ACEPP	Agriculture Commodity Export Promotion Program
ADS	Agriculture Development Strategy
AGDP	Agricultural Gross Domestic Product
AICC	Agriculture Information and Communication Centre
ALOP	Appropriate Level of Protection
APP	Agriculture Perspective Plan
AQUAPLAN	Australia's national strategic plan for aquatic animal health
AQUAVETPLAN	Australian Aquatic Veterinary Emergency Plan
ARB	Antibiotic resistant bacteria
ASEAN	Association of South East Asian Nations
ATL	Aflatoxin Tolerance Limit
AV	Acid Value
BAP	Best Aquaculture Practices
BHC	Benzene Hexachloride
BPO	Business Process Outsourcing
BRC	British Retail Consortium
CBD	Convention on Biological Diversity
CBS	Central Bureau of Statistics
CCP	Critical control point
CCRF	Code of Conduct for Responsible Fisheries
CFL	Central Food Laboratory
CITES	International Convention on Trade in Endangered Species
CPCC	Control Points and Compliance Criteria
CTC	Cut-Tear-Curl (tea manufacture method)
FNCCI	Federation of Nepalese Chambers of Commerce and Industry
Codex	Codex Alimentarius Commission
DDA	Department of Drug Administration
DADO	District Agriculture Development Office
DDC	District Development Committees
DDT	Dichloro diphenyl trichloro ethane
DLS	Department of Livestock Services
DLSO	District Livestock Service Office
DFTQC	Department of Food Technology and Quality Control
DOA	Department of Agriculture
DOC	Department of Commerce
DoFD	Directorate of Fisheries Development
DOE	Department of Environment
DPR	Department of Plant Resources
EIA	Environmental Impact Assessment
EUS	Epizootic Ulcerative Syndrome
FAO	Food and Agriculture Organization of United Nations
FBI	Food Borne Illness
FDC	Fisheries Development Centres
F.F.A.	Free Fatty Acid test

FPFO	Food products of forest origin
FSB	Food Standardization Board
GAA	Global Aquaculture Alliance
GACP	Guidelines on Good Agricultural and Collection Practices
GAP	Good agricultural practices
GAqP	Good Aquaculture Practices
GATT	General Agreement on Tariff and Trade
GDP	Gross Domestic Product
GFP	Good Forest Practices
GHP	Good Handling Practices
GHHP	Good hygiene and handling practices
GMO	Genetically Modified Organism
GMP	Good Management Practices
GoN	Government of Nepal
GSP	Good Storage Practices
GVP	Good veterinary practices
HACCP	Hazard analysis and critical control point
HPAI	Highly pathogenic avian influenza
HYV	High value crops
IBT	Ice Bank Tank
IFOAM	International Federation of Organic Agriculture Movements
IEE	Initial Environmental Examination
IFA	Integrated Farm Assurance
ILAC	International Laboratory Accreditation Cooperation
IPM	Integrated Pest Management
IPNM	Integrated Plant Nutrient Management
IPPC	International Plant Protection Convention
IPPM	Integrated Production and Pest Management
ISO	International Organization for Standardisation
ISPM	International Standards for Phytosanitary Measures
IT	Information Technology
JT/JTA	Junior Technicians and Junior Technical Assistants
LMO	Living Modified Organisms
MAP	Medicinal and aromatic plant
MOAD	Ministry of Agricultural Development
MOCS	Ministry of Commerce and Supply
MOFSC	Ministry of Forest and Soil Conservation
MOHP	Ministry of Health and Population
MOSTE	Ministry of Science, Technology and Environment
MRL	Maximum Residual Limit
NABL	National Accreditation Board for Laboratories
NACA	Network of Aquaculture Centres in Asia and Pacific
NaOH	Sodium hydroxide
NAP	National Agriculture Policy
NARC	Nepal Agriculture Research Council
NARDF	National Agriculture Research and Development Centre
NBSM	Nepal Bureau of Standards and Metrology
NCS	National Council for Standards
NDDB	National Dairy Development Board
n.e.c.	Not elsewhere classified
NGO	Non-Government Organization

NPPO	National Plant Protection Organization
NPR	Nepalese rupees
NS	Nepal Standards
NTB	non-tariff barrier
NTFP	Non-timber forest product
NTIS	Nepal Trade Integration Strategy
NWFP	Non-Wood Forest Products
OIE	International Office of Epizootics
PGS	Participatory Guarantee System
ppm	Parts per million
PRA	Pest risk assessment
QMS	Quality Management System
RI	Refractive Index
R.M.V.	Reichert Meissel Value
SAARC	South Asian Association for Regional Cooperation
SARSO	South Asian Regional Standards Organization
SAWTEE	South Asian Watch on Trade, Economics and Environment
SNF	Solid Not Fat
SO2	Sulphur Dioxide
SOP	Standard Operating Procedures
SPS	Agreement on Application of Sanitary and Phytosanitary Measures
SQCC	Seed Quality Control Centre
TAHC	Terrestrial Animal Health Code
TB	Total benefit
TBT	Technical barriers to trade
TPC	Third Party Certification
TSS	Technical Support Services
UNEP	United Nations Environment Programme
VAHW	Village Animal Health Workers
VC	Vertical Coordination
VDC	Village Development Committees
WAHIS	World Aquatic Animal Health Information System
WHO	World Health Organization
WTO	World Trade Organization
WTP	Willingness to Pay
UNCTAD	United Nations Conference on Trade and Development

CHAPTER 01

STATUS OF BIOSECURITY IN NEPAL: POLICY PERSPECTIVE

Krishna Prasad Pant

Abstract

This chapter introduces the concept of biosecurity and synthesizes analyses and main findings of the other seven background studies in this volume. It presents in some detail the main sources of biosecurity threats under two categories, the natural and anthropogenic events, and summarizes assessments on national capacity for biosecurity governance in terms of technical standards, policy, legislation and institutions. A number of suggestions are summarized which include research and analytical needs, emergency preparedness and response, and the importance of articulating innovative schemes for encouraging the private actors in the food supply chain to adopt essential biosecure practices. It reiterates the main conclusion of the analyses in this volume that Nepal needs to formulate a national biosecurity policy in order to be able to effectively respond to emerging challenges in this area.

1.1 Introduction

With inadequate food safety and quality control systems in domestic production and trade, Nepal is suffering from public health problems from unsafe food, limited agricultural export due to deficient certification system and compromised livelihood of smallholder farmers due to weak linkages of their products to high income markets. Unsafe food production and handling systems particularly in periurban newly commercialised areas have raised food safety challenges in domestic markets. Tourism industry, so vital for Nepal's economy, also suffers from these weaknesses. Food catering services to the tourism industry heavily depend on imported foods but even the safety of these imported products is not assured due to inadequate capacity to assess the risks of entry of poor quality foods. At the same time, smallholder farmers are losing their share of the high income segment of the domestic markets due to stiff import competition. Environment too is at risk due to the entry and establishment of pests and invasive species. Thus, overall, a deficient biosecurity related control measures have put at risk human, animal and plant health and life.

Biosecurity is a strategic and integrated approach to analyzing and managing relevant risks to human, animal and plant life and health, and associated risks to environment, based on the recognition of critical linkages among them (FAO, 2007). Biosecurity brings together policy and regulatory frameworks for risk management across the sectors of food safety, animal health and plant health to manage biological risks in these three sectors while protecting the environment and contributing to its sustainable use (Manzella and Vapnek, 2007). It protects the economy, environment and human health from the entry, establishment and spread of exotic pests and diseases, and thus also helps domestic production and export. Thus, biosecurity comprises of a set of measures designed to protect agriculture, the environment and people from exotic or emerging pests and pathogens. The measures are applicable at the national, regional and individual firm or farm levels. Biosecurity covers food production in relation to food safety; the introduction of plant pests, animal pests and diseases and zoonoses; the introduction and release of genetically modified

organisms and their products; and the introduction and safe management of invasive alien species (Manzella and Vapnek, 2007).

In the WTO rules, although biosecurity is not explicitly mentioned, biosecurity-related concerns are addressed in several agreements. Thus, Article XX(b) of the General Agreement on Tariff and Trade (GATT) allows members to take unilateral action on trade and adopt the necessary measures in order to protect human, animal or plant life or health, provided they are not discriminatory or used as disguised protectionism. The elaboration of this provision is one of the objectives of the Agreement on Application of Sanitary and Phytosanitary Measures (SPS Agreement) that deals with food safety and animal and plant health and safety. The SPS is attracted for all the trade related risks to human, animal and plant health and life, but biosecurity covers both the SPS measures which are trade oriented and other measures that enhance the safety and suitability of all domestically produced food and feed as also impact to environment.

In recognition of the added value of a biosecurity framework to address multiple and growing risks to human, animal and plant life and health, to environment and to trade and livelihood, in relatively cost-effective ways, the Government of Nepal (GoN) requested FAO to undertake essential analyses for articulating a biosecurity framework for Nepal. In response, a technical assistance project was formulated: *"Policy assistance for biosecure agro-food supply chain for enhanced market access and food security for the smallholding rural sector (FAO TCP/NEP/3402)"*. The project supported assessments of biosecurity status in agriculture including crops, livestock, fisheries, forestry, foods and processed food and feed stuffs. These sub-sectoral studies were complemented by two cross-cutting assessments: one, the current status of policies, legislations and institutions and gaps and overlaps in these; and two, the costs of compliance to biosecurity measures. Overall, thus, this volume seeks to present an analytical assessment of the commodity and sector-specific status of biosecurity in Nepal.

Besides introducing the concept of biosecurity and its essential elements, this chapter synthesizes the analyses and insights from the other seven background studies, which are themselves presented in the subsequent chapters of this volume. The rest of this chapter is organized as follows. The next section (Section 1.2) describes biosecurity threats and hazards that Nepal is currently facing. Section 1.3 identifies biosecurity related obstacles on agricultural trade. Section 1.4 identifies and assesses national capacity for biosecurity including technical standards, policy, legislation and institution. Section 1.5 explains cost implications and Section 1.6 presents some conclusions as the way forward.

1.2 Threats and Hazards

Emerging and potential threats to biosecurity in Nepal emanate from hazards like unsafe food, infectious diseases, alien invasive pests, environmental degradations, agroterrorism and bioterrorism. Risks from food safety hazards are high. A number of developments which include changes in agricultural practices and rapidly rising imports are contributing to increased threats of biological, chemical and physical hazards on food safety. With rapidly growing urbanization and large chunks of the rural areas being accessible to roads, traditional practices of self-production and consumption are shifting towards production for markets. As a result, the distance between production and consumption centres are increasing and consumers are much less knowledgeable of the quality[1] of the foods they consume and the production systems. The use of agro-chemicals is getting increasingly popular among farmers even though they lack awareness of the health and environmental hazards from such chemicals, particularly pesticides and veterinary drugs. Increased consumption of animal products such as meat, egg, fish and dairy products in urban centres also escalates the risks of zoonotic diseases. Changed lifestyle and mostly unregulated advertisements that fuel demand for ready to eat processed foods also are problems.

Threats from the hazards of infectious diseases are also increasing with increased transboundary movements of animals, plants and their products. Nepal has been trading with Tibet, China and India right from the ancient times and trading partners increased with the opening of trade in the early 1990s. In Nepal's case, the threats of the entry of diseases, pests and low quality foods are perceived to be even more severe due to the porous border with

[1] The term product quality refers to the physical product characteristics such as taste, texture, nutritional value, freshness, safety and appearance.

India and weak quarantine control systems and the virtual lack of import risk analysis. With increasing imports of food and other agricultural products, Nepal's domestic market has become a part of the global market requiring effective domestic and border control for quarantine diseases and pests including invasive alien species. Environmental pollutions from agro-chemicals are also widely reported. However, no incidence of agroterrorism and bioterrorism is reported so far. But experts warn that these threats cannot be ignored.

The sources of biosecurity threats can be grouped into two categories, natural and anthropogenic events. The natural hazards to biosecurity follow from the acts of nature such as disease outbreaks or epidemics. Anthropogenic threats result from intentional actions such as unsafe use of pesticides, veterinary drugs, hormones and food additives.

1.2.1 Natural hazards

Pests and pathogens such as insects, fungi, bacteria, virus and parasites that can establish and spread in the Nepalese climatic conditions are the major natural hazards to crops, livestock, fish, forest and food. Biosecurity assessments for various food products (discussed in the subsequent chapters) reported various natural hazards to biosecurity which are summarised in Table 1.1. In addition, radioactive gases such as radon are also among the natural hazards.

1.2.2 Anthropogenic hazards

Major anthropogenic threats are residues of pesticides, hormones and higher doses of antibiotics in food and in the environment in general. Table 1.2 summarizes anthropogenic hazards, including those compiled in various sub-sectoral studies (Chapters 3-7).

Nepal has a pesticides control law that empowers pesticide registrar to register safe pesticides and not permit unsafe ones. Over 1500 brand names of pesticides, including insecticides, fungicides and weedicides have been registered. Some hazardous pesticides like DDT, BHC, Methyl Parathion and Monocrotophos are already deregistered. The pesticides are used on crops by ignoring precautions on their application and the waiting period for harvesting. Farmers apply pesticides routinely irrespective of the needs. They generally mix contact and systemic pesticides and apply overdose. This may be due to lack of knowledge of hazards as well as on methods to assess the risks due to diseases and pests. Moreover, farmers rely for advice on the type and dose of pesticides on pesticide retailers (agrovets) whose interest could be to advise overdose in order to maximize profit. Although the average level of pesticide use in Nepal is relatively very low, about 151g/ha a.i. (Sharma et al., 2012), the application is high in commercial vegetable pockets. It is also reported that some farmers harvest their products even on the same day of application of the pesticide,

Table 1.1: Identification of natural hazards

Subsector	Natural hazard reported
Crops	Crops suffer from disease and pests. Though such disease and pest do not directly get transmitted to human beings, they cause economic losses and warrant human intervention such as unsafe use of pesticides (details in refer to Chapter 3 of this volume).
Livestock and poultry	Live and dead animals are also reported to carry pests and pathogens. Consumers of livestock and poultry products face threats from zoonotic diseases and animal production system. Import of meat animals also increases pests and pathogen hazards increasing threats from their entry, spread and establishment. Live-stock, poultry and fish production suffers from various diseases caused by parasites, fungi, bacteria and water pollution (details in Chapter 4 of this volume).
Fisheries	Debris flow through floods and landslides are other natural threats to aquatic animals. Several diseases are reported to infect fish, and their eggs and broods (details in Chapter 5 of this volume).
Forestry	Consumers also suffer from natural poisons in foods of forest origin such as poisonous mushrooms and grayanotoxin in honey (refer to Chapter 6 of this volume for detail).
Food and feed	Development of mycotoxins, especially aflatoxin, in feed and food are also naturally occurring. Mycotox-ins develop in many stored products including stored food, feed and dry fish (details in Chapter 7 of this volume).

Source: Compiled by the author.

Table 1.2: Identification of anthropogenic hazards

Sub-sector	Anthropogenic hazards reported
Crops	• Overdose of pesticides in commercially produced vegetables; • application of pre-set spray schedule in tomatoes and other off-season vegetables irrespective of the incidence of disease or pests; • handling and application of pesticides without proper protective gear; • non-compliance to waiting period; • use of pesticides in fruits and vegetables even after harvest to increase shelf-life; • use of unsafe ripening agents; • Sales of some banned pesticides under other names, • application of hormones in vegetables, • use of unsafe colouring matters in fruits and vegetables make appearance attractive, • use of fresh faeces and urine, and • use of contaminated water for irrigation (refer to Chapter 3 of this volume for details).
Livestock and poultry	• Over dose and higher frequency application of antibiotics in poultry, • Sale of poultry even on the same day after administering antibiotics, • use of chloramphenicol in poultry, • use of oxytocin hormone in lactating animals, • use of sodium bicarbonate, sugar, water in milk as preservative, • inadequate cleaning of udder before milking, • use of plastic and aluminium cans for milk transport, • unhygienic slaughtering, transportation, cutting, packaging, storage, distribution of meat, • contaminated washing water, • untidy holding containers and exposure of meat to flies and birds (refer to Chapter 4 of this volume for detail).
Fisheries	• Habitat destruction through water pollution and poisoning, • inappropriate aquaculture practices, • residues of agrochemicals and veterinary drugs, • heavy-metal contamination, • unauthorized supply of seeds of some of the fish species, • improper use of production inputs (refer to Chapter 5 of this volume for detail).
Forestry	• Adulteration of forest based food products by products of different species (refer to Chapter 6 of this volume for detail).
Food	• Food quality deterioration, toxin development, contaminants • unsafe food additives as preservatives and colour • use of untreated water • lack of hygienic processing and handling • irradiations for food sterilization. • Metanil yellow and rhodamine in sweets, Sudan red in chilli powder (refer to Chapter 7 of this volume for detail).

Source: Compiled by the author.

which is hazardous. Further, pesticides are also reportedly used after harvest of fruits and vegetables to increase their shelf-life or induce ripening. It has also been reported that some vendors still sell some banned pesticides under other names. It is also reported that some farmers apply hormones to vegetables and non-permitted ripening agents such as carbide in fruits. Some traders use colouring matters, many of which may be unsafe, to impress consumers with attractive appearance of some fruits and vegetables.

Similar is the case with the use of antibiotics in poultry. The frequency and dose of antibiotic application is on the higher side and in some cases farmers mix different types of antibiotics and administer to poultry. The overuse of antibiotics can be attributed to inadequate or even inappropriate farm advisory messages reaching the farmers. As with pesticides, poultry farmers mostly rely on agrovets for advice on antibiotics while may be biased towards advising higher doses so as to maximize profit. It is also reported that some farmers harvest

their produce even on the same day they administer the antibiotics. Cases of use of chloramphenicol in poultry and oxytocin hormone in lactating animals are also reported to be increasing risks to human health. Some farmers and milk handlers are reported to use sodium bicarbonate, sugar, water or straw-water as preservatives. Some malpractices like adding untreated water and baking soda (sodium bicarbonate) in milk and inadequate cleaning of udder before milking are additional hazards in milk. Use of plastic and aluminium can for milk transport also increases food safety threats. Similarly, meat can get contaminated during slaughtering, transportation, cutting, packaging, storage, distribution and cooking. Diseased animals, unhygienic workers and slaughter place, unclean cutting knives, contaminated washing water, unclean holding containers and exposure to flies and birds are some major sources of meat infections. As the quality of ingredients used for feed is not assured, the safety of milk, meat, egg and fish cannot be ensured. In addition, some farmers store feed for long periods without proper storage facility leading to high risks of mycotoxin contamination.

The major hazards in fish production are contagious diseases and habitat destruction through pollution or poisoning. Inappropriate aquaculture practices, water pollution and unsuitable method of food preparation cause food safety hazards in fish products. The main hazards are pathogenic micro-organisms, residues of agrochemicals and veterinary drugs, and heavy-metal contamination. Unauthorized supply of the seeds of some of the fish species threatens aquatic biodiversity. Improper use of production inputs and waste disposal are found to affect the environment.

Food safety hazards can also enter at the stage of food processing. Those food processors who buy unsafe primary products cannot produce safe processed products. In addition, food quality deterioration, toxin development, contaminants and unsafe food additives as preservatives and colour are major threats at the processing stage. Use of untreated water and poor hygienic practices during processing and handling are also sources of hazards. The technological hazard arises from failures of technological structures, such as irradiation and chemical spills. Technological threats are limited to some industrial plants such as pesticide manufacturing plants. Some pack-houses in other countries use controlled radiations for food sterilization. Other sources of hazards are the use of metanil yellow and rhodamine in sweets, Sudan red in chilli powder, calcium carbide in banana, and formalin in fish, milk and imported fruit juices.

Though not yet reported in Nepal, advancement in biological sciences has increased the threats of bioterrorism which can be aimed at agriculture and human being. Any terrorist act intended to disrupt or damage a country's agriculture using biological agent against crops, livestock, poultry, forest or fishery is agroterrorism. The biological agent may include pathogens such as a virus, bacteria, or fungi.

The intensity and impact of natural and anthropogenic hazards are affected by geographic conditions. Nepal comprises of alpine and tundra high mountains, sub-tropical hills and tropical Terai plains. Pests and disease occurrences are inversely related to the altitude and so is the case for the use of pesticides and veterinary drugs. It means that the state of biosecurity is better in mountain regions than in the hills and Terai. The mountain regions have climatic conditions similar to that in Tibet, China whereas the hill regions are similar to the Indian hills. The Terai region of Nepal shares the same agro-ecology as the Gangetic plains of India. Due to the long and porous border, maintaining the border quarantine control is much more challenging along the Indian border than in the north.

Mountain areas are almost pest free. Farmers hardly use any pesticide and chemical fertilizer, making farming almost organic by default. In the case of livestock, the transhumant system of herd management is still practiced, with herd composition mainly of yak, *chauri, chyangra* (hill goat) and sheep. Though the risks of zoonotic disease can be high due to the practice of consuming fresh blood of live *chauri* in some parts, this region uses local herbal medicines for herd management and the use of antibiotics and hormones is negligible.

Hill areas are heterogeneous in the use of pesticides and veterinary drugs. Vegetable growers in most parts of the hills are using very little or no chemicals. Unfortunately, those in the periurban areas and districts close to large cities are using high doses of pesticides and other chemicals, posing high threats of residues. In many cases, pesticides are overdosed and the waiting periods are not observed. Registered goat farms are emerging in the hill areas, which has

increased the need for veterinary medicines and antibiotics.

In contrast, farms in the Terai use much higher doses of pesticides and veterinary drugs. Field visits revealed that vegetables growers farming close to border areas are among those applying high doses of pesticides, also ignoring in many cases the "waiting period". Registered cattle and poultry farms are emerging in the Terai whereas buffaloes are generally reared using traditional methods. The emergence of dairy hubs in Chitawan, Nawalparasi and Rupandehi districts are creating an expanding market for veterinary drugs. One strong message coming from this study is that it is very important to take into consideration geographical contexts and differences while implementing biosecurity control measures.

1.3 Obstacles to Agricultural Trade

To make an agro food supply chain biosecure, all actors in the supply chain such as producers, collectors, graders and packers, transporters, wholesalers, processors or millers, distributors and retailers should be made equally responsible. Liability rules are one of the crucial requirements for making these actors responsible. As a result, the agricultural exports are currently facing four major hurdles.

First, most of the primary products are sold unpackaged, which means no labelling and no traceability.. In the absence of the traceability, it is not possible to make agro-food supply chain actors liable for compensation for malpractices. A system of traceability and liability is necessary for convincing the high income markets with highly aware consumers. Consumers are becoming conscious of food safety and quality – this is evident as many of them are quitting or reducing the consumption of some high risk foods such as salad vegetables, honey, ghee, yogurt (curd) and fish. Many foreigners living in Nepal try to source their food from overseas from reliable importing companies. The same is the case with star hotels.

Second, agricultural export is limited. Nepal trades mostly with India and the same is true for agricultural trade too. Major food and agricultural commodities exported from Nepal are ginger, noodle, large cardamom, pulses, herbs and tea. Ginger is mainly exported to India with export occasionally suffering on account of the SPS problems. Rhizome rot and contaminants like soil are the major problems faced by ginger export. Noodle is a processed product and so faces little SPS hurdle. The demand for large cardamom is very high and no specific hazard is known on this trade. Export is mainly to India and is not suffering due to SPS measures. Pulses have no specific quarantine problem other than storage pests; exports to Bangladesh and to some extent India are continuing. Herbs are diverse products. These are mostly exported raw to India and have not faced specific SPS problems but the export of processed herbs to the developed markets has sometimes suffered from certification and traceability problems.

Third, when quality and quarantine of imported products are not closely monitored and controlled, Nepalese products can face hurdles in export market. Statistics show that Nepal is importing sizable amount of honey from China. As Nepal has no clearly declared residue monitoring plan for imported honey, export of Nepalese honey face market access problem in European countries. In the case of live animals and animal products, trade in live animal is widespread across both the Chinese and Indian borders. Nepal imports sheep and hill goats from China in large numbers for the *Dashain* festival in October. Due to this import taking place over a very short period of time, it is almost impossible for Nepal's animal quarantine check posts to test the herd for quarantine disease and pests. Nepal imports live animals (goats and buffaloes for meat) from India throughout the year. This includes even culled, very old and emaciated buffaloes but without sanitary or animal health certificates. Animal Quarantine Check Posts in borders do inspect the animals but this is not very effective. The risk of importing animals with zoonotic and other diseases and pests is still high. Some meat animals (pigs and others) are exported to eastern parts of India and Bhutan, but so far quality and safety issues have not been raised by them. In the case of fishery, the national guideline for live fish import allows the import of only recommended species of fish. Standards have been prescribed for fish imports which include the need for a certificate of origin and health certificate. Similar standards are set for fish seed importers which also include standards for seed packing and transport.

Fourth, though medicinal and aromatic plants (MAPs) are among the major exports from Nepal, they suffer from lack of quality certification. Though

the Department of Plant Resources (DPR) is entrusted for certifying exports of MAPS, the department has no record of pest data to meet the requirements of importing countries. Indian importers however, do not generally demand such certification, but it comes at the cost of lower price. In some cases, adulteration of medicinal plants has also been reported. A small part of the aromatic plants harvested in the country is used for extraction of essential oils. But the export of such oils suffers due to problems in quality packaging and labelling aspects. More recently, some private laboratories are providing testing services for essential oils.

There is a consensus in Nepal that weak biosecurity control system is one key factor constraining the growth of Nepal's agro-food exports, including the establishment of processing industries. Nepal became a WTO member in 2004 and there was a high expectation that exports would pick up. Instead, what materialized is the rapid growth of food imports. For export trade to sustain, basic minimum SPS standards need to be met. On the import side, progress in instituting the system of import risk analysis has been very slow. Risks will also remain high until some innovative ways are found to extend the control system to informal border imports also. When there are problems in multiple fronts, addressing them in a fragmented way does not help; hence a holistic biosecurity framework is of immense value to sustain safe and growing trade. Imports of food and agricultural products are increasing much faster than exports. These trends need to be reversed for which one essential response would be to institute a system of import controls. What is required is a holistic approach. Nepal needs a biosecurity framework to reverse these trends against poor quality exports, quality of Nepalese farm products as well as for boosting exports.

1.4 National Capacity for Biosecurity

1.4.1 Policy and legislation

According to the FAO Biosecurity Toolkit (FAO, 2007), assessments of policy and legislative frameworks are two of the four essential components of a biosecurity assessment at the system level for a country (the other two being institutions and communication capacities). Nepal's policy and legislative frameworks are assessed in Chapter 2 of this volume, along with the framework for institutions. All policies and legislations developed during the past two decades that affected at least one aspect of biosecurity (food safety, plant health, animal health or environment) were selected for the review. Based on this, a total of 18 policies and 25 legal acts were assessed.

Very briefly, formulation of national policies is a learning process, with policies developed in later periods benefiting from analysis, and successes and failure of the earlier policies. On overall agricultural sector policy, the 1995 Agriculture Perspective Plan was the first such framework and the 2014 Agriculture Development Strategy (ADS) the latest and covers what matters most for the coming years. The focus of the ADS is on commercialization of Nepal's agricultural economy, with market demand being the main driver. Several other policy frameworks such as the 2004 National Agriculture Policy also stressed along the same line. Detailed assessment of the ADS in Chapter 2 gives an impression that while one finds in the ADS several aspects of biosecurity, policies are scattered with little synergy amongst them, challenging the implementation of biosecurity measures in synergy with other elements of the ADS. The review finds that there is a need for a policy framework focused on biosecurity which would complement the ADS's drive towards rapid commercialization. Modern, demand-driven agricultural growth will not sustain without an equally effective strategy and policies for food safety and quality as well as environmental sustainability. Chapter 2 also discusses gaps and inadequacies in and overlaps among various policies. It makes a strong reasoning that a consolidated biosecurity policy is essential for synergy and cost-effectiveness of the programmes in various areas such as the protection of health and life of the living things as well as their habitat within the country, and for the enhancement of exports of food and agricultural products.

Sound biosecurity legislation is necessary to create an enabling environment of predictability and certainty through good governance and respect for the rule of law. Law clarifies the roles, responsibilities and rights of different stakeholders, including those parts of the government with policy and delivery roles for biosecurity outcomes and programmes, in order to ensure consistency and accountability (FAO, 2007). During the past half a century, Nepal has enacted some two dozen acts that have some element of biosecurity. These are reviewed in Chapter 2 of this volume from the angle of biosecurity. Overall,

it is concluded that the legislative provisions for biosecurity are both very limited and scattered, in part because different acts were developed during different periods. Some laws are very old with inadequate provisions for emerging issues while others lack essential provisions for the effective implementation of the biosecurity framework. Furthermore, current regulatory frameworks do not cover all the areas as required by the SPS agreement. In particular, it has poor liability rules such as recall and traceability, making biosecurity weak in both the domestic and export markets. Similarly, provisions of pest risk analysis are not clearly stipulated for imports. Efforts are made to regulate the end product quality but the legislations are inadequate in terms of preventive approaches such as good practices and management systems aspects. In addition, no legislation clearly spells provisions for good practices in conformity assessment such as inspection, certification and testing and role of accreditations. In view of the above, it is concluded that most of the acts need updating and some amendments, and a new act needs to be developed for implementation of the biosecurity policies (details in Chapter 2).

1.4.2 Technical standards for biosecurity

Technical standards are core building blocks of a biosecurity framework. Standards include official global standards developed by inter-governmental bodies, global standards by private agencies, regional standards, as well as standards developed by individual countries. All the five commodity-focussed papers in this volume (Chapters 3 to 7) introduce the standards that apply to their products and discuss issues facing Nepal. On the whole, these analyses identified a number of issues – fully missing or incomplete standards for Nepal, weak capacity of the public sector to enforce the standards, and low level of adoption of the standards by the private actors due to reasons such as awareness, training, infrastructure facilities and high cost of compliance.

Nepal faces a host of technical challenges in formulating, or adapting, and implementing standards based on global or regional best practices. As an example, there is the International Standards for Phytosanitary Measures (ISPMs) developed by the IPPC to prevent pest introduction and spread through trade. Nepal's National Plant Protection Organization (NPPO) is entrusted to protect plants from pest invasion, but implementation of the ISPMs is constrained by weak technical capacity, including in the declaration of pest and disease free areas. In some cases, there are no global standards to start with. For example, while FAO has developed a Guide to Implementation of Phytosanitary Standards in Forestry, which covers forest products like timber, fuelwood, forest seed, tissue culture plant and sawnwood, but fully misses out on food products of forest origin (Chapter 6 of this volume).

Chapter 4 on livestock products discusses many issues on food safety and quality standards as they apply to both live animals and livestock products. It notes there that while the DLS has developed Code of Practices for Safe Production of Livestock and Poultry, including COP for animal transportation and housing, the instruments are not adequate for implementation of such codes. One interesting observation made in Chapter 7 on food supply chains is that where supply chains are more commercialized and vertically coordinated, e.g. poultry chain, there are also internal pressures to adhere to the standards. The contrasting case is that of buffalo meat where adherence to standards is low.

Other problems and issues in this area noted in various background studies are highlighted below. One of them is not being able to differentiate products for markets based on safety and quality attributes and those that are not meeting such attributes. Though relevant certifications, for example, it is recognized that most food products grown by smallholder farmers in interior villages, particularly in the hills and mountains, are safe for consumption as very little pesticides and chemical fertilizers are applied. The same is the case with some farmers in commercial production pockets who are transforming their farms into organic farms, particularly for vegetables. And yet, little progress has been made on differentiation with certification, including organic certification. Differentiating farm products in the market, namely those following safe use of pesticides and others that are not, while challenging, would considerably boost the adoption of biosecure practices in vegetables farming, one of the major source of pesticides problem. A recommendation made in many studies is to provide recognition to products from areas where the adoption of the Integrated Pest Management (IPM) technology is very high. Progress in this area would also provide a boost to exports.

Nepal has also made progress in developing mandatory standards. These have been done for a number of food products and product groups, notably milk and milk products, fats and oil, fruits and vegetable products, spices and condiments, tea, coffee, cocoa and their products, common salt, cereals, pulses and their products, processed drinking water, non-alcoholic beverages, sweetening agents, and sweets and confectionery. Some standards are also available for preservatives and heavy metals. But the main issue remains that technical capacity for conformity checks is limited to the central laboratory and to some extent to the five regional laboratories. This is simply inadequate. Another issue noted is that while conformity tests are done for imported products, such testing is not made mandatory for domestically produced and marketed products.

1.4.3 Institutional capacity

A clear institutional framework is an important part of a more harmonized and integrated approach to biosecurity. The institutional framework identifies the competent authorities for establishing biosecurity controls and ensuring their implementation. It also sets out the rules and procedures governing their roles and defines the mechanisms through which they work towards shared goals (FAO, 2007). As reviewed in detail in Chapter 2, Nepal has several institutions with mandates for safe food, feed and medicine, and quarantine control of plant, animals and their products. At least five ministries are directly involved (agriculture, health and population, commerce and supplies, forest and soil conservation, and science, technology and environment). Ministry of Agricultural Development is responsible for plant and animal quarantine and food safety, and the Ministry of Health and Population works on food borne diseases, epidemiology, quality of mother's milk substitutes and control of drugs including veterinary drugs. Likewise, the Ministry of Commerce and Supply is concerned with trade, including that of agricultural products while the Ministry of Forest and Soil Conservation is entrusted to protect forests and wildlife and regulation of forest products. The Ministry of Science, Technology and Environment is playing the lead role in environmental conservation. Functions of all these ministries are supported by several departments under each of them.

The review in Chapter 2 highlighted a number of weaknesses in institutions for moving forward to an effective biosecurity framework. Several of them are well known to experts in Nepal but they need to be reiterated here. First, coordination, monitoring and enforcement are found to be particularly weak with the obvious non-compliance of many regulations relating to standards and quarantine measures. The review also brought to attention several overlaps and ambiguities in institutional responsibilities. Thus, as an example, while veterinary drugs are administered by the DLS, the authority to control the drug lies with the Department of Drug Administration (DDA) under the Ministry of Health and Population.

Second, support services from the public sector are distributed very thinly, clearly grossly inadequate to meet the challenge of implementing a modern biosecurity framework. For example, as regards private veterinary service providers, while precise data are hard to find, a guess is that around 3,000 paravets are providing services in Nepal, mostly in pockets with commercial livestock farms. This leaves out a very large number of animals raised by millions of family farms without any or with very little animal health services. This is worrisome not only because the risk to biosecurity is high, but also because most of these livestock growers have to depend on private agro-vet shops. The quality of their messages and the products they sell are not always consistent and accurate.

And third, while Standard Operating Procedures (SOP) are in place for testing and quality control in all Nepal's veterinary laboratories, their full compliance is not possible without highly trained and motivated staff. Commodity-specific chapters in this volume discuss specific issues with laboratories for various food products. Lack of trained staff is a recurring issue raised in all these reviews. Several papers also focus on trade where an issue is lack of confidence in the quality report provided by the Department of Plant Resources (DPR) due to outdated methods of testing, thus negatively impacting exports.

In summary, it is recognized that while it is easier to identify the gaps, coordination and capacity building of all these essential agencies is not an easy task. There are also crucial synergies to be addressed in this process. It is for these reasons that what is needed is a holistic framework for building institutions and capacity by connecting all related agencies. This is the framework for biosecurity.

1.5 Cost Implications and Incentive Compatibility

Adoption of biosecure practices not only generates various private and public benefits, but also increases the costs of production, handling and quality assurance of agro-food products. Such costs of compliance (COC) to latest regulations and standards are incurred not only by farmers and agribusinesses but also the government. All five sub-sectoral studies (Chapters 3-7) have sections on the COC and benefits. These were estimated for selected food products based on field visits, stakeholder consultations, literature and expert judgment. Given its importance, a separate paper in this volume, Chapter 8, is devoted to the topic of COC. Although far from being comprehensive, the estimated incremental costs as well the insights generated in the process of eliciting these costs were found to be very useful. It was stressed in all papers that the COCs provided a basis for discussing policy responses, including the sharing of the cost between the public and private sector. All five background studies also address this topic of cost sharing.

The COC has four issues to deal with. First, in practice, there is always a trade-off involved between the COC and level of protection sought, generally understood as the appropriate level of protection (ALOP) or tolerable level of risk. Higher the level of protection a country seeks, higher will be the COC which is reflected in the food price. Information on the COC is therefore essential for taking sound decisions about variations of standards along the agro-food supply chain.

Second, knowledge of the COC helps farmers and business operators to compare the incremental cost against possible increases in revenues from sales in the market. Note that the COC is incurred not only in terms of investment and operating expenses but also, in many cases, in the form of reduced marketable production when a farmer bears the extra cost but fails to recoup it from the market. For, example, the COC for production of safe ginger and tomato are NPR 9.60/kg and NPR 6.39/kg, respectively, which translate into break-even sales prices higher by 26 and 38 percent, respectively. The corresponding numbers for biosecure milk are NPR 8.83/litre and 30 percent (see Chapter 8 for detail).

Third, information on the COC and its composition help articulate intervention measures to reduce the COC, reform marketing policies and make the intervention incentive compatible. For example, purchase of Ice Bank Tank (IBT) by farmers for chilling evening milk, to avoid the use of caustic soda, amounts to about a half of the total COC for safe milk production. Establishment of chilling vat in accessible distance avoids this investment in IBT, reducing the COC of milk production.

Fourth, the information on COC helps to identify cost sharing arrangement between the public and private sectors along the supply chain. The background studies (Chapters 3 to 7) discuss and identify areas for cost sharing between the public and private sector.

1.6 Way Forward

Nepal's agriculture needs to be biosecure for improving and sustaining human health and life, animal and plant health, overall environment, as well as for exports. Towards this goal, a number of suggestions were made in various sections of this paper, including insights from the other seven chapters of this volume. What follows presents some concluding observations in brief.

First, one key conclusion of this and the rest of the chapters is that Nepal has no choice but to work hard towards a biosecure agriculture and which requires, to start with, the formulation of a National Biosecurity Policy.

Second, a robust research and analysis programme is essential on biosecurity issues, several of them being new and emerging topics. This and the rest of the chapters discussed many such issues where understanding is poor and evidence lacking for policy formulation. The list is long to be repeated here. Very briefly, these included: understanding governance issues (policy, institutions and legislations), role and strengths of public and private biosecurity service providers, risks of existing and new hazards, their probable impacts and risks and exposure pathways, the economics of the adoption by private actors of the biosecurity measures, the role of public support including targeted subsidies. Such research and analysis needs to be multi-disciplinary, involving for example scientists, layers and economists.

Third, emergency preparedness and response planning are necessary for biosecurity. This requires collection, sharing and analysis of information on

biosecurity risks at every stage of the agro-food supply chain from input supply, production to final consumption. The response also includes control and eradication of animal and plant pests and diseases and assurance of food safety. Emergency preparedness will determine critical points in the food and agriculture system that may be the entry point for threats. It will include establishment of a coordination mechanism through a multiagency coordination group or other similar means. The risk management process for food safety (food defence) will address inspection at food catering, food processing plants, distribution, retail shops and border points. Other aspects include surveillance of food borne diseases, laboratory analysis of food samples, and developing mitigation strategies for early detection, prevention and control.

Fourth, in early years, government support is necessary in awareness creation among the farmers and other agro-food supply chain actors. Technological support is also necessary till the measures can generate additional income to cover the costs of compliance. The type of supports can be different for the smallholder farmers than that to large commercial farmers. The former need technological, physical inputs and quality control support whereas the latter can adopt biosecurity measures and require technological and certification support. Farmers and private sector may need help in the areas of safe production technology, safe harvesting techniques, safe collection points, clean water for washing and cleaning, suitable packaging materials, ice facility and cold chain for perishable products (like milk, meat, fish and some vegetables), suitable transport vehicles, and sanitation in retailing. In addition, consumers need information on safe storage and cooking practices and understanding label directions for consumption of safe food.

Fifth, Nepal needs to develop biosecurity in production, post harvest handling, processing, packaging and labelling to at least meet the Indian standards. Nepal has need for a NepalGAP and is currently being supported to set up standards as well as a certification structure for the same under an FAO funded regional project. Nepal has experiences of some successful good practices, such as the Integrated Pest Management (IPM), which should be made the entry points for establishing GAPs. Indeed, the IPM field schools could be converted to "GAP schools". GAP certification, labelling and traceability should gradually encourage those consumers who can afford to buy safe products and pay more. This process should drive and sustain the market-driven model of agricultural transformation that the government is seeking to promote. This is also the core thrust of the Agricultural Development Strategy that will be the main policy framework for Nepal's agriculture in the years to come.

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CHAPTER 02

A REVIEW OF POLICIES, LEGISLATIONS AND INSTITUTIONS FOR BIOSECURITY

Krishna Prasad Pant

Abstract

Effective implementation of biosecurity measures needs fully articulated policy, comprehensively enacted legislation and clearly mandated organizational structure. This paper reviews biosecurity related policies, legislations and institutions in Nepal with a view to identify their strength, gaps and overlaps. Although there is no as yet a biosecurity-specific policy and legislation, many provisions in the existing policies and legislations are related to biosecurity. The study finds 18 policies formulated during the past two decades and 26 legislative acts developed since 1957 and currently active are in one way or other related to biosecurity. It also found that the functions of eight government departments are directly related to one or more aspects of biosecurity. The study documents several gaps and overlaps in these policies and legislations, and inadequacies in the current institutional setup. It recommends that Nepal needs a consolidated, holistic framework and policies for biosecurity. The assessments made in the study should be useful for policy makers to formulate such a biosecurity framework.

2.1 Introduction

According to FAO, biosecurity is a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) for analysing and managing relevant risks to human, animal and plant life and health, and associated risks to the environment. It covers food safety, zoonoses, the introduction of animal and plant diseases and pests, the introduction and release of living modified organisms and their products, and the introduction and management of invasive alien species.

FAO's Biosecurity Toolkit (FAO, 2007) defines biosecurity capacity of a country as the ability of relevant organizations to perform appropriate functions effectively, efficiently and sustainably in order to protect human, animal and plant life and health, and associated aspects of the environment. The Toolkit's Part 2 is a guide to assess biosecurity capacity. In the analytical framework presented, this assessment is to take place at two levels: i) system level; and ii) sectors of biosecurity /organization level. At the system level, four dimensions of capacity are stressed: i) policy framework; ii) legal framework; iii) organizational arrangements (including coordination); and iv) communication. The emphasis is on capacity assessment across the entire biosecurity arena.

The Toolkit further elaborates on the four core system level frameworks as follows. The *policy framework* defines a country's overarching biosecurity goals and objectives, as well as the broad course of action to be followed. Policy frameworks vary in accordance with specific national (or sub-national) needs and circumstances. The legal *framework* delimits general and specific rights and obligations of stakeholders involved in biosecurity including those parts of government with responsibility for the delivery of core biosecurity functions. It defines a system of enforcement, penalties and appeal. The *organizational arrangements* refer to the type of

mechanism through which stakeholders collaborate in the planning, budgeting, delivery and monitoring of core biosecurity functions, and the interdependencies and relationships between them. At this point, the Toolkit notes that the definition and division of these core functions provides the link between the system level and the organizational level assessments, by defining how normative and technical roles and responsibilities are distributed among specific government agencies and/or through sub-contracts to other stakeholders (third parties). Lastly, the *communication* encompasses the information flows and dialogue between the stakeholders involved in biosecurity.

The purpose of this paper is to assess Nepal's current state of policy, legislative and institutional frameworks from the standpoint of a national biosecurity strategy and framework, and thus to identify gaps, overlaps and requirements for a biosecure agricultural economy in Nepal. This scope fits very well with what the above Toolkit calls national biosecurity capacity assessment at the system level, with its four dimensions (policy, legal, organizational and communication).

Most countries do have policies, legislations and standards for the safety of food, animal, plants etc. and Nepal is no exception. The formulation of these instruments over the years has also been contributed by membership to international organizations and agreements. These include, for example, the WTO itself (and all of the Uruguay Round Agreements such as on Sanitary and Phytosanitary (SPS) measures), various standards setting bodies such as the Codex Alimentarius Commission (Codex), International Office of Epizootics (OIE) and International Plant Protection Convention (IPPC), Convention on Biological Diversity (CBD) and so on. While this is the case generally, what seems to be seriously lacking in the context of biosecurity is that the formulation and implementation of these policies and legislations is typically scattered across policy documents, acts and agencies, leading to a fragmentation of effort, waste of resources, duplications and the risk of lapses within the system. This is where a national biosecurity framework adds value by responding to the challenges in a holistic manner.

This study is based on desk review and discussions with experts. In-depth review was made of 18 policy documents, 25 legal acts, and functions and mandates of government agencies having something to do with Nepal's biosecurity. Available papers on policy, legislations and institutions were reviewed and experts consulted where deemed essential.

The rest of the paper is divided so that the next three sections review and assess current policies, legislations and institutions, respectively. This is done from the standpoint of the relevancy to biosecurity issues. On the basis of these assessments, Section 2.5 discusses gaps and overlaps in these three areas, i.e. policy, legislation and institutions and Section 2.6 gives the conclusion.

2.2 Policies Related to Biosecurity

Formulation of national policies is a learning process, with newer policies benefitting from experiences with the success and failure of the earlier policies. In what follows, policies formulated during the past two decades and affecting at least one aspect of biosecurity— food safety, plant health, animal health or environment—are reviewed in a chronological order.

Agriculture Perspective Plan: The 20-year Agriculture Perspective Plan (APP) formulated in 1995 was Nepal's first consolidated, elaborated and long term policy document in the agricultural sector. Its overall objective was commercialization of the mostly subsistence agriculture and acceleration of agricultural growth. This transformation was expected from diversification and realization of comparative advantages which expand opportunities for agribusinesses. Though the APP did not directly articulate strategy and policy on food safety, quality, quarantine control or other aspects of biosecurity, the importance of provisions was implicit in the proposed transformation and commercialization of agriculture. It recognized the effects of agro-chemicals on environment and human health and emphasized Integrated Pest Management (IPM). It also recommended tree plantations, particularly fruit trees for sustainability of the farming system. However, the APP placed heavy emphasis on chemicals such as pesticides, hormones, antibiotics and chemical fertilizers, without adequately addressing their food safety consequences.

National Seed Policy: National Seed Policy (1997) emphasized on replacement of low yielding traditional seeds with modern variety seeds. In addition, it

stressed on conservation of agro-biodiversity and establishment of breeders rights over new variety of seeds. It proposed for conducting 'research' (which may also be construed as risk assessment) on GMO seeds. Such seeds could be released for use only if they do not compromise biosafety in the country. Before releasing the GMOs, the policy required that 'research' needs to be conducted in the presence of the competent authority to prove that their adverse effects on local living things and environment are not likely to occur. In addition to seed replacement and GMO risk assessment, the policy proposed for seed quality control not only through seed certification and truthful labelling, but also following quality declared seed system. The policy also proposed private sector participation in seed testing, seed analysis, seed sampling, crop inspection etc. for maintaining seed quality in the country. Thus the seed policy was concerned with seed quality control, agrobiodiversity conservation and biosafety which are the elements of biosecurity.

National Tea Policy: National Tea Policy (2000) aimed at promoting private sector participation in production, processing and trade of tea. It laid emphasis on the development of tea industry as the medium for employment promotion, income generation and foreign exchange earnings. Its objectives, among others, are to ensure quantity and quality improvement in the production of tea by encouraging participation of private sector especially tea entrepreneurs and tea farmers; and promoting market for tea by making tea enterprises sustainable and lucrative. It proposed brand promotion of tea. It also emphasized on the expansion of tea farming with environmental protection. On the other hand, the policy allowed tea farmers to directly import chemical fertilizers and pesticides from abroad without any concerns for pesticide residues. Pesticides MRL is generally recognized as the major problem in tea export but this is not addressed by the policy. Tea policy is thus weak in biosecurity.

National Fertilizer Policy: National Fertilizer Policy (2002) liberalized fertilizer trade to facilitate the involvement of the private sector in this farm input. It aimed to support raising agricultural productivity by ensuring supplies of good quality fertilizers through production, import and distribution by the private sector. Specifically, the policy document emphasized on the provision of conditions for enhancing fertilizer consumption and promotion of integrated plant nutrients management (IPNM) system for efficient and balanced use of the organic and chemical fertilizers. The policy adopted strategies such as ensuring fertilizer availability, making fertilizer distribution system transparent, competitive and effective, maintaining the quality of the fertilizers, and managing the IPNM system. Likewise, Fertilizer (Control) Order (1999) called for monitoring and managing supply of chemical fertilizers for environmental sustainability. The provisions on fertilizer quality control and the promotion of IPNM system support biosecurity.

Nepal Biodiversity Strategy: The Nepal Biodiversity Strategy (2002) aimed at protection and judicious use of biodiversity for, inter alia, protection of ecological processes and systems. It is a comprehensive document for the protection of biodiversity in the country. In terms of biosecurity, the strategy has some weaknesses. For example, the threats to wetland biodiversity are identified as area encroachment, unsustainable harvesting of wetland resources, industrial pollution, agricultural runoff, siltation, and the introduction of exotic and invasive species. But the problem of exotic and invasive species on terrestrial ecosystem is not recognized. In addition, the strategy has no provision for risk analysis of imported consignments that pose threat to biodiversity and it does not cover plant diseases.

Irrigation Policy: Irrigation Policy (2003) required the promotion of conjunctive use of ground water and surface water along with the promotion of water efficient non-conventional irrigation systems such as rain water harvesting, pond irrigation, sprinkler irrigation, drip irrigation and treadle pump irrigation. The policy aimed at developing round the year irrigation facilities and institutional capacity of water users for sustainable management of existing systems. Provisions on the efficient use of water help environmental sustainability and thus contribute to biosecurity. However, the policy is silent on water quality for irrigation. In many places, untreated sludge is being used for irrigation, increasing risks of pathogen contaminations and heavy metal uptake by plants.

National Coffee Policy: National Coffee Policy (2003) aimed at import substitution and export promotion of coffee. Its objective is to develop

sustainable coffee industry for income generation, employment promotion, foreign exchange earnings and environmental protection. The policy implicitly assumes that planting coffee will improve and protect the environment. The policy proposed the development of organic coffee with a national logo. The coffee policy also envisaged a coffee laboratory for quality analysis and control. On the other hand, the policy has no provisions for grading and cleaning of coffee and also ignored the environmental effects from coffee processing. Organic coffee plantations and quality control are supportive of biosecurity.

National Agriculture Policy: Within a decade of the APP implementation, the government felt the need for a separate policy document with broader approaches and coverage, and taking into consideration new developments such as Nepal's WTO membership. This led to the formulation of a National Agriculture Policy (NAP) in 2004. The main objectives of the NAP are to improve the standards of living of the Nepalese farmers and to contribute to food security and poverty alleviation through higher economic growth realized by the promotion of commercial and competitive agriculture. The specific objectives of the policy include raising productivity and production; developing commercial and competitive agricultural system; and conservation and utilization of natural resources and environment. The NAP is also a framework policy document and thus provides avenues for the formulation of other subject-specific and product-specific policies for further elaboration of its provisions. Further to the APP approach of developing pocket areas, the NAP proposed the development of large production pockets for exploiting economies of scale in the use of infrastructure like roads, electricity, markets, etc. Unlike the APP, however, the policy covers all essential inputs and all outputs that can be profitably grown in different parts of the country. The role of the public sector is envisaged as the provider of essential pubic goods and a facilitator for private sector participation in agricultural development.

Many policy statements and provisions are supportive of biosecurity. Thus, it requires the regulation of pesticides to minimize their effects on water and environment and also to control the use of veterinary medicines and hormones to protect human health. It also emphasizes on increasing the production and use of organic manure to substitute chemical fertilizers as far as possible. It also proposed for developing food standards to control quality and certify food products. The policy recognizes the role of international treaties, agreements and requirements for setting national standards. The NAP also proposes for IPM and IPNM and has provisions for reducing the use of chemicals such as pesticides, hormones, antibiotics and chemical fertilizers.

Biosafety Guidelines: The objective of the Biosafety Guidelines (2005) is to conserve biodiversity, protect environment and human health from LMOs (mentioned GMO throughout the document) and also to utilize biotechnology. The guidelines require conducting regulatory procedures while assessing potential risks from LMOs and their products GMOs. They focus the risk assessment more on the LMOs and their products than to molecular or multi-cellular methodology applied for producing these materials. The guidelines caution for careful step-by-step release of the LMOs and their products in the environment after due precaution and risk assessment for the environment and human health. The document provides guidance that the control of the LMOs can be relaxed only if no harm is detected in the environment. The guidelines also give some directives for a ban on the entry of such organisms or materials in the market unless the 'field test' (that can be interpreted as risk analysis) of these materials is completed. There is however a problem with the guideline which is that the impacts of the LMOs on the environment and human health can take long time and may not be observed in the short run as envisaged by the guidelines. Thus, overall, the biosafety concerns addressed by the guidelines are valuable for biosecurity.

National Agro Biodiversity Policy: National Agro Biodiversity Policy (2006) with amendment (2014) provides overall policy framework for conservation of agricultural biodiversity in the country. Some of the objectives of the policy relating to biosecurity are conserving, promoting and sustainably using agro-biodiversity and contributing to maintaining sustainable ecological balances over time. This policy also has a provision that requires obtaining permission from authorized agencies to conduct research on GMOs. It further states the government can also put a ban on importing GMO that has potential risk of altering biodiversity and rendering negative impacts on the environment.

Agribusiness Policy: Agribusiness Policy (2006) followed upon the NAP 2004 with the following objectives - further supporting market-orientation and competitive agricultural production; contributing to increased capturing of the domestic markets; supporting agro-industries on export promotion; and assisting poverty alleviation through agribusinesses. The policy emphasizes on product diversification, service delivery and private sector involvement to transform the subsistence agriculture to commercial one. The policy measures suggested include development of infrastructure (business service centres, markets and collection points, and rural roads and electricity) for post-harvest, marketing and processing. The policy stresses on the quality control of agriculture inputs, services and outputs for commercialization of agriculture. For producing quality products as required by the domestic and export markets, the policy proposed for designation and demarcation of three types of production areas, namely commercial crop and commodity production area; organic and pesticide free production area; and agricultural products export area. The policy proposed for technical and other supports to agricultural collection centres, processing plants and animal slaughterhouse. It also proposed for 25 percent rebate on electricity cost for cold and frozen storage, cold chain, cold chamber and chilling vat and animal slaughterhouses for private entrepreneurs for 10 years from the date of establishment. It also proposed for establishment of accredited independent analytical laboratory in public and private sectors. Thus, there are several provisions that can promote biosecurity in the agro-enterprise sub-sector.

National Biosafety Framework: National Biosafety Framework (2006) presents policy, legislation, administrative procedures and technical instruments necessary to ensure an adequate level of protection during transfer, handling and use of the LMOs produced through modern biotechnology. The LMOs are recognized as a threat to human health and conservation and sustainable use of biodiversity (MOFSC, 2006). The framework proposed a biosafety policy with the main objectives of protecting biodiversity, human health and environment from possible adverse effects of the transboundary movement of the products of modern biotechnology. The policy stresses on developing legal, technical, administrative aspects of biosafety and some mechanisms for public participation for biosafety. It also emphasizes on the development of institutional, human resources and technical capabilities for biosafety related functions. It calls for adoption and accommodation of regional and international standards on risk assessment and management. The framework proposes for framing a national biosafety Act in order to regulate the use, development, import, movement, storage, and release of the GMOs – this is yet to be enacted. Thus the provisions of the biosafety framework are partially supportive of biosecurity.

Dairy Development Policy: Dairy Development Policy (2008) recognizes the importance of livestock sub-sector in the Nepalese agriculture and presents a long-term vision of encouraging participation of public, private and cooperative sectors in milk production. It has the objectives of increasing milk production, expanding milk business, import substitution and export promotion, and milk quality control. For increasing milk production, it emphasizes on extensive and effective animal disease control. For expanding milk business, proposals are made for loan and technical supports for quality milk and milk products. Likewise, for import substitution and export promotion, the policy proposes for negotiations aimed at removing tariff and non-tariff barriers in export markets and generating awareness among farmers and entrepreneurs about the importance, need and technology for quality control of milk and milk products. Finally, for quality control, five policy provisions are stated. First, the policy proposes for regular monitoring of milk and milk products in the market and consumer awareness on storage, expiry period and methods of consumption. Second, it proposes for revision of standards of milk and milk products. Third, it recommends for development and enforcement of suitable packaging standards of milk and milk products. Fourth, implementation of a code of conduct for processing plants is proposed for collection and processing of milk. Finally, it also emphasizes on the provision and strengthening of laboratories for quality assurance of milk and milk products. However, the policy document does not mention provisions for legislations for quality control, Good Management Practice (GMP) and third party certification. It thus gives an impression that the policy is somewhat lenient towards dairy entrepreneurs on quality control.

Nepal Trade Integration Strategy: Nepal Trade Integration Strategy (2010) (NTIS) is a framework document for the development of trade. It is also a follow-up to the Nepal Trade Competitiveness Study (2003). The NTIS identified 19 products and services[2] as priority products with export potentials. It identified that building a successful, competitive export sector requires, inter alia, secure market access and strong domestic support institutions. The major challenge on market access is non-tariff barriers (NTBs) and related regulatory requirements. One of the four objectives of the NTIS is to strengthen domestic technical capacity for dealing with NTBs and other business problems. It also recommends for developing supportive institutions and improving supply capacity of domestic producers to meet market entry requirements of importing countries. This requires, among others, domestic support infrastructure in technical standards and sanitary and phytosanitary standards. The strategy emphasizes on Good Agricultural Practices (GAP), IPM and Quality Management System (QMS) in tea, lentils, cardamom and ginger. It also recommends for Third Party Certification (TPC) programmes to build a competitive agro-food export supply capacity. The NTIS recommends for the development of GAPs and pest management guidelines in cardamom production based on a full pest risk assessment (PRA) and quality management through GAPs and improved post-harvest techniques such as good manufacturing practices and traceability. The report recommends for addressing virus and virus vector problems by controlling transboundary movement of cardamom germplasm.

Industrial policy: The major objectives of the Industrial Policy (2011) are to increase commodity exports through enhanced quality and competitiveness. Similarly, it aims to achieve sustained growth of the industrial sector with the application of new and environment-friendly production processes. This policy prioritizes agro-forest based industries, but quality aspects of these industries are not adequately incorporated in the policy. One of the strategies of the industrial policy is to develop technology, market, skills and research to assist industries based on agriculture, non-timber forest products, animal husbandry, dairy, bird farming, fruits and herbs. Though this policy emphasizes on the development of industrial sector in the country, including agriculture and forest based industries, this does not directly address the issues related to biosecurity such as food quality and safety, quarantine issues on imported raw materials and environmental pollution from industrial production.

Poultry Policy: Poultry Policy (2011) aims to improve food and nutritional security through increased production of quality poultry products. It also aims at modernization of the poultry business and improving competitiveness in environmentally sound ways for meeting domestic demand, substituting imports and finally promoting export of poultry products. It has provisions aimed at lowering the effects of reduced demand and production of poultry products due to the fear of the transmissions of zoonotic diseases from birds. But it is quiet on how this is to be done. In addition, the policy includes a statement that no effect on human health and environment will be permitted from poultry farming. However, the policy does not explicitly take into account the health effects of unsafe poultry products to the human health. It is silent on the effects of higher antibiotics and hormone residues on consumers' health. Strategy developed to implement the policy includes a provision on the biosecurity of the poultry farm by declaring certain areas around the farm as disease-free area. But it is not clear from the document how the disease-free area will be enforced. It also proposes to strengthen laboratories for exploration, research, surveillance, control and eradication of poultry diseases. Such measures are advantageous for biosecurity in the country.

National Seed Vision: National Seed Vision 2013 - 2025 (Seed Sector Development Strategy 2013) with a vision of "Quality seed for the well-being of farming families" aims to promote use of quality seeds by diversifying farmers' choice to raise crop yields and income. For high quality seeds, it considers genetic purity, trueness to type with high degree of physical purity, uniformity, high germination potential, optimum moisture and vigour, freedom from diseases and pests and noxious weeds. The vision is to substitute seed imports, make the country seed self-sufficient, and promote seed export. However,

[2] Agro-food (1 Cardamom, 2 Ginger, 3 Honey, 4 Lentils, 5 Tea, 6 Noodles, 7 Medicinal herbs/essential oils); Craft and Industrial Goods (8 Handmade paper, 9 Silver jewelry, 10 Iron and steel, 11 Pashmina, 12 Wool products); and Services (13 Tourism, 14 Labour services, 15 IT and BPO services, 16 Health services, 17 Education, 18 Engineering, and 19 Hydro-electricity).

the vision has no clear recommendation on pest risk analysis on the import of seeds and pests and diseases surveillance within the country.

Agriculture Development Strategy: Agriculture Development Strategy (ADS) (MOAD, 2014 draft), seen as a successor to the APP, aims at providing long term strategies for Nepal's agricultural development. It has a 20-year vision and a 10-year planning horizon. The scope of the ADS is very wide and covers the following: food security, productivity enhancement, connectivity and resilience; sustainable production and resource management through climate change mitigation; adaptation and improved land and water management and water allocation; increased private sector development (including cooperative sector), delivering fair reward to all stakeholders in the value chain; and policies, institutions, and investments.

Although the ADS does not explicitly mention the term biosecurity, it points to several issues related to biosecurity and provides suggestions. It identifies SPS-related problems emerging from changes in the marketing system. The document sees high potentials in value adding agriculture through improved quality, safety and labelling; certification to standards for safety, quality, fair trade and organic branding; and processing and product development for spices and MAPs.

Among the 13 policy issues identified by ADS[3], those directly related to biosecurity are competitiveness, trade, food and nutritional security and legislative reforms. Agricultural products face difficulties in meeting international quality standards due to inadequate application of GAP and GVP. As a result, Nepalese products face export barriers for not meeting standards called upon in the WTO Agreements on SPS and technical barriers to trade (TBT). The ADS identifies overuse of chemicals, use of imported hybrid seeds, and poor management of effluent from intensive livestock farms as unsustainable practices. In addition, limited testing facilities for residues of pesticide, heavy metals and other contaminants in food are identified as problems along with zoonotic diseases (tuberculosis, avian influenza, rabies, and swine fever). The ADS recommends for significant policy changes to improve quality through enhanced grades and standards and a supporting system of implementation of good practices, such as GAP, good manufacturing practices, good hygiene and handling practices (GHHP), and good veterinary practices (GVP).

The ADS recognizes that the markets are increasingly open and homogenized to international tastes and requirements for levels of quality, packaging, safety, and even process attributes such as socially or environmentally friendly methods. The report also identifies that regional and global agricultural quality and safety systems are based on standards of best practice operating procedures, internal control systems and product traceability requiring strong government regulatory systems with sufficient capacity for monitoring, regulation and enforcement, supported by non-government industry-based institutions to provide training, certification, auditing and analytical laboratory services. The report recommends that *"The regulatory capacity must encompass the whole food chain, from rigorous assessment and registration of agricultural inputs (such as pesticides, veterinary medicines and biotechnology products) and livestock feeds, through to food processing additives"*. These recommendations are geared towards making agriculture more biosecure. The ADS policy options emphasize on sustainability and access of all to nutritious and safe food. It calls for high level of scrutiny for quality and safety. Among the four strategic components of the ADS—governance, productivity, commercialization and competitiveness—food safety and quality aspects fall under competitiveness. The ADS policy recommendation is for strengthening regulations and institutions for enhancing food safety and quality by propagating GAP and GVP, together with IPM, for increasing productivity.

One of the eight principles[4] of the ADS is food security and food safety. The ADS recommends for a combination of legislative, capacity building, and institutional measures for food safety and quality. It points to the need for formulation, adoption and implementation of food security and quality standards so as to avoid import restrictions by

[3] The 13 policy issues identified by ADS are productivity, competitiveness, trade, commercialization, infrastructure, credit and insurance, tax and subsidy, land, food and nutritional security, institutions and human resources, climate change and natural resource management, social and geographic inclusion and legislative reform (ADS, Page 40).

[4] The stated eight principles of ADS are food security and food safety, private sector development, cooperative sector development, inclusiveness and sustainability, growth, productivity, competitiveness, and transparency and accountability (ADS Page 44).

trading partners. It also recommends adopting legislation for accreditation of national laboratories through establishing an accreditation body and joining International Laboratory Accreditation Cooperation (ILAC)[5] to establish the recognition of the Nepali accreditation body. It also recommends for strengthening and upgrading of major laboratories for food, veterinary, seed, soil and plant protection to internationally accredited levels. The ADS also recommends for building surveillance, monitoring and diagnostic capacities for plant pests and diseases, animal pests and diseases and post-entry quarantine services.

Summarizing this sub-section, it is clear that different policies formulated for different purposes touch upon some aspects of biosecurity in the country. The recent policy document ADS deals with many aspects of biosecurity. This confirms that the government is well concerned with the health and environmental problems from insecure food production and imports, including disease and pest problems from imports. The problem is that the policies are scattered, with weak synergies among them, making implementation difficult and challenging. Even in the latest policy document, the ADS, the provisions related to biosecurity are spread in different parts of the document. Therefore, a consolidated biosecurity policy is necessary for exploiting synergies in efforts.

2.3. Legislations related to Biosecurity

Many Acts have been enacted in Nepal during the last half a century and some two dozen of the current Acts affect one or the other aspects of biosecurity. The legislations in the early days were naturally less sophisticated in addressing problems but are being continually improved upon over the years with experiences and information about the health and environmental effects. In what follows, the Acts that have something to do with at least one aspect of biosecurity are identified and brief reviews presented in chronological order.

Export Import (Control) Act (1957) (amendment 2006) empowers the government to apply full or partial quantitative restriction on the exportation or importation of goods, without stating any condition or period. The biosecurity related objectives listed in the act include (i) protection of life or health of human, animal or plant from adverse effect; (ii) conservation of exhaustible natural resources (in conjunction with restrictions on domestic production or consumption); and (iii) maintain the criteria of classification, standardization or marketing of consumer goods in international trade. The act can be applied to food and agricultural trade, but the provisions are so elementary that they do not meet the requirements of transparency, non-discrimination and risk analysis. Nevertheless, the act can be applied for improving biosecurity.

Aquatic Animal Protection Act (1960) (first amendment 1997) outlaws the use of any kind of electric current, explosive or poisonous substance with intention of catching and killing any aquatic animal. However, fish farmers can use any method of killing fishes in private water other than poison. It also prohibits closing or demolishing doors of fish ladder, dyke and any other kind of structure placed in the water for the protection of any aquatic animals. However, the law has no provision for regulating the release of invasive species of aquatic animals into nature and the impact of such invasive aquatic animals on the natural aquatic animal species. Similarly, the act has no provision on fish health, water quality, aquatic habitat, and effects of contaminated fishes on human health.

Food Act (1966) (third amendment 1992) prohibits production, sale or distribution of adulterated[6] or sub-standard[7] foodstuff. It has provisions on standard development and quality control of food products at production, processing, storage and handling including contaminants and adulterations. These provisions aim to maintain purity in foodstuffs

[5] ILAC is an international cooperation of laboratory and inspection accreditation bodies for increasing cooperation among laboratories and inspection systems to reduce technical barriers to trade. A closely related body for collaboration, the International Accreditation Forum (IAF), however, works on management systems, products, services, personnel and other similar programmes of conformity assessment.

[6] Definition of adulterated foodstuffs: (1) foodstuffs rotten so as to be harmful to health, or prepared or kept in a filthy or toxic condition; or (2) foodstuffs wholly or partially made of any sick or disease carrying animal or bird or of harmful plant so as to be unfit for human consumption; or (3) foodstuffs that may be harmful to health as any food additive, colour, preservative, internally or externally mixed chemical compound or pesticide exceeds the ceiling as prescribed.

[7] Definition of sub-standard foodstuffs: (1) foodstuffs whose main ingredient is reduced in quantity or which is mixed with any other substance whereby lowered its natural quality, provided that, if the name and quantity of any foodstuff made of two or more items are clearly marked in such foodstuff and if it is not harmful to health, such foodstuff shall not be deemed as sub-standard foodstuff; or (2) foodstuffs below the standard or below the minimum necessary standard as prescribed or above the standard if maximum standard is prescribed (Food Act, Article 2).

and maintain their proper standard by preventing any undesirable adulteration, reduction or extraction of any natural quality or utility from foodstuffs. The government can issue orders for setting quality standards of foodstuffs upon the recommendation of Standard Fixation Committee. The Food Act also prohibits the sale of foodstuffs by falsely claiming a different product or one of higher quality. A license is required for the production, sale or storage of foodstuffs for commercial purposes. But the legislation is not risk-based and does not have food safety related requirements such as residues and contaminants based on Codex standards and texts. In addition, it has no provision for quality control of foodstuffs for export to meet the requirement of the importing country. Similarly, it has no provision on due diligence, food traceability and recall from the market in case of adulterated or substandard food products. It has no provision of mutual recognition or equivalent for food tests and certificates. The act has provisions on product standards, but not on system standards that are necessary for international trade. The definition of adulterated foodstuffs includes those wholly or partially made of any sick or disease carrying animal or bird. But this provision overlaps with Animal Slaughterhouse and Meat Inspection Act (1999) and Animal Health and Livestock Services Act (1999).

National Parks and Wildlife Conservation Act (1973) (fourth amendment 1992) exempts killing or wounding wildlife in self defence, or saving life of other person or domestic animals from sudden attack of any wildlife. The act also empowers the government to kill or capture wildlife that cause considerable loss to human beings or to domestic birds and animals and also to rogue wildlife suffering from diseases or disability with low chance of survival. But this act has no provision of controlling wild animals from spreading contagious diseases within the country or across borders.

Black-marketing and Some Other Social Offenses and Punishment Act (1975) (amendment 2010) has provisions for controlling unduly high price of and adulterations in consumer items. More specifically, the legislation prohibits sales of sub-standard goods claiming as standard ones, and adulteration of goods to reduce the standard of the goods without disclosing that fact. The act also prohibits sales of adulterated and date-expired medicines and non-medicines as medicines. The upper limit for fine is NPR 25,000 and due diligence of corporate bodies is to be counted while setting the punishment. An informant gets 25 percent of the fine as his commission.

Feed Act (1976) (amendment 2010) sets guidelines and provisions for standards and enforcing them for locally produced and traded animal feeds[8]. It has provisions to maintain appropriate standards of feeds to prevent undesirable adulteration in the feed and subtraction or extraction of any natural quality or utility contained in the feed. It prohibits production, sale, distribution, export, import and storage of contaminated[9] feed or those not meeting the quality standards. The Act has provision for determining the quality of feed, minimum quantity standards of its constituents and permissible limit of additives. The legislation helps in protecting health of animals and humans through quality and low contaminated feeds. Though the act prohibits contaminated feeds, it has no provision on recall of such feedstuffs from the market. The act has no provision on traceability, due diligence and equivalence. Similarly, the law has no liability rules for death or disease of animals by consuming the contaminated feeds.

Drugs Act (1978) (second amendment 2000) prohibits misuse or abuse of drugs and allied pharmaceutical materials as well as false or misleading information relating to efficacy and use of drugs, including veterinary drugs. It also bans the production, sale, distribution, export, import, storage and consumption of drugs that are not safe for public consumption, inefficacious and of substandard quality. Similarly, it prohibits adulteration in drugs and sale or distribution of date expired drugs. The Act prohibits sale, distribution, storage or consumption of substandard medicine[10]. If any substandard medicine causes any harm or loss to any person, the Act has

[8] The Feed Act defined feed as solid or liquid materials or the mixture of them used to feed birds, animals and fishes.

[9] The Act has defined contaminated feed as the feed in which the proportional content of the main constituent has been decreased to make it substandard; or other materials has been mixed; or which has been decomposed, or waste or toxic materials has been mixed, which are harmful to birds, animals and fish.

[10] The Act defines medicine as the substance or constituent added to the substance used for curing any disease occurred to human beings, animals, or birds or for preventing from diseases; or for destroying the bacteria and insects that transfer diseases to human being, animals or birds; or the substance used for causing effects on physical structure or process of human being or animals or birds.

liability rules for recovering the cost of compensation from the distributor of the medicine. It has made a provision for inspection of production, storage, sale or transportation of medicines. The government is authorized to forbid production, storage, sales or transportation of medicines if suspicion arises on safety, effectiveness and quality of medicines. If the test of the medicine confirms that it is unsafe for human, ineffective or of poor quality, such medicines need to be destroyed and production license can be revoked or suspended. The act has no provision for risk analysis of imported drugs. It bans date expired drugs, but does not specify the number of days that should be remaining for expiry while importing a drug. The definition of a drug includes substances used to destruct vermin or insects which cause diseases in human or animal. It means that even the pesticides come under the definition of drugs that overlap with the Pesticides Act (1991). Though the act also governs the veterinary drugs, it has no provision for liability of death of animals due to low quality drugs.

Nepal Standards (Certification Mark) Act (1980) (amendment 1991) authorizes the government to form a Nepal Council of Standards for the purpose of making arrangements for determining standards in relation to any good, process or services and affixing marks thereon. The Council is to determine standards in relation to any goods, process or service and grant recognition to any governmental or nongovernmental laboratory for the purpose of determination of standards or tests. The act also establishes Nepal Bureau of Standards for issuing licenses for the use of voluntary certification marks or certificates of standards and inspecting standard of any goods, process, or service. The government can make the standards determined by the Council compulsory for the producer, manufacturer, distributor or service provider in the interest of public health and public security. But this provision is for goods or processes other than pharmaceuticals and foodstuffs whose standards are prescribed under the Drug Act (1978) and the Food Act (1966). It also entrusts the government to prescribe standards of goods meant for export or import in the interest of public health or public security. The act, however, has no provision for addressing environmental problems caused by the production process of standard certified products.

Solid Waste (Management and Resource Mobilization) Act (1987) (first amendment 1992) requires controlled disposal of solid wastes harmful to health through infectious or contaminative disease or otherwise. This act entrusts Solid Waste Management and Resource Mobilization Centre to make arrangements for solid waste management. The Centre may order any enterprise, agency or individual to clean harmful solid waste that is likely to adversely affect the public health. The Centre may itself make arrangements for removing or cleaning such solid wastes and charge necessary fees to the enterprise, agency or individual. For welfare and convenience of the public, the Centre may issue order prohibiting such actions as keeping, throwing, burning, burying, or otherwise storing, disposing of or destroying harmful solid wastes in any public or private place. The act also authorizes the Centre to prevent air, soil or water pollution from solid wastes with adverse effects on human, animals, plants and other objects. The act also prohibits polluting streets or other public places by slaughtering of any kind of biped or quadruped, leaving or throwing dead birds or animals, cleaning fish or throwing rotten fruits, vegetables or other materials. This act entrusts Solid Waste Management and Resource Mobilization Centre to make arrangements for animal slaughterhouses which overlap with Animal Slaughterhouse and Meat Inspection Act (1999).

Seeds Act (1988) (amendment 2010) has provisions on seed quality standards through testing, certification and truthful labelling. For the purpose of quality control it requires permit to export and import seeds of notified varieties. The aim of this Act is to produce high quality seeds, process them and test in order to make available quality seeds to the farmers. It has provision for forming a seed committee to formulate national policies on seeds, to make arrangements for producing and distributing seeds and to control seed quality. The committee is given power to approve new seed varieties and release them and grant breeders right on new variety of seed after testing its speciality, uniformity and permanence. The Act empowers the government to establish an agency for certification of seeds on the basis of prescribed quality standard. The act has no provision for risk analysis of imported seeds as well as on the expiry of the seeds. It established no liability for crop failure due to sales of low quality seeds.

Pesticides Act (1991) regulates import, export, production, purchase, sale and use of pesticides. It prohibits import, export, production, use, purchase and sale of any pesticide other than those notified by the government. License is compulsory for formulation, sales, distribution, or (large scale) commercial use of the notified pesticides. This act includes the provisions of safe use of pesticides. It empowers Pesticide Registrar and Pesticide Committee to regulate pesticides production and imports requiring import certificates, reseller licenses and production permissions. The act has provision to fix standards of pesticides. The act does not require a prescription for selling pesticides. It has no liability rules for death or disease of human or animals due to unsafe consumption of pesticides. The act has no separate provision for organic pesticides as well as obsolete pesticides. It includes no provision for reducing the health effects and environmental pollutions from pesticides. It requires no risk analysis for registration of the pesticides. Moreover, the act has no provision on the liability due to pesticide poisoning from storage or field application. Likewise, the act has no provision on deregistration of any pesticide or to ban a pesticide already registered.

National Dairy Development Board Act (1992) (amendment 1998) has provisions for National Dairy Development Board with objectives, inter alia, to maintain the health and convenience of the general public by promoting milk production through public participation and coordination with private investors. The Board is expected to support the formulation of policies relating to dairy business particularly, importing goods required for the production and promotion of milk and dairy products and exporting the produced milk, dairy products and feeds and also to prepare dairy development plans. It is supposed to identify measures for solving problems in the livestock development and animal health sector. The Act also entrusts the Board to provide technical support to establishment, reform, promotion and protection of dairy industries. Though the preamble of the act states maintaining health of general public as an objective, the act itself has no provision on human health protection.

Mother's Milk Substitutes (Control of Sale and Distribution) Act (1992) regulates mother's milk substitutes as well as the sale and distribution of infant foods in the market. The act prohibits manufacturer and distributor to make an advertisement for promoting the use of mother's milk substitutes and giving an impression or creating a belief that the feeding of them is equivalent to, or better than, mother's milk. It also forbids manufacturer and distributor to give or distribute samples of products to any person and to promote mother's milk substitutes in the health care system. It is said that such products shall conform to the standards specified or recommended by the Nepal Bureau of Standards when it is manufactured, sold or otherwise distributed and the Central Food Laboratory shall have the powers to test whether such products marketed are fit for consumption by a human being. Manufacturer and distributor of mother's milk substitutes shall get the product tested by the Central Food Laboratory and obtain certification. The act gives strict and elaborate labelling requirements for such products. The act has provision for compensation to the person aggrieved from any action of manufacturers, distributors or health workers contrary to this act. The quality and labelling requirements of mother's milk substitute or infant food, however, overlap with the general provision of the Food Act (1966).

Water Resources Act (1992) has provisions that water utilization should not have substantial adverse effect on the environment through pollution, soil erosion, floods or landslides. Similarly, users of groundwater need to comply with the act for water conservation. The act authorizes the government for fixing quality standard of water resources for various uses and setting the pollution tolerance limit for water resources. The act prohibits water pollution by way of using or putting any litter, industrial wastes, poison, chemical or toxicant to the effect that the pollution tolerance limit of the water resource is exceeded. This provision, however, overlaps with Environment Protection Act (1997). The act has no provision on human, animal or plant health from uses of polluted water.

Nepal Agricultural Research Council Act (1992) (amendment 2010) establishes the Council and makes provisions for enhancing economic standards of the people through research services in agriculture. It gives a mandate to the Council for conducting research in plant and animal diseases and food quality. The Council is entrusted to develop new varieties of seeds, analyzing fertilizers and agricultural products, and providing technical facilities for agricultural farms and laboratories.

Forest Act (1993) (first amendment 1999) aims to promote a healthy environment through development and conservation of forests and the proper utilization of forest products. The objectives are fulfilling basic needs of people, attaining socio-economic development, promoting healthy atmosphere and managing forests. For management purpose, forests are divided into a number of categories - national forests, protected forests managed by the government, community forests, leasehold forests and religious forests managed by the people. The act, however, does not address the problems of diseases, pests and invasive species in the forests.

National Tea and Coffee Development Board Act (1993) is enacted to bring about harmony in the farming and processing of tea and coffee, and produce tea and coffee of high quality by using modern technology. The Board is to facilitate the supply of loans, seeds, plants, chemical fertilizers, pesticides, equipment, fuels, and technical service required for the small farmers. But the act has no provision for quality production or organic production of tea and coffee and pesticide residue limits on them.

Consumer Protection Act (1997) (amendment 2010) confers right to the consumers to be protected from the sale and supply of consumer goods and services which may harm life, body, health and property. It prohibits acts of diminishing or degrading the quality or utility of consumable goods or services. Only those goods or services that meet the set standards can be sold, exported or imported. The act prohibits production, sales, supply, export or import of sub-standard consumer goods which include lower than specified quantity of essential ingredients or any other material mixed, or stale, rotten or stored or prepared in dirty or toxic conditions or in which any chemical, colour or flavour has been used so that they become harmful to health. It also includes consumer goods which are fully or partly made of any diseased or disease-causing animals or birds or harmful vegetation or of a quality which falls short of the minimum necessary standard or exceeds the maximum standard prescribed if any. The act has strong liability rule in place. Consumer who suffered a loss or damage shall get compensation on the basis of such loss or damage. In the case of death, the heir can get the compensation. Though it is an Act with a wide scope covering all consumer goods and services, this is much stronger than the food act even for controlling food quality. But this act has no provision on biosecurity to reduce threats of bioterrorism, for example through postal parcels or other mediums.

Environment Protection Act (1997) aims at reducing environmental impacts of development activities. The objective is to maintain clean and healthy environment through appropriate management and utilization of natural resources and minimizing the negative impacts likely to be caused from environmental degradation on human beings, animals, plants, nature and physical objects. The Act has several provisions for avoiding or minimizing negative impacts of physical activities in forestry, agriculture and environment and development activities on human beings, animals, plants and infrastructure. It prohibits pollution that cause significant adverse impacts on the environment or likely to be hazardous to public life and people's health. It also prohibits disposing sound, heat radioactive rays and wastes from any mechanical devices, industrial enterprises, or other places beyond prescribed standards. It also has provisions for establishing different laboratories or prescribing any existing laboratory to help in the activities related to environment protection and pollution control. Similarly, the law has provision for compensation for sufferers from creation or disposal of sound, heat or wastes or other pollution. It has provisions for environmental impact assessment (EIA) for polluting production process and initial environmental examination (IEE) for less polluting production process. But this act is related to environment per se and people's health not with the environment related health and life of animals and plants. Even for the human health problems from pollution it is not clear to whom and how the problem be attributed among several polluters. Moreover, this act has no provision on transboundary pollution. The Act's provision on protecting areas with rare wildlife, biological diversity and plants somehow overlaps with that in the National Parks and Wildlife Conservation Act (1973).

Animal Health and Livestock Services Act (1999) provides necessary regulations for animal health and livestock services to produce healthy food. The government is authorized to examine animal (livestock, poultry and fish), animal products or animal production inputs if a contagious disease is suspected. If the presence of such a disease is confirmed, such animal, animal products or animal

production inputs can be destroyed and movement and transport of animals from that place may be restricted. License is necessary for selling biological products, chicks, fingerlings and also for meat processing. The act authorizes the government to set quality and standard of biological products, chicks, fingerlings or meat processing. It also has provisions for sales, distribution, export and import of quality animal products. Likewise, it regulates animal quarantine, breeding, establishment of an industry and export import, and even prevention of cruelty to animals. The quarantine check post may prohibit the entry of animal, animal products or animal production inputs if information is received that the consignment is brought from regions with outbreak of contagious diseases or fail to produce sanitary certificate. A ban can also be imposed if any animal is found dead by contagious diseases or the vehicle carrying the consignment is found to be contaminated with contagious diseases. For effective quarantine control, the act requires a recommendation letter for import or export of biological products, chicks, fingerlings or animal feed. The license for meat processing overlaps with the provisions of the Food Act (1966). The act authorizes the government to constitute a committee for the prevention of cruelty to animals, but the cruelty to animals is neither defined nor outlawed. No power is given to the committee for preventing cruelty. Although the act authorizes the government to appoint a Veterinary Inspector in order to inspect the quality and standard of veterinary drugs or biological products, the veterinary drugs fall under the purview of the Drugs Act (1978). Moreover, the Act does not cover adequately how animal health in farms can be improved and livestock services effectively delivered to farmers for the production of healthy animal products. It also does not cover zoonotic diseases and effects of residues of veterinary drugs and hormones on the consumers or traceability of the animal products.

Animal Slaughterhouse and Meat Inspection Act (1999) is formulated to prohibit the adulteration of meat and meat products and to maintain their quality standards by avoiding the degradation in its natural quality. It aims to reduce the risks of meat borne zoonotic diseases among the consumers and has provisions for establishment of slaughterhouse and arrangement for meat inspection to safeguard the health and welfare of the people in general and to control adulteration in meat and meat products and to maintain reasonable standard of meat by protecting the wholesomeness, quality and adequacy of meat. Entrepreneurs of animal slaughter houses and meat sellers need to obtain permits for the meat business. The meat being sold needs to be certified. This act is not yet implemented due to resistance of meat entrepreneurs. The act is incomplete in itself. It does not cover how the animals should be transported to the slaughterhouses, and how the animals should be kept for inspection. It has no provision for hygienic condition of the slaughterhouse or slaughter place. Similarly, it has no provision on meat storage and cooling requirements. Nothing is written about packing and packaging of meat and meat products and sanitation on meat transportation and retailing.

Nepal Veterinary Council Act (1999) (amendment 2010) establishes the Council to make veterinary business effective. It has provisions for controlling the quality of veterinary services through registration of veterinary practitioners and their classification on the basis of education and experiences. The Council is also to explore or invent new veterinary drugs. It is entrusted to prepare policies, plans and programs for smooth operation of veterinary business and veterinary health service. The Council also has a mandate for suggesting the government for setting standards of veterinary drugs, biological substances, feed, pullets, animal products and materials. It also gives advice to the government on matters related to veterinary and animal health. The provision about the veterinary drugs overlaps somehow with the Drugs Act (1978).

Local Self-Governance Act (1999) guarantees people's participation in governance. Some of the principles adopted by the act are making the local government accountable to the people in its own areas and encouraging the private sector to participate in local self-governance in the task of providing basic services for sustainable development of their territory. The functions of District Development Committee include arranging supply of medicines and inspect and monitor their quality standards. It has provisions on vesting the rights to the local government for controlling plant and animal diseases and food quality in the market, managing solid waste and other pollutions and protection of the environment. The act authorizes local governments to operate veterinary hospitals, as needed, for the prevention and control of animal diseases within the

area. This act gives authority to local governments to impose a ban on any activity that cause or likely to cause adverse impact on people and environment within their territory. The municipalities are also responsible for securing public interest by killing rabid and stray dogs and specify places to bury dead animals and birds. The municipalities are entrusted to determine places for keeping pinfolds and animal slaughterhouse and manage them. However, the punishment part of the act is very weak. Nobody can be charged for non-implementation of the provisions contained in this act. If somebody goes against this act, the maximum possible punishment is a fine of NPR 1,000 for the first time which doubles for each repeated crime.

Contract Act (2000) has provisions for the supply of quality goods as per a contract and special provisions concerning compensation. As per the provision, the goods sold or to be sold shall be deemed to be of merchantable quality which means that the goods sold or to be sold for any specific purpose should be suitable for that purpose. In the case where good are purchased on the basis of samples, the act authorizes the buyer to compare the quality of the main supply with the sample to ensure that the former corresponds to the latter on quality. The act, however, does not take into account the special nature of food and agriculture related contracts.

Plant Protection Act (2007), which replaced Plant Protection Act (1972), provides legal provisions for preventing the introduction, establishment, prevalence and spread of pests from import and export of plants and their products. The act prohibits the import of any plant, plant products, biological control agents, beneficial organisms or soil without obtaining an entry permit and phytosanitary certificate. The legislation also empowers the government to designate routes for import and export and requires compliance to import and export formalities including phytosanitary certificates. It also has provisions for exporting pest free consignments of plant and plant products. This act authorizes the government to use phytosanitary certificate for import, export or re-export in combination with inspection, test and treatment, pest risk analysis. It also has provisions for the declaration of quarantine pests and controls in consignments. The Act regulates the production, trade and within-country movement of plants and plant products. It also has provisions for establishment of laboratories, checkpoints and quarantine stations. Though the act requires pest risk analysis and determination of regulated pests, these are not categorically specified for import consignments.

Agriculture and Forestry University Act (2010) established the University to conduct study, teaching and research on agriculture and forestry in an integrated manner. The act authorizes the University to establish Research Centres as needed in order to carry out research activities in the fields of agriculture and forestry.

A new bill—Nepal Accreditation Council Bill—is available in a draft form. This bill proposes an Accreditation Council for equivalence and accreditation of laboratories or organizations, in public as well as private sector, involved in testing, calibration and conformity assessment of production and management system. It also proposes for establishment of subject-specific Accreditation Boards on the recommendation of the Council for managing the functions of equivalence and accreditation. In addition, a draft of Nepal Standard Bill is also available. This bill was developed for integration of laws related to standards and also for amendment of related existing laws. This bill proposes for a Nepal Standard Council. But this draft bill does not cover medicine and food standards.

To conclude this sub-section, it is worth quoting a paragraph from the FAO Biosecurity Toolkit, "Sound biosecurity legislation is necessary to create an enabling environment of predictability and certainty through good governance and respect for the rule of law. Law clarifies the roles, responsibilities and rights of different stakeholders, including those parts of government with policy and delivery roles for biosecurity outcomes and programmes, in order to ensure consistency and accountability" (FAO, 2007). To summarize the status in Nepal, current legislative provisions for biosecurity can still be considered to be limited and scattered. Some laws are very old with inadequate provisions while others still lack the provisions necessary for effective implementation of biosecurity. Current regulatory framework does not cover all the areas as required by the SPS agreement. As discussed above, it has, for example, poor liability rules such as recall and traceability, making biosecurity weak in domestic consumption and export. On imports, the provisions of pest risk

analysis are not clearly stipulated. The regulations on end product quality are somehow justifiable given the level of Nepal's development and appropriate level of protection, but are inadequate on quality control in the production process. In addition, no legislation clearly spells provisions for laboratory accreditations. From the standpoint of the legislative needs for biosecurity, it is clear that the related laws are widely scattered in different acts that were developed over a long period and under different forms of government. Most of the acts need amendments and a new act needs to be developed for implementation of the biosecurity policies.

2.4 The State of Institutions for Biosecurity

Recognizing the importance of safe food, feed and medicine, and also of the need for quarantine control of plants, animals and their products, several institutions have been established in the country. The main responsibilities for food quality and quarantine control are entrusted to the Ministry of Agricultural Development (MOAD), quality control of medicines to Ministry of Health and Population (MOHP), quality control of other products to the Ministry of Commerce and Supply (MOCS), biodiversity conservation and biosafety to Ministry of Forest and Soil Conservation (MoFSC) and environmental protection to Ministry of Science, Technology and Environment (MOSTE).

The main mandate of the MOAD is agricultural development through technology generation and transfer to farmers and the provision of essential services for food and agriculture. It is also a regulatory body for quality and quarantine control. National SPS Notification Authority under the MOAD is responsible for notification to the WTO of legislation, regulations, standards and guidelines affecting trade – a total of 19 such notifications on technical regulations and directives have been made by 2011. The notifications on product regulations include the mandatory technical regulations for product standards of maize, paneer, clove powder, cornflakes, preservatives, fennels, green tea, lunchmeat, rice and MRL of heavy metals. The MOAD controls the quality of farm inputs (seeds, fertilizers and pesticides) and that of primary and processed agricultural products through three departments under it—DoA, DLS and DFTQC. The DoA being the focal point for APPPC and IPPC performs tasks of plant quarantine, plants diseases, pest control and pesticide control. Plant protection directorate under DoA is responsible for pesticide registration, conventional pest management and IPM. Likewise, the DLS is the focal point for OIE and performs functions relating to animal quarantine, animal disease control and administration of veterinary drugs. It has also responsibilities for meat inspection.

The DFTQC performs functions relating to the development of food technology, food quality control, feed quality control and food quarantine. This department administers food related technical regulations under Food Act (1966) and Feed Act (1976). Under these legislations, 110 technical regulations have been approved including that for large cardamom, ginger, honey, tea, coffee, pasta/instant noodles, lentil, etc. The department operates the CFL for food testing, has inspectors for food inspection and has the right to inspect food processing plants for compliance to the legislation and standards. DFTQC develops and implements food and feed related mandatory horizontal and vertical standards. Its mandate is to control quality of food and feed produced domestically and imported for protecting health of people and animals within the country and also to promote exports of these products. The department has also developed codes of practices for biscuits, instant noodles, pasteurized milk, edible vegetable oils, and processed drinking water. The department is also working as SPS enquiry point, Codex focal point, and National Codex Committee secretariat. The DFTQC and all other departments support the MOAD in the formulation of legislations and application of internationally acceptable standards for quality and quarantine control.

Under these departments, laboratories are developed at central and regional levels. The major laboratories related to biosecurity are CFL[11] under DFTQC; National Veterinary Diagnostic Laboratory, National Veterinary Quality and Medicine Management Office Laboratory, National Avian Disease Diagnostic Laboratory (Chitawan), and Feed Analysis Laboratory under DLS; Plant Protection Laboratory and Soil/fertilizer Analysis Laboratory under DOA and Seed Quality Control Laboratory under MOAD.

[11] Central laboratory of DFTQC is accredited to Indian laboratory for chemical and microbiological tests, particularly for some test parameters related to fats and oil and microbiological safety.

Department of Drug Administration (DDA) under the MOHP is responsible for quality control of medicines including that of veterinary drugs. The DDA is responsible for ensuring the safety, efficacy and quality of drugs made available for use. Nepal Bureau of Standards and Metrology (NBSM) under MOCS has developed 862 Nepal Standards (NS) and NS/ISO standards (as of 2011) that include product and process standards and vocabulary terminology. Nearly one-third of these voluntary standards are for agricultural products, agricultural inputs, processed food products and additives used in the processed food products. The MoFSC hosts the focal points for biosafety and biodiversity as well as for Cartagena Protocol on Biosafety and the Convention on Biological Diversity (1992). MoFSC is also involved in other issues such as sustainable forestry certification and implementation of the International Convention on Trade in Endangered Species (CITES) in animals. The Ministry's Department of Plant Resources and Department of Forest are responsible for executing the mandates of the ministry. The MOSTE is concerned with environmental issues for controlling pollution and conserving environment. Its Department of Environment was established recently to execute the mandate of MOSTE. Still another institution related to biosecurity is the Federation of Nepalese Chambers of Commerce and Industry (FNCCI), which is the representative agency of the private sector and works on policy advocacy on behalf of private business.

In closing, institutions are necessary for enforcement of the legislative provisions. It is generally accepted that the monitoring and enforcement are weak with obvious non-compliance of regulations relating to standards and quarantine measures. Capacity strengthening of relevant institutions is necessary so that they are able to perform their functions effectively, efficiently and sustainably in order to protect human, animal and plant life and health along with the protection of associated environment to achieve sustainability. For capacity building they need clear policies, strong and clear legislations, efficient regulations, functional organizational arrangements, well trained staffs, smooth communication and information exchange and strong supports from the private sector. It is pertinent to close this sub-section with the following statement from the FAO Toolkit on Biosecurity:

"A clear institutional framework within which to manage biosecurity is an important part of a more harmonized and integrated approach to biosecurity. The institutional framework identifies the competent authority or authorities responsible for establishing biosecurity controls and ensuring their implementation, as well as any other stakeholders involved. It also sets out the rules and procedures governing their roles and defines the mechanisms through which they work towards shared goals" (FAO, 2007).

2.5 Overlaps and Gaps in Policy and Regulatory and Institutional Set Ups

2.5.1 Overlaps

The policy documents developed by different agencies in different contexts and urgency tend to overlap, refine and reinforce their provisions. But overlaps in legislation create problems in implementation. Around 25 legal acts are, in one or the other way, concerned with the present concept of biosecurity. The more seriously and deeply recognized the problem, the more are the overlaps. For example, several acts have provisions on food quality and standards. Food Act (1966) is dedicated to safety and quality of food products. But the Black-marketing and Some Other Social Offenses and Punishment Act (1975), and Consumer Protection Act (1997), with much stronger liability rules, overlap in their provisions with the Food Act for food quality control and liability rules. Mother's Milk Substitutes (Control of Sale and Distribution) Act (1992) has quality and labelling requirements for mother's milk substitutes or infant foods that overlap with the Food Act (1966). Animal Health and Livestock Services Act (1999) requires a license for meat processing which overlaps with the Food Act (1966). Though the Standards Act clearly mention that food and pharmaceuticals are not within the purview of this act, its implementing agency, the Department of Standards and Metrology, has developed voluntary standards for several food products.

At least four acts have provisions for the management of animal slaughterhouse. Animal Slaughterhouse and Meat Inspection Act (1999) has elaborated provisions for slaughter house, giving the responsibility to DLS. But, Local Self Governance Act (1999) entrusts the authority of slaughterhouse development to the local governments. In addition, the definition of

adulterated foodstuffs under the Food Act (1966) includes those meat wholly or partially obtained from any sick or disease carrying animal. Likewise, Solid Waste (Management and Resource Mobilization) Act (1987) entrusts the tasks of arranging for animal slaughterhouses to Solid Waste Management and Resource Mobilization Centre.

Legislation on veterinary drugs is also overlapping. The Animal Health and Livestock Services Act (1999) authorizes the government to appoint Veterinary Inspector in order to inspect the quality and standard of veterinary drugs or biological products. But the veterinary drugs are under the purview of Drugs Act (1978). Similarly, Nepal Veterinary Council Act (1999) has provisions for monitoring such drugs. Likewise, the definition of drug under the Drugs Act includes substances used to destruct vermin or insects which cause diseases in human or animal. It means even the pesticides come under the definition of drugs that overlap with the Pesticides Act (1991). Though the Drugs Act (1978) also governs the veterinary drugs it has no provision of liability for death of animals due to low quality drugs. Black-marketing and Some Other Social Offenses and Punishment Act (1975) prohibits sales of adulterated and date expired medicines as well as non-medicine as a medicine, which also overlaps with Drugs Act (1978).

Overlaps in legislations are both the cause and effects of un-clarity in institutional roles. The institutions are vital in developing legislation concerning their works. Biosecurity related institutions have many overlapping roles and responsibilities. For example, quality control of feed is under the jurisdiction of DFTQC but the responsibility for animal nutrition is under the DLS. Similarly, authority to control the veterinary drugs is under the DDA whereas the responsibility for controlling animal diseases is with DLS. Likewise, honeybee and fish diseases are OIE-notifiable under the Terrestrial Animal Health Code (TAHC), honey quality is the responsibility of DFTQC and the OIE focal point is with DLS but honey and fish productions are handled by DOA. Similarly, import of forest plants and control of invasive wild species and related risks are under the purview of the MOFSC, but the quarantine control is under MOAD. The focal point for Cartagena Protocol on biosafety[12] is MOFSC whereas the GMO and LMO are mostly the concerns of the agricultural sector. Biosecurity is much wider concept encompassing the biosafety as well and falls under the jurisdiction of many departments.

2.5.2 Gaps

Food security and poverty alleviation are among the core objectives stressed in GoN's current policies, and yet the policies lack clear and focussed provisions on safeguarding human health, environment and biodiversity from negative impacts of substandard, poor quality and contaminated food, feed, medicines, and other chemicals. Many gaps were noted in the earlier sub-sections. For example, tea policy allows tea farmers to directly import pesticides but has no provision on pesticides MRL. Likewise, irrigation policy is silent about water quality for irrigation, risks of pathogen and heavy metal contaminations. Dairy Development Policy does not mention quality control, GMP or third party certification. The Industrial Policy does not directly address food quality and safety, quarantine issues of imported raw materials and environmental pollution from the industrial production. WTO agreement requires risk assessment and transparency for application of any legislation that affects trade but is yet to be followed in Nepal. In legislative provisions, liability rules are either lacking or at least inadequate on problems relating to food safety and quality and quarantines crossing of diseases and pests. Provisions on pest and disease risks analysis are lacking in most of the legislations and inadequate in some others. The existing legislations have various provisions with regard to maintaining quality of food, feed, medicines and seeds. But they are broken to pieces into different acts, posing a big challenge in effective implementation.

To conclude the section, Nepal has the essential policy and legislative and institutional frameworks for seriously addressing biosecurity. Currently these are scattered and so are of limited effectiveness to tackle biosecurity, which is an integrated and holistic framework. As assessed above, one finds the manifestation of this fragmentation in all three areas - policy, legislation and institutions. It could be said that while the institutions are effective

[12] Cartagena Protocol on Biosafety requires adopting necessary measures in order to avoid or minimize the adverse effect likely to be caused from the use of GMOs for agriculture purpose, animal husbandry, fishery, forestry purpose or processing on the human health, biodiversity and environment. It requires conducting risk assessment for the development, handling, transfer, transport, use and release of GMOs.

in delivering services in their sectoral functions as guided by existing policy and available legal frameworks, the management of cross-sectoral issues is weak and communication among them inadequate.

2.6 Conclusions

The Government of Nepal, with support from various donor agencies and expert services, has developed policies, legislations and institutions to address different aspects of biosecurity during different time periods. One finds some legislation developed some 50 years ago but that have still some linkages to recent efforts in biosecurity. Food Act and related acts are weak in addressing risk-based food safety requirements. The detailed review in this paper shows that although recent policies and legislations have incorporated many provisions essential for responding to biosecurity-related challenges, they are still inadequate for what is needed for achieving biosecurity in the country. There are several gaps, overlaps and inadequacies on such policies and legislations. Legal provisions and regulations are necessary for meeting standards set by Codex, OIE and IPPC. For safeguarding the interest of consumers, close monitoring of food safety and quality is necessary. For such monitoring, there is a need for strong institutions and adequate legislative provisions that empower the institutions. For coordinating the different pieces of legislation, there is a need for a strong biosecurity policy. The country, therefore, needs a new framework and separate set of policies for addressing biosecurity. This also requires amendment of over two dozen legal acts and regulations under them or enacting a separate consolidated biosecurity act for implementation of the policy.

Nepal's per capita income is rising and poverty head count ratio is falling over the years. As a result, demand for high quality convenient food products are growing rapidly. Increasing urbanization is another factor in creating market for agro-food products from villages. New agribusinesses are emerging in the country, particularly on perishable products such as poultry and dairy processing, flower, fruit and vegetables, honey, processed food, packed water and like. At the same time, and for the same reason as above, imports have been growing rapidly, including across the porous border with India. The latter adds to the further challenge of managing quarantine and safety of imported foodstuffs, plants and animals. In the meantime, due to fluid political situation, enforcement of existing policy and laws has been weak and inadequate, threatening food safety more frequently than otherwise. As the risks of hazards such as residues and diseases have the potential to move across agro-food supply chain, human, animal and plant health and environmental issues have converged together making sectoral approaches inadequate and ineffective. Security lapse at one point in the agro-food supply chain can have consequences for the rest of the food chain. Therefore, a holistic approach to biosecurity with an integrated framework is what has now become necessary.

Policy provisions are essential for improving quality, safety, labelling, traceability and certification. They also set course of actions for the government to address biosecurity risks in food and agriculture and provide a common basis for assessing biosecurity risks (FAO, 2007). On the basis of the policy assessment in this paper, combined with technical assessment of biosecurity in crops, livestock and poultry, fisheries, forestry and food safety and quality, presented in the subsequent chapters of this volume, the next step is to develop a biosecurity policy framework.

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CHAPTER 03

BIOSECURITY ASSESSMENT FOR THE FIELD CROPS AND VEGETABLES

Bhim Nath Acharya

Abstract

This paper assesses biosecurity issues for the crops sub-sector, notably vegetables and high value crops, and thus complements biosecurity status reports on four other categories of food products in this volume. It identifies gaps between current production practices and the desirable, biosecure practices. The study finds that the main source of biosecurity concern at the production stage is with excessive use of pesticides in commercial vegetables and not generally across the country as most of the cereals and high value crops are grown fairly safely. In addition, food quality and safety is increasingly compromised in the post-production stages for reasons of infrastructure, hygiene and weak control of existing rules. For many gaps, compliance costs are low and so require modest interventions. Where compliance costs are large, innovative approaches are needed for funding the costs, which include creating a regulatory environment for the private sector to invest and also recoup the cost from the market.

3.1 Introduction

Biosecurity is a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) for analysing and managing relevant risks to human, animal and plant life and health, and associated risks to the environment. It covers food safety, zoonoses, the introduction of animal and plant diseases and pests, the introduction and release of living modified organisms and their products, and the introduction and management of invasive alien species. Most countries have policies, legislations and standards for the safety of food, animal, and plants, but their formulation and implementation is typically scattered across government agencies, leading to fragmentation of effort, waste of resources, duplications and the risk of lapses within the system. This is where a national biosecurity framework adds value by responding to the challenges in a holistic manner.

The core building blocks of biosecurity are various good practices, e.g. for agriculture, livestock, fishery, post-production handling, manufacturing, and so on. These practices are collections of principles to apply for managing on-farm production and post-production processes, the control and compliance systems, resulting in safe and healthy food. Many countries have already formulated or are in the process of developing national good practices, the most prominent of these being Good Agricultural Practices (GAP). Nepal is in the process of formulating its own NepalGAP.

This paper takes stock of the biosecurity-related issues for the crops sub-sector, similar to other background status reports such as on livestock, fisheries and forestry (Chapters 4-7 in this volume). Three categories of crops are considered in this chapter: i) cereals and pulses; ii) vegetables and fruits; and iii) high value crops (HVC). As in other studies, the focus is on the GAP and similar other frameworks.

As in other background papers to follow, this paper also provides some analysis of the cost of compliance

to good practices, the cost being the difference in costs between the current and the new biosecure practices. It also presents stakeholders' views on the sharing of the incremental cost between the government and private stakeholders. One insight from this exercise is that information on compliance cost and its sharing between the public and private actors is highly useful for articulating policy and support measures, including subsidy.

The study is based on both secondary and primary sources of information, literature review and insights from experts. For primary information, field visits were made and interviews and discussions held with farmers, farmer groups, cooperatives, traders, processors and other stakeholders. A total of 20 districts were visited for interactions with farmers, including markets/collection centres in six districts. Visits were also made to selected plant quarantine offices. One consultative meeting was conducted in Dhulabari, Jhapa to validate the data and issues, with a focus on ginger.

The rest of the paper is organized as follows. The next section provides a background on what constitutes the essentials of biosecurity for the crops sub-sector, which provide the basis for discussing the gaps for Nepal, later in the paper. IndiaGAP is used to illustrate the issues. Section 3.3 assesses the status of biosecurity in crops sub-sector, covering aspects of gaps and desirable interventions, and biosecurity-related policy, legislation and institutions in the crops sub-sector. Section 3.4 discusses compliance costs and public-private sharing of responsibility in meeting the compliance cost. Section 3.5 concludes.

3.2 The Concept of Biosecurity for Crops sub-sector

Biosecurity is a strategic and integrated approach that brings together a variety of instruments or processes in attaining the goal of biosecurity (FAO, 2007). These instruments or processes are various good practices and control systems that include detailed guidelines on what exactly is to be achieved. The need for a strategic and holistic approach for biosecurity arose for minimizing or avoiding the fragmentation and duplication of efforts, waste of resources, and lapses in the system that undermine the effectiveness of the efforts. Good practices provide the details on implementation.

For the crops sub-sector, broadly defined here to include cereals, vegetables and high value crops (HVCs) such as tea, ginger, cardamom etc., the core building block for biosecurity is the GAP. Its scope is limited to on-farm production and post-production processes at the farm. There are other best practices or control systems for the rest of the supply chains. These include Good Hygienic Practices (GHP), Good Storage Practices (GSP) and Good Manufacturing Practices for different segments of the chain. Then there is the HACCP and other quality control standards developed by the food industry and producer organizations and even by NGOs.

Individual countries seek to develop their own GAP and other practices drawing upon the best of the global practices and standards and adapting them to the country needs. The general trend is to use the global standards as far as possible because this harmonizes standards and facilitates trade. Such global practices and references are available in standards developed by inter-governmental bodies such as the Codex Alimentarius Commission, IPPC and OIE, as well as standards set by private bodies such as the GlobalGAP. Note also that there could be several separate GAPs for different products or sub-sectors. For example, as Nepal is yet to develop a NepalGAP, a concrete illustration of a GAP would be IndiaGAP.

India has been developing several GAPs – for food grains, fruits and vegetables, plantation crops, spices and condiments, oilseeds and nuts, livestock, etc. The Bureau of Indian Standards adopted IndiaGAP (Part 1 Crop Base) in 2010. Its Annex A presents *Control Points and Compliance Criteria*, which run into 23 pages of tables and 21 main Clauses and numerous sub-clauses covering all aspects of crop production. Table 3.1 shows the list of the 21 main Clauses. It is written in the above Annex that these control points and compliance criteria need to be followed by an applicant producer (individual grower and/or member of a grower group) as well as by the certification body for the independent verification of the agricultural practices that have gone into the production of the produce. In addition, the applicant producer needs to demonstrate compliance with all applicable statutory and regulatory requirements.

Table 3.1: IndiaGAP (Crops) - List of 21 Clauses of the Control Points and Compliance Criteria

Clause No.	Clause No.
A-1 Site Record and Traceability	A-11 Drainage System
A-2 Land and Soil Management	A-12 Crop Protection
A-3 Grower Record	A-13 Crop Maturity
A-4 Seeds and Planting Materials	A-14 Harvesting
A-5 Nursery	A-15 Post-Harvest Handling
A-6 GMO not Applicable if no GM Varieties are used	A-16 Packaging
A-7 Cultural Practices	A-17 Loading and Transport
A-8 Sowing/Planting/Transplanting	A-18 General
A-9 Plant Nutrient Management/Fertilizer use	A-19 Environmental Issues
A-10 Irrigation/Fertigation	A-20 Complaint Procedure
	A-21 Product Recall Procedure

Note: The list runs into 23 pages. What are shown in the table is only the main headings. Each heading has many sub-headings. As an example, heading A-12 Crop Protection has the following 9 sub-headings (and their further sub-headings as well): A-12.1 Pest Control, A-12.2 Integrated Pest Management (IPM), A-12.3 Plant Protection Products, A-12.4 Application Equipment, A-12.5 Plant Protection Product Residue Analysis, A-12.6 Storage and Handling of Plant Protection Products, A-12.7 Measuring and Mixing Equipment, A-12.8 Storage of Empty Containers, and A-12.9 Disposal of Empty Containers and Obsolete Plant Protection Products.
Source: Compiled by Author based on information in IndiaGAP (Part 1 Crop Base), BIS (2010).

The standards take into account not only the quality and safety of the crop produced but also the care and attention gone into integrating pre-harvest practices like soil and water management, nutrient management and pest management, harvesting, post-harvest handling, packaging, storage and other logistics. Annex B of that document presents a list of about 60 Indian standards, adopted over the decades, which facilitate the implementation of the main IndiaGAP standard. These are various codes, guidance, guidelines, considerations etc. for activities like the design of farm drainage tile or pipe system, grain handling equipment and accessories, code for design of surface farm drainage system, ethylene dichloride and carbon tetrachloride mixture etc.

Recently, FAO has developed a SAARCGAP Scheme which has been brought out in three parts namely Part I – GAP standards/ requirements (food safety; quality; environmental management; workers health, safety and welfare); Part II - Structure for implementing GAP in a country - Guidance for establishing Standardisation Organization; governing structure; Part III - Certification of GAP - Certification criteria, process, Certification Body requirements, Rules for using Certification Mark and finally an Annex listing all documents needed under Scheme. Four countries including Nepal are being supported to adapt the same in their countries.

In closing this section, it is useful to take note of some challenges related to GAP, as laid out in an FAO brochure. These are as follows:

a) In some cases GAP implementation and especially record keeping and certification will increase production costs. In this respect, lack of harmonization between existing GAP-related schemes and availability of affordable certification system has often led to increased confusion and certification costs for farmers and exporters.
b) Standards of GAP can be used to serve competing interests of specific stakeholders in agri-food supply chains by modifying supplier-buyer relations.
c) There is a high risk that small scale farmers will not be able to seize export market opportunities unless they are adequately informed, technically prepared and organised to meet this new challenge with governments and public agencies playing a facilitating role.
d) Compliance with GAP standards does not always foster all the environmental and social benefits which are claimed.
e) Awareness raising is needed about the "win-win" practices which lead to improvements in terms of yield and production efficiencies as well as environment and health and safety of workers. One such approach is Integrated Production and Pest Management (IPPM).

3.3. Assessment of the Status of Biosecurity in Crops sub-sector

3.3.1 Overview of the current status and issues

As agriculture gets commercialized, that is linked to and driven by markets, the adoption of modern production techniques such as high yielding seeds, fertilizers, pesticides and controlled irrigation is bound to grow. This has the effect of boosting productivity and production as well as the ability to supply differentiated products, contributing to growth and incomes, and consumer welfare. The increased use of modern inputs such as varieties of seeds, fertilizers and pesticides also bring with them undesired negative effects such as pollution, salinity, increased pest residues and an elevated risk of pests and diseases.

These second round effects of the green revolution have varying effect on different crops. It may be noted that the context here is commercialized farming, not the traditional and largely subsistence agriculture where most of these arguments do not apply. The focus of this paper is on the crops sub-sector, notably cereals, vegetables and high value crops (HVCs).

As regards *vegetables*, demand has been growing rapidly, fuelled by market demand from expanding urban areas, rising per capita consumption and year round availability due to improved varieties. The most important biosecurity concerns with vegetables are related to the use of pesticides and their effects on human health – both consumers and farmers - and pollution in growing areas. Unlike cereals, there are real and significant risks of pesticide residues as vegetables are consumed fresh and immediately after harvest. Vegetables are also more prone to diseases and pests. Use of hybrid varieties are also contributing to increased use of chemicals/pesticides and micronutrients. All in all, therefore, pesticides management is a serious issue in the vegetables sub-sector. Box 3.1 summarizes the main findings of a 2009-10 survey on vegetables farming in Nepal.

Box 3.1: Vegetables farming in Nepal and biosecurity issues

Nepal Vegetable Crops Survey 2009-10 (CBS, 2010) provides comprehensive statistics on vegetables farming in Nepal. It estimated that total annual production is 2.82 million tons, worth NPR 45 billion, with some 51 percent of the total output in the Terai and the rest in the hills. Grown in 232,295 hectares of land, average productivity comes to 12 tonnes/ha. While 70 percent of Nepal's households are involved in vegetable growing, only 18 percent are engaged in commercial farming. In terms of area, production and value, cauliflower tops the list (404,580 tons) followed by tomato (317,657 tons), cabbage (302,067 tons), pumpkin (166,424 tons) and radish (164,076 tons). Cauliflower, tomato and cabbage, which can be grown throughout the year, are also the most commercialized three vegetables.

The CBS survey also shows that vegetables grown in the high and mid-hills are typically for self-consumption and use negligible amounts of pesticides and fertilizers, and thus these products are almost organic. In contrast, there is an increasing tendency among commercial farmers linked to market to use more fertilizers and pesticides. In the Terai, the level of pesticides used in vegetables is considered to be similar to those in the bordering districts of India. Its use was found to be most prominent (used by 72 percent farmers) in the eastern and central Terai. Organic vegetable farming is still in its nascent stage, with only 8 percent of the farmers found using organic pesticides. Overall, almost 50 percent of the vegetable farmers reported using pesticides (insecticides or fungicides). The CBS survey also estimated that a total of NPR 9 billion is invested in vegetable farming annually, the largest portion (26 percent) being for organic fertilisers, followed by purchase/production of seeds (22 percent) and land preparation (16 percent).

From the standpoint of biosecurity/GAP, the dominant issue is management of pesticides. In contrast to cereals and pulses, vegetables are more prone to diseases and pests and so pesticide use is relatively high, although it is low compared to other countries. The use of hybrid varieties and offseason production also demands higher use of chemicals/pesticides and micronutrients and hormones. The risk emanates from the fact that vegetables are consumed fresh and right after harvest, unlike cereals, and so pesticide residue is the main issue. In GAP, waiting periods are prescribed, but in practice it is difficult to enforce. So, pesticide management needs to be taken much more seriously for moving up towards biosecure agriculture.

Source: Nepal Vegetable Crops Survey 2009-10, CBS (CBS, 2010).

In the case of *high value crops* (HVCs), a number of them have seen rapid growth in Nepal, notably ginger, cardamom, tea, coffee, turmeric and garlic. These products have large export potentials and so, except coffee, are also included in the list of products for promoting exports in the Nepal Trade Integration Strategy (MOCS, 2010). For HVCs such as cardamom, tea and ginger, value chain actors vary as compared to those for cereals and pulses. In ginger, small, semi-commercial and commercial farmers are involved in production. About half of the farmers, generally small ones, sell ginger immediately after harvesting at the farm gate or local hat-bazaar while other producers store for some time sell to large traders. With increased market orientation, both domestic and exports, value chains of the HVCs have been emerging and taking shapes, with variations in the length of the chains and the actors involved. In ginger, small, semi-commercial and commercial farmers are involved in production. Box 3.2 notes some gaps for ginger and tomato.

Value chains of cereals and pulses involve much fewer stages as compared to high value corps. In the value chains for rice, wheat, maize and pulses, the main stakeholders are input suppliers, producer farmers, local traders or collectors, city traders, wholesalers, industry/millers and retailers. Overall, the assessment points to a situation that is not as alarming, unlike with vegetables in commercialized pockets. When it comes to cereals, one could say that farming is largely organic or green, and so simple proven practices can have high pay-offs, i.e. without the need for large and expensive interventions.

To a large extent, the same also applies to high value crops. For example, for ginger and tomato, simply washing first and grading the products based on size, colour and quality can fetch premium prices, while the rest of the products could be sold at the average market price. The implication is that simple proven practices can have high pay-offs, i.e. without the need for large and expensive interventions. What is worrisome, however, is that food quality and safety is being increasingly compromised in the post-production stages due to the poor state of infrastructures and general unhygienic conditions, as well as weak control and enforcement of existing acts, directives and guidelines.

IPM is seen as the way forward for addressing one of the core concerns discussed in this paper. Views differ on the effectiveness of the IPM – some seeing this as a panacea while others expressing doubts about the claimed effectiveness. There is indeed a lack of evidence on the effectiveness of the IPM programme based on sound impact studies. In the meantime, innovative schemes appear to be needed for incentivising farmers to adopt the IPM technology, at least in the initial stages of adoption.

The GoN's extension programme does take into consideration guidelines and suggestions found in the GAPs, as well as feature prominently in projects such as the GAFSP. The messages are being taught, demonstrated and disseminated through various modes of extension such as farmers' field school and user groups and cooperatives. This is a non-divisive issue in the sense that all agree that more of these should be done. The further expansion of the IPM's farmers' school approach is highly recommended. There is also a view that the current districts under intensive IPM programmes be declared as "IPM-districts" so that, *inter alia*, products from there fetch a premium price in the market. The GoN could commission impact studies and applied research to articulate cost effective approaches, including incentive measures for farmers for adopting IPM and other good practices.

Box 3.2: Some gaps - Ginger and Tomato

Most of the ginger produced in Nepal can be considered to be biosecure (almost organic) as farmers use only farm yard manure and local inputs for production. For this reason, biosecurity can be enhanced and value added with relative small interventions, which include monitoring and certification. As most farmers sell ginger immediately after harvest, standards are poor in post-production phase as farmers sell without grading, cleaning and proper packaging. The case of tomato is different. Field visits revealed that tomato growers in some areas are not unaware of the harmful effects of pesticides. They have this feeling that production cannot be sustained without pesticides. There is very little of grading, packaging and labelling for tomato, as is the case with ginger. There is no product identification, market segmentation or separate marketing channel for IPM tomato.

As regards **production inputs**, pesticides are a dominant concern for biosecurity and thus assessed in a separate sub-section below. As regards *improved seeds*, overall, only a small proportion of farmers use improved seeds in cereal crops (15 percent in paddy, 13 percent in wheat and 9 percent in maize, according to NLSS (2010/11)). In the case of vegetables, on an average, one third of the households growing winter potato used improved seeds followed by 29 percent for onion. Likewise, 26 percent of summer vegetable growers and 16 percent of winter vegetable growers were found to use improved seeds. The use of improved seeds on maize, vegetables and lentil are not growing. But the adoption of hybrid seeds is on the rise. Hybrid varieties need more care and management and are also more prone to disease and pests. Another issue that needs to be addressed is the use of infected seed, which increases the risk of virus and other microbial infections in plants.

As regards *fertilizers*, imbalanced use of fertilizers (much more N relative to P and K) and inadequate micronutrients affects soil health and ultimately the crop and food products. Unbalanced use of mineral and organic fertilizers, or over fertilization, leads to harmful levels of nitrate in plants. Also related to soil nutrients, is the issue of elevated risk of microbial contamination and parasite afflictions due to the use of fresh animal and human faces and urine as fertilizers, especially given that water is also contaminated. The good news is that the IPM is gaining popularity, from cereals to fruits to vegetables.

Biosecurity issues are also closely linked to **trade**. Managing imports from a biosecurity standpoint is crucial for all agricultural economies. Some countries accord top priority to this matter, e.g. New Zealand and Australia. In Nepal's case, the main phytosanitary concerns emanate from imports from India given the long porous border.

There are 12 quarantine checkpoints functional along the Indo-Nepal border and three along the Nepal-China border. They are responsible to quarantine all plant diseases, insects and pathogens considered harmful to Nepal's plants and plant species. The two questions invariably raised while discussing this matter are that, first, the 12 check posts are not adequate for such a long border, and second, the capacity of these posts to enforce controls is weak (see for example K. C. et al., 2004). While the appropriate number of check posts could be debated, that the facilities need to be strengthened is hardly a divisive matter.

It is not just the one-way phytosanitary risks from imports from India. India is also Nepal's principal market for crops, vegetables and other HVCs. This market is projected to grow immensely and thus Nepal needs to take seriously its ability to produce and export safe and quality products. India has now IndiaGAP for crops and other products and therefore one way, or the only way, for making progress in this area is to study those requirements carefully and adapt NepalGAP accordingly. While global standards are essential for some products, it is meeting the IndiaGAP standards that matter more currently for most farm products. In the course of this study, hardly any paper was found that addressed this topic directly – that is exploring the gaps between Nepal's current standards and IndiaGAP. It is also useful to align with the GAP standards developed for SAARC countries as this will, in the long run, help in facilitating regional trade.

3.3.2 Pesticides – a dominant concern for biosecurity

With the availability and spread of HVCs and modern production inputs, total production has increased, but at the same time this has raised the risk of hazards and environmental concerns. The most common issues are soil and water contamination from over use of chemical fertilizers and pesticides, their residues in foods and vegetables, and further to other ecosystems. As said, inappropriate use of fertilizers, i.e. excessive use and wrong mix, in crops is not a serious issue in Nepal. In contrast, pesticides appear to be the major issue to be addressed, especially in vegetables. In view of this, a sub-section is devoted here to pesticides.

In Nepal, pesticide problems have been reported in almost all farming activities - food grains and fresh vegetables, fisheries and wildlife. The use of pesticide for plant protection has steadily increased with the introduction of high yielding varieties of paddy, wheat, maize and vegetables. The data show that the trend of pesticide import has been increasing every year. On average Nepal consumes 151g/ha a.i. of pesticide. This level is much lower compared to uses in the neighbouring countries – India and China - as well as other developing countries such as Indonesia and Thailand. However, the use of pesticide in Nepal is

much higher in the intensive production pockets and commercial cultivation areas. A study on pesticide pollution in Nepal revealed that 52 percent of the respondents in the study area lacked knowledge of the environmental effect of chemical pesticides (PPD, 2013). The dominant pesticides used are insecticides and fungicides.

While there are some studies on the impact of agricultural pesticides on human health and environment, there is little information on environmental contamination and poisoning cases. Chemical pesticides are also used to kill fishes in rivers, streams and ponds. According to the Nepal Drug and Poison Information Centre's 2012 report, every year there were around 1,800 poisoning cases from agricultural agents during 2007-2011.

More than 50 percent of all pesticides used in farmers' fields is wasted either due to misuse or over use of pesticides which eventually threatens the non-target groups such as humans, pet animals and environment. There is an urgent need for rationalizing the use of toxic pesticides which not only cause secondary pest outbreaks but also pest resurgence. On the one hand, farmers are using fungicides to control insects while on the other hand they also often frequently use red level pesticides which are already banned in other countries. The end outcome is the likelihood of the minor pests being elevated to the status of major pests.

The following is a listing of some observations on pesticide use as recorded during field visits:

- Farmers were generally aware of the fact that pesticides can have negative effects to consumers as well as to themselves;
- Some of them responded that they are considering changing the current practices by adopting IPM practices;
- There is an overall feeling that pesticides are medicines for plants;
- According to some farmers in the Terai, it is almost impossible to grow vegetables without using any pesticides;
- In some areas, farmers were found to frequently use pesticides, especially in tomatoes and off-season vegetables, even when there was no disease or pests;
- Improper use - over dose and frequent applications – was also noted in several cases;
- Many farmers were not following the standard pre-harvest waiting period, even spraying on the same day as they pick their products and sell;
- One unidentified pesticide locally called *Kanpure Power* that looks like BHC is reported some shops; and
- Uses of the date-expired pesticides and discarding of empty containers in public places.

3.3.3 Policy and legislation

The **policy framework** for biosecurity in crops is assessed briefly with a view to understanding the gaps as well as overlaps. The following key polices were reviewed: Agricultural Policy (2004), Agri-business Promotion Policy (2006); National Fertilizer Policy (2002); Irrigation Policy (2003), National Seed Policy (2000), Agriculture Bio-diversity Policy (2007) and Land Use Policy (2012). Chapter 2 of this volume is also devoted to assessments of policies and legislations.

On the whole, current strategies, policies and programmes stress on modernizing farming business through market-orientation and commercialization. They support the use of modern technologies. At the same time, most policies speak of the importance of regulating the use of technologies for food safety, health and environment. Agricultural policy clearly states that the Nepalese farm products should meet international as well as national food safety standards. Similarly, agri-business promotion policy stresses on the export of quality products, which again requires meeting global sanitary standards. Fertilizer policy promotes the use of quality fertilizers and integrated plant nutrient system. The seed policy stresses on providing quality seeds on a timely basis. It also lays emphasis on agricultural biodiversity conservation.

Overall, Nepal's policy framework is considered to be comprehensive in its coverage of issues and concerns. Its underlying premise is modernization and growth, through links to market via value chains. This orientation, also at the core of the new ADS, is taken positively in Nepal as there seems to be a consensus that this is the way forward. When it comes to issues such as food safety, plant health and biosecurity, it is felt, based on the assessment for this study, that these were not the primary concerns of these policies to start with, and hence one finds that the policies lack clear guidance and provisions on biosecurity issues, including environment. The policies are less useful

for guidance when a trade-off emerges as an issue, e.g. between growth and environment. In this paper several examples are seen where the current policy framework is lacking when it comes to biosecurity, e.g. the national fertilizer policy is silent on the impact on environment, especially on water contamination and soil quality deterioration.

As with policy, the **legal framework** for biosecurity in crops was reviewed with a view to assessing the gaps and overlaps. There is no separate and explicit legislation for biosecurity. However, there are many laws, rules and acts to protect human, animal and plant health through various control measures, which are essentials for maintaining biosecurity. For the specific purpose here, i.e. to assess gaps and overlaps in the context of biosecurity, a number of relevant acts and guidelines were reviewed. These were: Interim Constitution (2007), Local Self Governance Act (1999), Consumer Protection Act (1997), The Export Import (Control) Act (1956), Plant Protection Act (2007), Seed Act (1988), Food Act (1966), NARC Act (1991), Drug Act (1978), National Park and Wildlife Conservation Act (1972), Forests Act (1999), Aquatic Animal Protection Act (1960), and Environment Protection Act (1997). This is indeed a very exhaustive list of legislations.

Some comments would be pertinent here. Very briefly, it is important to note that the Local Self Governance Act, despite not being primarily agricultural, is crucial for food safety at the ground level or implementation level. This Act entrusts all local government organizations in the district, towns and villages with the responsibilities of protecting public health and conserving environment and biodiversity. These organizations have authority to even impose bans on activities that are likely to cause adverse effects on food safety, health, environment etc. within their territory. Likewise, the Consumer Protection Act is highly relevant for human health, services and quality control of foods and other goods.

A review of the Food Act and Foods Rules shows that food inspectors have a crucial role in preventing or minimizing adverse effects of substandard or low quality foodstuffs on human health. In the districts, the Chief District Officer leads the group, together with technical agencies for scientific backup, ensuring that markets and trade adhere to requirements laid in these acts and rules. Moving on to the provisions in the Seed Act, it has provisions that regulate the quality degradation in agricultural sector and food grains through the seeds. For testing of the contamination in the seed and quality of the seed, provisions have been made to establish central and other laboratories with experts to conduct the test, and form various sub-committees at the centre. In contrast to the above, National Park and Wildlife Conservation Act, Forest Act, Aquatic Animals Protection Act and Environmental Protection Act all have laid explicit and concrete emphases on biodiversity, ecosystem services and environment.

One noted problem encountered in implementing the acts and rules in Nepal is that at times the provisions are expressed in rather general terms, making it difficult for implementing or monitoring them. Otherwise, the main issue with the legal framework is that while it is broad and deep in coverage of issues, these are not implemented effectively for reasons such as the political will, institutional backing and budgetary limitations.

3.4 Compliance Cost and Public-private role

3.4.1 Compliance cost

As mentioned earlier, the use of chemicals and pesticides in Nepalese agriculture is fairly low – indeed very low in most places – in an absolute sense but also relative to applications in other Asian countries. As a result, productivity is also low and it is for this reason that important policy frameworks such as the APP called for sharply raising the use of modern farm inputs.

From the angle of the GAPs, the main problem is with pesticides because, given the poor level of awareness, it can be easily abused even at low application rates, and it is pesticides that have much larger negative effects on the health of human and other living beings, the soil and the environment. Awareness of the availability and use of technologies for spraying pesticides on a timely basis is also poor. A simple example is farmers' lack of awareness or ignorance of the appropriate "withdrawal period" once pesticides are applied to tomatoes. The interventions needed to change these practices should not cost much, both budget-wise and organization-wise, while benefits are immense. On the whole, the most important

intervention seems to be raising farmers' awareness about good practice technologies in production and handling. Other intervention would be promoting IPM approach in production.

Table 3.2 provides, with applications to tomato and ginger, a rough order of the benefits and incremental cost of interventions in adopting more biosecure practices along the value chain. The information in the table was put together at stakeholder seminars and field visits, as well as based on literature and expert interviews. It shows compliance costs for eight of the many more good farming practices that need to be adopted. The eight practices are increased awareness, training, withdrawal period, using crates and picking materials, discarding contaminated products, good practice in using local manures, and using purer water. The cost calculations are based on tomato.

The assessment shows significant gains from fairly small interventions. One reason for the high benefit-cost ratios for these practices is that the product in question (tomato) being a perishable, sales take place quickly after harvest. As an example, the cost to a farmer of adopting the "waiting period" after application of the pesticide in tomato is about NPR 0.22/kg. This practice could yield an incremental return of an additional NPR 0.5/kg if the product is differentiated so that consumers identify it and pay a premium price. In all interventions presented in the table, it is understood – including as expressed by farmers and stakeholders in field seminars – that the benefits would be much higher in the long run than the incremental costs incurred initially.

3.4.2 Public-private partnership in sharing incremental costs

A biosecure production system generates positive externalities to the benefit of the society as a whole, besides benefitting those directly involved, namely farmers and other actors in the value chain. For this reason, moving towards biosecure agriculture requires judicious role of both the public and private sectors. The public sector needs to support the adoption of biosecure practices through policies, legislations, training and information and even financial subsidy initially.

Table 3.2: Incremental cost of adopting GAPs for ginger and tomato and expected benefits

		Benefits	
Biosecure measures	**Cost**	**Financial Benefit**	**Economic/Social Benefit**
1. Awareness of the right time/frequency of pesticide application in tomato	NPR 1,600/ person	• Higher income • Premium price	• Good plant and human health • Less environmental pollution
2. Training on pesticide application and its negative effects on health and environment	NPR 1,600/ person	• Higher income	• Less environmental pollution • Good human health
3. Strictly following the withdrawal period for harvesting after pesticide application in tomato	NPR 0.22/kg	NPR 0.5/kg	• Good human health
4. Use of right crates and picking materials	NPR 0.13/kg	NPR 0.25/kg	• Higher benefits with fewer harvest loss
5. Establishment of an institution, equipped with laboratory, for certification	N.A.	N.A.	• Higher price for certified products • Easier access to the international market
6. Discarding products contaminated with faeces of animal and bird birds	NPR 0.01/kg	NPR. 0.05/kg	• Human health benefits
7. Use of well decomposed local manures and tested urines	NPR 0.1/kg	TB	• Healthy crop products
8. Irrigated water meeting irrigation water quality requirements	nominal	TB	• Healthy crop products

Note: TC refers the total cost and TB refers to the total benefit.

Source: Author.

For this paper, a preliminary exercise was undertaken towards identifying areas of this public-private partnership which entailed cost sharing. For farmers, this amounts to identifying additional financial cost as well as the cost in terms of the reduction in production that may result from the adoption of biosecure practices. The numbers there are preliminary as these were put together based on limited discussions with farmers in the field. A more in-depth assessment of this nature would be essential to translate the ideas into concrete policy and programme. This follow-up assessment is an important recommendation of this work.

In Table 3.3, it is noted that raising farmers' awareness is an important and crucial activity which needs to be initially provided or facilitated by the GoN, with 100 percent cost borne by them. Field surveys revealed that farmers would be in a position to better articulate cost-sharing arrangements and other forms of partnership only after their level of awareness is raised. This is the case of the small farmers; commercial farmers, on the other hand, are in a position to bear the incremental cost for biosecure measure by themselves and they also stand good chance of reaping the benefits from that investment, including through access to export markets.

As identified in the previous section, in the case of ginger and tomato, especially for tomato, IPM approach is the best production option identified by the farmers during interactions in the field assessment. The responsibility of the government should include the provision of the IPM technology and related to IPM production practices and resource persons for extension and training, besides should be the responsibility of the government. Likely, other technical and policy support should be the role of government. On the other hand, However, it falls upon the private sector and farmers/cooperatives to assume responsibilities for market linkages, grading and packaging materials, quality control of irrigation and cleaning water, quality control and other concern biosecure-friendly plant protection measures, etc.

3.5 Concluding remarks

The paper reviewed and assessed biosecurity issues for the crops sub-sector – notably vegetables and high value crops. The purpose is to raise issues, identify gaps and discuss options for moving forward towards a more biosecure agriculture in Nepal.

It is worth repeating again that food safety, biodiversity and sustainability of resources have become priority concerns for Nepal and the way forward is to work within the umbrella of a biosecurity framework. Farming is both a provider of these services as well as the beneficiary. Several farm products, notably high value crops, are in the list of Nepal's trade policy for export promotion. Any country aspiring to be an

Table 3.3: Responsible organization and private-public cost sharing for biosecure measures

Biosecure measures	Responsible organization	Cost sharing
1. Awareness of the right time/frequency of pesticide application in tomato	MoAD/DoA Extension services/farmer groups	1:1 private/public
2. Training on pesticide application and its negative effects on health and environment	DOA (Plant protection directorate)/ Farmer group	1:1 private/public
3. Strictly following the withdrawal period for harvesting after pesticide application in tomato	Government pesticide inspectors/ farmers	Both public and private
4. Use of right crates and picking materials	Private stakeholders in value chain	100% private
5. Establishment of an institution, equipped with laboratory, for certification	Government (MoAD)	100% government
6. Discarding products contaminated with animal and birds faeces	Farmers	100% farmers
7. Use of well decomposed local manures and tested urines	Farmers	100% farmers
8. Irrigated water meeting irrigation water quality requirements	Farmers	100% farmers

Source: Author.

exporter needs to comply with a number of standards that are at the core of biosecure agriculture.

One of the messages from the assessment is that the status as regards biosecurity is not, on the whole, alarming or serious at the farm level, with the exception of pesticides use in vegetables in highly commercial areas. However, food quality and safety is increasingly compromised in the post-production stages due to poor state of infrastructure (e.g. electricity), general hygiene as well as weak control and enforcement of existing acts, directives and guidelines. Pesticide residue is an issue in the case of export-oriented HVCs.

If it is correct that high risk environments are limited to certain areas and pockets and crops/varieties, therefore, responding to the problems should be relatively easy. One message from this study is that small and targeted interventions could generate high payoffs towards improving the overall biosecurity of the agricultural sector. Such interventions include raising awareness, demonstration and extension, supporting key infrastructures and enforcing already agreed controls, rules and guidelines.

The paper also assessed gaps in practices and associated compliance costs, albeit the analysis is far from being comprehensive. Many of the gaps and hence the compliance costs are minor or moderate. For these, the above mentioned small interventions would suffice. For others, cost can be large and it is where innovative approaches are required. The paper also discussed the issue of cost sharing between the government and private sector. For this to work, the latter would need to be convinced that they can recoup the cost from the market, e.g. through differentiated products that fetch higher prices. A case in point is the adoption of the IPM practices. For this to work in the scale required, there have to be incentive schemes for farmers to adopt the practices. Very little exists in the literature in Nepal on the design of incentives.

Besides undertaking these policy-oriented studies, there is a need for good statistics that help prepare status reports periodically. In particular, nationally representative data on pesticide residues by crops are lacking, which has hindered the process of building consensus on the nature and scale of the problem and hence the response measures, including targeted projects. The data base should also include some other indicators based on the GAP's control parameters with a view to preparing periodic status reports.

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CHAPTER 04

BIOSECURITY ASSESSMENT FOR THE LIVESTOCK SUB-SECTOR

Damodar Sedai

Abstract

This paper reviews and assesses biosecurity issues for the livestock sub-sector. It introduces the concept and essentials of biosecurity in this sub-sector and raises issues, identifies gaps and discusses options for moving forward towards a more biosecure livestock sub-sector in Nepal. Value chains of two key livestock products - diary and meat – are used to highlight biosecurity concerns. The review identifies a large number of gaps between the current and desirable practices along the supply chain. It finds that large-scale intervention and investment are not necessarily required for closing many of these gaps, which can be closed with modest interventions such as raising awareness, enforcing existing rules and regulations and enforcement of the control and compliance system. Among the recommendations made include creating an enabling environment, and innovative schemes, that encourage and incentivize the private actors to invest in good practices and also recoup the extra cost from the market through higher prices for safer and quality foods.

4.1 Introduction

Biosecurity is a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) that analyze and manage risks in the sectors of food safety, animal life and health, and plant life and health, including associated environmental risk. Biosecurity covers the introduction of plant pests, animal pests and diseases, and zoonoses, the introduction and release of LMOs and their products, and the introduction and management of invasive alien species and genotypes. It is a holistic concept of direct relevance to the sustainability of agriculture, food safety, and the protection of the environment, including biodiversity.

The purpose of this study is to take stock of biosecurity-related issues for the livestock sub-sector. Biosecurity for the livestock sub-sector is conceptualized as a series of management practices and control systems designed to minimize the entry and spread of infectious agents to the livestock, on the livestock farm and beyond that to the food chain and final food products. Being a holistic approach, these biosecurity management practices cover many activities spanning risk assessment, risk management and risk communication, such as testing and screening for diseases, isolation or quarantine of infected animals, immunization, selective purchasing, and monitoring and herd evaluation.

The study has made a fresh attempt to identify gaps between current practices that livestock producers have been following currently and "good practices" that are the goal for a biosecure livestock sector. Likewise, the study presents preliminary estimates of the cost of compliance, i.e. the incremental cost required for closing the gaps, as well as stakeholders' views on how the incremental cost should be shared between the private actors and government. While preliminary, this line of analysis is considered useful for identifying the size and nature of the government support, including the identification of innovative schemes to incentivize the private sector to invest in food quality and safety.

Field visits and stakeholder consultations were an important source of primary information for this study. A total of 11 districts from three ecological belts of the country were visited. Different sets of questionnaires and checklists were prepared for different stakeholders. Direct field observation and interactions with different stakeholders were also conducted to assess the present situation and the cost involved in the milk supply chain. The sample informants in the field included 23 milk collection centres and milk cooperatives, 5 traders and 10 chilling centres, field staff of line ministries, officers of food quarantine laboratories and customs offices, feed and manure industries, traders in livestock markets and agro-vets. One final workshop focusing on milk supply chain was held in Chitawan.

The rest of the paper is organized as follows. Section 4.2 provides the essentials of the concept and scope of biosecurity in the livestock sub-sector. Section 4.3 reviews various aspects of the livestock economy and related biosecurity issues, thus providing a background to the issues to be discussed in the subsequent sections. This Section is titled assessment of selected issues on livestock biosecurity in Nepal, consists of six sub-sections, providing backgrounds and assessments of the current status, including various gaps that need to be closed for improving upon the state of biosecurity in Nepal. It also includes fresh analyses on two subjects – compliance cost and the role of the public and private sectors. Section 4.4 gives concluding remarks.

4.2 Biosecurity in the Livestock sub-sector

Increases in per capita incomes, with large contribution from remittances, urbanization and changing food habits have boosted the demand for livestock-derived foods. As a result, livestock production systems are undergoing through major transformations, notably characterized by medium- and large-scale firms vertically linked to primary producers and service providers. These industrial production systems tend to be efficient but also pose increased animal and public health risks, in contrast to traditional subsistence systems.

What are the constituents or elements of biosecurity for the sub-sector consisting of livestock products and animal health? One finds them in most standard paragraphs on the concept of biosecurity. For example, the following nine elements or concepts, with no particular order, were in the opening paragraph of this chapter introducing the concept of biosecurity:

- Risk analysis
- Risk management
- Environmental risk assessment
- Introduction of animal pests and diseases
- Introduction of zoonoses
- Introduction and release of LMOs and their products
- Introduction and management of invasive alien species and genotypes
- A strategic and integrated approach
- An approach encompassing policy and regulatory frameworks

OIE's detailed Guidelines for the Evaluation of Veterinary Services (Chapter 1.3.4. of the Terrestrial Animal Health Code) are both comprehensive and widely followed across the world. According to these guidelines, the national Veterinary Service should be able to demonstrate capacity, supported by appropriate legislation, in the below areas (as compiled by Mahato et al., 2004).

1. Exercise control over all animal health matters - These controls should include compulsory notification of prescribed animal diseases; inspection of animals, animal products, products destined for animal feeding, products destined for prevention, treatment or diagnosis of animal diseases, animate or inanimate vectors of diseases, premises, equipment, facilities and means of transportation in contact with animals and or animal products; related documentation; movement control including registration of holdings and animal identification; quarantine of infected premises/areas; testing, treatment, destruction of infected animals or contaminated materials; controls over the use of veterinary medicines; etc. The scope of the legislative controls should include domestic animals and their reproductive material, animal products, wildlife as it relates to the transmission of disease to domestic animals, and other products subject to veterinary inspection.
2. Prescribe methods for control and to exercise systematic control over the import and export processes of animals and animal products in so far as this control relates to sanitary and zoosanitary matters.

3. Control imports and transit of animals, animal products and other materials that may introduce animal diseases.
4. Provide accurate and valid certification for exports of animals and animal products.
5. Control over chemical residues in exported animals, animal products and feedstuffs.
6. Present a functional animal disease reporting system which covers all regions of the country.
7. Effective responsibility for the veterinary public health programmes relating to the production and processing of animal products, especially for export and effective monitoring and control of zoonotic diseases.
8. Effective controls (including nationwide consistency of application) over the registration supply and use of veterinary medicines, biological and diagnostic reagents.

Another source lists the following as core control measures:

1. Control of infectious diseases;
2. Control of inputs (e.g. establishment, feed, fodders, water, vaccine, drugs etc.);
3. Control of livestock and poultry movement;
4. Use of a suitable vaccination/medication program;
5. Efficient hygiene and sanitation procedures;
6. Control of rodents, insects and wild birds;
7. Control of vehicular and human traffic;
8. Control of equipment movement;
9. Use of a suitable sampling and testing program; and
10. Good practices in the value chain.

Biosecurity is not just a list of various essentials – it is a strategic and integrated approach that brings together in one place all the policy and regulatory frameworks for analysing and managing relevant risks to human, animal and plant life and health, and associated risks to the environment. Thus, good farming and livestock practices are only two of the several such elements that are pillars of this integrated approach. Most countries do have policies, legislations and standards for the safety of food, animal, plants, etc. but their formulation and implementation is typically scattered across government agencies, leading to a fragmentation of effort, waste of resources, duplications and the risk of lapses within the system. This is where a national biosecurity framework adds value by responding to the challenges in a holistic manner.

4.3 Assessment of Selected Issues on Livestock Biosecurity in Nepal

The overall purpose of this section is to help understand the status of biosecurity in livestock sub-sector of Nepal. It has six sub-sections which provide essential backgrounds and eventually focuses on identifying various gaps that need to be closed for improving the state of biosecurity in Nepal. The last two sub-sections provide fresh analyses on compliance cost and the role of the public and private sectors.

4.3.1 Overview of the meat and dairy sub-sectors

Livestock sub-sector contributes to about 14 percent of Nepal's GDP and 32 percent of agricultural GDP. The 1995 perspective plan (APP) had forecast the share of livestock sector in the AGDP to reach 45 percent in 20 years (i.e. by 2014/15). Nepal has the highest livestock population per capita and per unit of cultivated land in Asia. Nepal's livestock sector is dualistic – subsistence farming with traditional practices existing side by side with rapidly growing commercial farming. Biosecurity issues differ between these two systems and therefore should be taken into account in analyses and responses.

Increase in per capita incomes, with remittances playing a large role, urbanization and changing food habits have boosted the demand for livestock-derived foods. As a result, livestock production systems are undergoing through major transformations, notably characterized by medium- and large-scale firms vertically linked to primary producers and service providers. These transformations tend to make the production systems both efficient and vulnerable to bio-hazards.

There are several studies that provide good background information and analysis on the livestock economy and its food sub-sectors, as well as related topics like food safety. Two fairly recent FAO studies in particular, titled *Market-led quality meat production and processing* (FAO, 2010a) and *Dairy sector study of Nepal* (FAO, 2010b), are useful for comprehensive reviews and assessments of the meat and dairy sectors of Nepal. Although somewhat dated, Chapagain (2004) also provides several insights on issues relevant to this paper on the poultry sub-sector.

Meat sub-sector – For 2012, total meat production in Nepal was estimated to be close to 300,000 tonnes, which translates to a per capita meat production of about 10.4 kg/year. Per capita consumption should be notably higher after counting imports that are considered to be large (there are no exports from Nepal). The share of various meats in total meat production is as follows: buffalo meat 60 percent, goat and sheep 19 percent, chicken meat 15 percent and pork meat 6 percent. It is estimated that over 85 percent of the demand for goat meat is met by imports from India.

FAO (2010a) provides projections to 2020. Total demand for all meats will increase by a compound growth rate of 6.6 percent per annum between 2010 and 2020 (from 280,000 to 530,000 tons) while production will trend up by just half that rate, or 3.3 percent per annum (240,000 to 333,000 tons). As a result, meat deficit will balloon from 40,000 to 196,000 tons, or 17.2 percent per annum. The projections are based on average annual per capita consumption of 14 kg in urban areas and 9 kg in rural areas and an average per capita consumption growth of 3.87 per annum (based on the NLSSs of 1995/96 and 2003/04). These numbers clearly point to an alarming outlook for trade deficit in meats, but also an immense market potential to raise production in Nepal.

The above study also discusses and analyses a number of topics of relevance to biosecurity. These include, for example: new and emerging channels or potential sources of bio-risk such as increased reliance on feeds, cross border trade and changing cost structure; regulatory impediments and facilitators in the meat value chains; and role of stakeholders in promoting quality meat production and processing.

Dairy sub-sector - Private sector involvement in organized dairy business has increased rapidly in Nepal. There are today many private dairies, including cooperatives, of various sizes operating both within and outside the Kathmandu valley. These dairies produce pasteurized milk and other products such as yoghurt, ice-cream, butter and ghee. There are also many small scale mechanized dairies and numerous cottage-type firms handling limited quantity of milk for producing various milk products particularly pasteurized milk, ghee, ice cream and yoghurt. Private entrepreneurs have also been active in producing cheese in the mid and high mountain regions.

About 15 percent of the total milk produced is estimated to come to the formal market, 35 percent sold to informal markets (door to door, restaurants, etc.) and the rest 50 percent either home consumed or used for processing (NDDB, 2012). As much as 70 percent of the milk collected is marketed in Kathmandu valley itself, with the parastatal, Dairy Development Corporation, being a major player with a share of 40 percent of the total distribution. It is estimated that there are 250 dairies of varying size active in Nepal. There are also close to 1,800 milk producer's cooperatives and 162 private chilling centres in 62 districts. The NDDB (2012) study also notes that about 95 percent of the milk collected in the formal market is sold as pasteurized milk in city centres. Available per capita milk in Nepal is estimated to be 52 litres per annum.

4.3.2 International guidelines and codes of conduct

There are a number of international agreements, guidelines and codes that are valuable in setting national standards and practices for biosecurity. These may be grouped into three categories: i) standards set by inter-governmental bodies; ii) standards of private certification bodies; and iii) best practices used by neighbouring countries and regional bodies.

The Codex and OIE are the two most important inter-governmental bodies for setting standards relevant to the livestock sector, with Codex concerned with raw/frozen or chilled meat and food products and OIE on animal health and welfare. Background on these organizations and their functions are readily accessible, and so only a brief introduction is given. The Codex system is discussed briefly in another background paper in this series (food value chain, Chapter 7).

The OIE is relevant here because its focus is on animal health and welfare. The OIE develops two types of health standards for animals and animal products – trade standards and biological standards. The four publications containing the OIE standards are: i) Terrestrial Animal Health Code; ii) Manual of Diagnostic Tests and Vaccines for Terrestrial Animals; iii) Aquatic Animal Health Code; and iv) Manual of Diagnostic Tests for Aquatic Animals.

These Codes and their Manuals are designed as reference documents to be used by national veterinary administrations or others as guides for establishing the national health regulations for the import and export of live animals and animal products. In addition to recommendations specific to diseases, the OIE has also developed general principles relating to risk analysis methodology, which consists of import risk assessment, assessment of veterinary services, zoning/regionalisation, and surveillance and monitoring.

ISO 22000*: *2005 Food Safety Management Systems specify requirements for a food safety management system where an organization in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption. The ISO 22000 standard emphasizes on certification requirements for HACCP and provides a good basis for standardization and harmonization of the HACCP systems worldwide. The standard also includes Prerequisite programmes (e.g. Good hygiene practices or GHP and Good Manufacturing practices or GMP).

GlobalGAP is a private global organization that sets voluntary standards for the certification of production processes for livestock and other farm products. The GlobalGAP is modular-based, consisting of: 1) *the All Farm Base Module*, which is the basic module that farm producers of all types need to comply with; 2) *the Scope Module*, which defines criteria for three food production sectors (crops, livestock and aquaculture); and 3) *the Sub-scope Module*, which cover the requirements for a particular product (e.g. poultry) or different aspect of the food production and supply chain. Thus, to obtain a *Certification* for, say, poultry, the producer must comply fully with the first module, the livestock part of the second scope module, and finally the poultry part of the sub-scope module. Livestock producers are also required to source their compound feed from reliable suppliers.

Good Agriculture Practice (GAP) is a set of practices that address environmental, economic and social sustainability for on-farm process with a view to attaining safe and quality food and non-food agriculture products. Good Veterinary Practice (GVP) is also included in GAP. There are different codes, standards and regulations for GAP/GVP which are developed by food industries, producers, governmental and non-governmental Organizations to codify agricultural practices at different levels of the supply chain and covering a range of commodities, to facilitate trade and reduce non-compliance risks regarding pesticides, veterinary drug residue and other contaminant hazards. Nepal is also working for some years now to formulate a NepalGAP.

4.3.3 Policy, legislation and institutions

The FAO toolkit for biosecurity (FAO, 2007) suggests assessing biosecurity status and performance at two levels: the system level; and the sectors of biosecurity/organization level. The system level assessment consists of four components: i) policy framework; ii) legal framework; iii) organizational arrangements; and iv) communication. At the sectoral/organizational level, assessment should focus on the capacity of relevant competent authorities (in terms of mandate, structure, processes, resources, infrastructure, etc.) to deliver core normative and technical functions, based on *inter alia* a risk analysis approach, to attain biosecurity. In what follows, the above framework is used for assessing current biosecurity status and performance by reviewing the first three elements of the system level assessment. In this volume, there is a separate chapter (Chapter 2) dedicated to the review of policies, legislations and institutions, and so the following assessment for livestock can be brief.

Nepal's key ***policies*** that apply to the livestock sub-sector in relation to biosecurity issues are National Agriculture Policy 2004; Dairy Development Policy 2007; Agri-business Promotion Policy 2006; Agriculture Biodiversity Policy 2006; Poultry Policy 2011 and Pasture Policy 2012. Other frameworks that should be added are National Milk Marketing and Strategy Study 2001, Livestock Insurance Policy 2013, National Standards of Organic Agriculture Production and Processing 2007. The 2004 Agricultural Policy touches upon a number of related topics: quarantine certification, disease surveillance and control, regulatory mechanism, strengthening of quarantine offices and laboratories, control of drugs, hormones, chemicals, pesticides, etc., in-situ conservation of specific species/biodiversity, commercialization of agricultural commodities, organic farming, regulation of GMOs, accreditation of national laboratories, and seed certification.

The Dairy Development Policy 2007 addresses, *inter alia*, improvements through regulatory mechanism

the quality of milk and milk products for consumers' satisfaction, setting up chilling centres so as to expand the coverage of milk collection areas, and encouraging the establishment of powder plants and dairy industries. Likewise, the National Standards for Organic Agriculture system prescribes, *inter alia*, the following: no production from live genetically modified animals; no use of hormones for reproduction and growth; and use of antibiotics in animals only on the recommendation of the certifying body; and residue in the products to remain below set national standards.

Another instrument, Standards for Export-Import of Meat and Meat Products 2007, has specified national requirements for microorganism and parasites, antibiotic residue and aflatoxin levels in meat and meat products, and has recommended microbial standards for meat and meat products from poultry. Likewise, standards have been set for Maximum Residual Limits of some common veterinary drugs in poultry meat, as well as the withdrawal period of some veterinary drugs for slaughtering when drugs are used in poultry and Aflatoxin Tolerance Limit (ATL) in meat and feeds. Standards for Poultry Feed 2007 and Standards for Livestock Feed 2007 cover proximate nutrients and mineral contents.

There are many ***Acts and regulations***, orders, directives, standards, protocols and guidelines in Nepal that are directed to, *inter alia*, animal health and livestock products and their value chains (see Chapter 2 for details). Very briefly, Table 4.1 presents their listing which shows that there are a total of 58 individual Acts, regulations, orders, etc. This list is indeed very exhaustive and reinforces a comment made by many writers that the problem is not lack of them but their implementation. FAO (2010a) likewise highlights a list of 22 Acts and regulations for regulatory framework for meat, and makes the same point - that lack of legislation is not the constraint; it is the lack of enforcement.

Public sector ***institutions*** or ***organizations***, the third element of the system level assessment of the biosecurity status, involved in the livestock sector are well known and documented in other background papers (notably Chapter 2). However, for the sake of completeness, these include the following: the MoAD, DLS, the DFTQC, various laboratories under the DLS and DFTQC[13], Department of Drug Administration under the MoHP, Directorate of Livestock Market Promotion and Community Livestock Project (CLDP), National Dairy Development Board (NDDB), and Dairy Development Corporation. List of Acts and regulations, orders, directives, standards, protocols and guidelines in Nepal related to the livestock sub-sectors is presented in Table 4.1.

At ground level, the quality and coverage of the various services provided by the state varies greatly across regions and livestock types. Several reasons are given for this such as budgetary limits, high cost of service provision in Nepal, inability to replicate proven, innovative approaches to provide extension and other services, among others. It is estimated that there are about 3,050 Village Animal Health Workers (VAHW), 315 livestock officers and 2,160 paravets in Nepal. They are involved in livestock development, clinical services, diagnosis, extension, quarantine and disease control activities. It is also estimated that over 3,000 paravets are providing primary treatment in the field as private service providers. In 2002, the DLS and MoAD had estimated that one government veterinarian was looking after 60,512 ruminants and one government junior technician was looking after 9,494 ruminants.

Likewise, the coverage of livestock services is limited to about 18 to 23 percent of total animal population depending on the region and its remoteness (DLS, 2011). Field surveys and secondary information indicate that only 10-15 percent of the prescriptions are written by veterinary doctors, the rest being by either the Village Level Animal Health Workers or by veterinary technicians.

These statistics convey an often stated point that public support provision is simply too inadequate. The solution is to look for innovative approaches to service provision as it is unlikely that budgets and staffs can be scaled up sharply. Finding innovative approaches requires applied research, which is what is missing in Nepal to start with.

[13] These include Central Veterinary Laboratory, Regional Veterinary Diagnostic Laboratories, National Veterinary Standards and Drug Administration Office , National Avian Disease Diagnostic Laboratory (Chitawan) and Livestock Quality Management Laboratory under the DLS.

Table 4.1: List of Acts and regulations, orders, directives, standards, protocols and guidelines in Nepal related to the livestock sub-sectors

Broad categories	List of specific Acts, regulations, order etc.
Acts and regulations *(total 11)*	Acts and regulations on food, drug, feed, pesticide, National Dairy Development Board, National Cooperative Development Board, cooperative (regulation), animal health and livestock services, NARC, slaughterhouse and meat inspection, and Nepal Veterinary Council.
Orders *(total 3)*	Livestock feed production development committee, chemical fertilizer (control), bird flu control.
Directives, standards and protocols *(total 18)*	Directives for export-import inspection and quality certification system, standards for testing veterinary biological, standards for veterinary laboratory, SOP for quality testing of different biological standards for livestock transportation, standards for meat shops, SOP for animal quarantine inspection and certification, hatchery standards, poultry breeding farm standards, standards for broiler chicken management, import standards for parental and commercial chicks, standards for export-import of meat and meat products, standards for import of hatching eggs (for chicken production), standards for import of consumable eggs, guidelines for sales/distribution of the domestically produced day- old chicks within the territory of Nepal, quality standards of importation of fingerlings, standards of species for importation of fishes and packaging and transport standards of fingerlings.
National standards, known as Nepal Standards *(total 8 foods)*	Standards for the following products: ghee, livestock feeds, processed milk, hard cheese, skim milk powder, whole milk powder, yogurt, and processed cheese.
Guidelines in place *(total 3)*	Quarantine guidelines for the use of exporters/importers and government staff on-duty to simplify the process, guidelines for organic agriculture production and processing system, and technical guidelines for export of organic agriculture products, certification (first amendment).
Acts in the process of amendment *(total 3)*	Animal Health and Livestock Services Act, Slaughterhouse and Meat Inspection Act, and Veterinary Council Act.
Proposed new Acts *(total 4)*	Veterinary Drug Act, Animal Welfare Act, and Animal Feed Act.
Drafts of national standards *(total 7)*	National microbiological standards for milk. standards for milk and milk products, code of practice for raw milk production, collection, chilling and transportation, code of practice for animal shed, code of practice for poultry shed, standards for pig feed, standards for poultry feed, and standards for animal feeds.
Drafts of national voluntary standards *(total 1)*	Standards for feed ingredients (wheat bran, maize, soya cake, mustard cakes, fishmeal, bone meal).

Source: Compiled by the author.

4.3.4 Assessment of the gaps in livestock biosecurity

This section summarizes the gaps between what are desirable and what are the current situations or status. The assessment is based on a review of literature, interactions with various stakeholders during field visits and expert views. It may be noted that a gap also conveys a sense of recommendation or suggestion – they are two sides of the same coin. Thus, analysis of gaps provides the main basis for identifying response measures. The next section on compliance costs and public-private role also includes some aspects of the gaps.

For clarity of presentation, the gaps are grouped into six categories: i) management of livestock farms; ii) transport, marketing and retailing; iii) veterinary drugs, supplements and feeds; iv) pesticide and other residues in foods; v) import and export system at borders; and vi) legislation, strategy and policy. In all, a recording of all gaps led to 37 bullet points. The points made below are self-explanatory and so do not need any further comment.

Management of a livestock farm

- Highly sub-standard fencing/sheds of farms;
- No practice of farm registration, animal identification and traceability system;

- Wrong practice of introducing new animals from unknown sources to existing herd without quarantine/separation;
- Missing management system for herd health;
- No disease control plan at the farm and way-off in risk assessment or risk management;
- Inappropriate practice in waste and manure management.

Transport, marketing and retailing

- Lack of proper controls on national standards for transporting live animals (space, distance, means of transportation, feeding and watering, time of transportation etc.);
- Unhygienic transportation of carcasses, leading to risk of hazards; little use of ice – use of chilling van still a long way to go;
- Unhygienic practice of slaughtering and contaminated water causing heavy microbial loads in the meat;
- Simple measures not followed such as using treated water and nets etc to protect from flies and insects;
- Most retail shops in Kathmandu still do not follow the standards for meat shops (licensing, sanitation, structure etc.) enforced by Kathmandu Municipality some 7-8 years back.

Veterinary drugs, supplements and feeds

- No separate veterinary drug act in Nepal;
- Dispersed mandate for the management of drugs/feeds/supplements which dilutes regulatory system (e.g. veterinary drugs are registered, regulated by the DDA, while feed supplements are imported on the recommendation of the DLS, and feed act under DFTQC);
- No veterinary prescription required for buying drugs;
- No control over the safety of the many types of higher antibiotics being used;
- No mechanism to discourage/control overuse of antibiotics in dairy animals;
- Vet shops not having separate counters for vet drugs and pesticides;
- Need for control mechanism for formulation and adoption of judicious use of antibiotics, hormones, probiotics, etc. in the value chain.

Pesticide and other residues in foods

- No comprehensive and periodic study available on pesticide residues in milk;
- Lack of response to the concern that the increasingly applied pesticides in crops and vegetables is being leaked to livestock and its environment via feeding straws, fodders and other vegetable leaves;
- Although pesticides like DDT, malathion are no longer used in dairy animals, other chemicals are, including unidentified chemicals;
- Inadequate controls on the use of antibiotics and growth hormones in food animals;
- Inadequate framework for testing antibiotic residues in meat, milk or eggs.

Import and export system at borders

- Dismal progress so far in implementing risk analysis methods in importation of livestock products;
- Weak coordination among border and cross-border authorities in regulating informal trade in live animals and livestock products for safety of food products and live animals;
- Low progress in implementing policy and measures announced several times to strengthen border quarantine and testing facilities;
- On exports, poor progress on declared policy/measures to harmonize standards with those from neighbouring/SAARC countries.

Legislation, strategy and policy

- Current Animal Concentrate Act is old and not based on WTO-SPS agreements and OIE's terrestrial animal health code;
- Slaughterhouse act and regulation not enforced beyond Hetauda;
- Inadequate progress in amending existing acts, regulations and standards to align with best international guidelines and practices (notably SPS);
- Current Food and Feed Acts and regulations define "quality" in a vague way and do not cover microbiological or toxicological specifications;
- Production and processing provisions in *National Standards for Organic Agriculture* not followed in practice;
- Continued drawbacks in strengthening capacity, both facilities and manpower, of basic, regional and central labs for timely diagnostic services;
- Weak awareness programmes on biosecurity measures, sanitation and hygiene, residual effects of veterinary drugs, pesticides and chemical fertilizers and possible hazards involved in the product chain;

- Undue delay in endorsement and implementation of Dairy Development Strategy;
- Lack of Animal Health and Breeding Policy tailored to different eco-zones;
- Inadequate policy research to identify innovative schemes of incentives, rewards and penalties for various actors along the supply chain.

4.3.5 Cost of compliance for implementing good practices

Inducing or enforcing GVP, which is essential for biosecure livestock farming, is not easy in a subsistence farming system with millions of small farmers owning 1-2 cows or buffaloes or goats scattered across the country. The way forward is extension programmes that raise awareness, and demonstrate good practices and their benefits. The other mode of production is commercial farming where farmers are linked to markets through supply chains. The DLS has defined that for commercial viability, the number of dairy cows in a small dairy farm should be at least 10 heads. In view of this, analysis of compliance cost in this study has been done for a farm of this size.

The incremental cost of compliance with various GVPs, and the sharing of the costs between the private stakeholders and the government, was compiled based on interviews and discussions during visits to four representative dairy farms/supply chains in eleven districts, as well as with experts in Kathmandu. A final stakeholders' seminar was held in Chitawan which was attended by about 30 persons representing farmers, producers' associations, dairy cooperatives, technical and other staffs of the DLS and local officials. The incremental cost estimated was assumed to be for an average dairy herd of 10 cattle. The elicited responses on costs and sharing run into many pages and so not amenable to reproduce in a short paper like this. What has been done here is to present one set of such information compiled at the Chitawan stakeholders' meeting. Table 4.2 summarizes the results which are self-explanatory.

The discussion revealed a considerable variation in the cost of compliance across the field sites visited, which is normal given the wide variations in costs, management practices and other factors (e.g. genetic make of the cattle). Record keeping was very weak and so the quality of the responses was poor. It was also reported that the reason for the low baseline cost (i.e. for current practices), in contrast to the GVP scenario, was because some of the prescribed practices were not followed at all, e.g. recordkeeping, fencing and sheds, basic hygiene and water quality.

Table 4.2 : Compliance with good practices and compliance costs – the case of a milk supply chain (cost in NPR., based on a farm of 10 cattle)

	Existing practice		Good practice	
	Comment/unit	Cost (NPR)	Comment/unit	Cost (NPR)
1. Farm inputs				
Fence/wall	only in limited farms	2 lacs	Wall fence	7 lacs (cement)
Dairy Cow number	10	10 lacs		10 lacs
Quantity of milk /day	14 L /Day/ Cow	25/ L	Improved practice	35/ L
Recording system	Rudimentary recording	1,000/ farm	Detail recording	2,000/ farm
Fodder /Pasture used	mainly straw, less greens	100/ animal/day	Hay, silage, green and straw	200/animal/day
Concentrate Feed quality	Poor quality	22-27/Kg factorywise	Quality assured feed	3 lacs/quality equipment
Water quality	Hand pump and tested for arsenic and selenium	1000/month	time to time testing for bacteria	2000/test (per month)
Personnel hygiene practice	Not satisfactory	soap/detergents	Perfect hygiene condition	300/person/ month
Animal shed condition	Well ventilated, dry	14-15 Lacs/ shed	More secured	20 lacs/ shed
Use of milking machine	Not in place	0	Use of milking machine	Total 1.5 lakhs

	Existing practice		Good practice	
	Comment/unit	Cost (NPR)	Comment/unit	Cost (NPR)
Type of can for milk collection	40%plastic, 60% aluminum	2500 .00 for plastic can and 6000.00 for a aluminum can	Stainless steel can	
Drug purchase on Vet prescription	10-15 %	5000 - 6000/ course	Vet prescription	
Use of higher antibiotics in animals	All types of antibiotics used	2500-3000/case	No use of antibiotics to be used in human medicine; no such drugs for prevention	
Use of BHC/ DDT/pesticides for controlling ectoparasites	Ivermectin and cypermethrin	1000.00/yr/animal	Withdrawal of milk for at least 9 days	4.5 thou to 5.0 thou/case
Use of hormones	Oxytocin in buffalo. GnRh in cattle	500/case	No use of oxytocin	
Withdrawal of milk for 9 days due to use of higher antibiotics	Not practiced	0	Withdrawal of milk for at least 9 days	4.5 thou to 5.0 thou/case
Separate keeping of new animals	Not well practiced		To be separated	2 lacs/cow shed
Cost of treatment/ sickness	4000.00/ case		Biosecured condition	2500.00/ case
No of labour used in farm	1 per 10 cows	9300.00/Mo	Well retained	15000/month
Cost of transportation to collection center	NPR 2.00/Liter by Rikahaw, pick up		Delivery to collection center	2.00/Liter
Trained person in place	Basic knowledge		Trained person in place	
2. Collection center inputs (at collection centre)				
Type of can for milk collection	Aluminum 100%	5500/Can	Stainless steel can	6500/ Can
Preservation by using	None	0	Cold chain	
Sent to chilling center by	Power trailer	3 Lacs and diesel cost 500,00/ day	Chilling van	14 Lacs
Cold chain facility	Electricity	0.50 paisa/L	Diesel generator	5 lacs
Hygiene practice of collector	Simple cleanliness using soap /detergents	2.00 per can + person	For SS Can + person	
Holding time at Collection center	3 hrs in morning and 4 hrs in evening	None	cooling facilities	
3. Chilling center inputs				
Full electricity availability	12-14 hrs power cuts		Full electric supply	500.00 / day incl diesel cost
Quantity collection /day	500- 5000 L/Day	2.00/L	Same . Reqd. pressure cleaner and heater	3.00/L
Milk holding time(hrs.)	6-15 Hrs	2.00/ L	Improvement of center	2.00/ L
Storage technique	In chilling vat, not at home		Improvement of center	

	Existing practice		Good practice	
	Comment/unit	Cost (NPR)	Comment/unit	Cost (NPR)
Chilling van used by public sector	DDC Van		Same . Reqd. pressure cleaner and heater	
Chilling van used by private sector	0	0	0	
4. Trader and transporters inputs				
Condition of used chilling van to carry milk to the processing plant	Temp at 4 degree Celsus	1.50 /L	Smooth movement	
Adding of water during transportation	No	0	Timely repairing	
Adding of preservatives during transportation when road is blocked	No practice. But sometimes use Soda bicarb in very hot days or strikes	0	No use of soda also	
Quantity per trip	9000 to 12000 L	1.5/L	Same as present	1.50/L
Transportation fare per trip/ tanker	Tanker of diff. capacity used	13500- 18000 accord. To distance	Same as present	Depending upon cost of fuel
5. Dairy plant/ Industry Inputs				
Collection of milk separately or mixing	Mixing of milk	30- 34/L	Separately collected	45/L
24 hr Cold chain facility exist	yes using electricity and power generator	0.40/L	Yes	0.60/ L
cost of Milk sample testing on arrival/sample	Garber's method, milk analyzer, CMT		Timely maintenance of equipments and availability of kits/ chemicals	Based on the technique used
Pasteurization facility in place	72 degree for 20 sec	3.00/L	Monitoring of the time and temperature	
Mechanical sterilization of plastic bags	No such facilities in small firms, but yes in big firms		u-V rays sterilization	
Quality Dairy equipments	Indian, Chinese, Local	Variable	Italian standard	70 lacs
GMP applied certificate in place	Not in place		GMP and GHP applied	
HACCP : Temp. control system applied in the plant	Not in place	0	HACCP in 1-2 places	
Value added products preparation	Yogurt, Paneer, Ghee, Khoa, Butter	By technician	Other diversified products	As per training course

Source: Author - compiled at the dairy supply chain stakeholder seminar at Chitawan organized for this study.

4.3.6 Sharing of the compliance cost among public and private actors

Information on cost sharing was also collected together with that on compliance cost during field visits and specifically at the Chitawan seminar. Table 4.3 shows the results on cost sharing as well as responsibilities as elicited at Chitawan. The underlying principle governing the respective roles is that the government provides public goods that the private actors do not, and also creates an enabling environment for investment, while the private actors bear those incremental costs which they can later recoup from the market, by way of higher price for safer and better quality foods. Stakeholders at the workshop also mentioned about various subsidies from the GoN.

What follows is a narrative on the division of responsibility of various actors. This is based on field visits, Chitawan workshop as well as literature and expert opinions.

Thus, it is believed that the MoAD should provide an integrated biosecurity policy and related acts and regulations, rather than in a fragmented manner as now, and within which the private sector would operate. The responsibility for inter-ministerial coordination, so crucial for a broad programme like biosecurity, also falls upon the MoAD as the lead ministry in this area. Next comes the role of the DLS which is the principle technical office for livestock and veterinary services. The DLS needs to gradually build capacity for science-based approaches such as the use of risk-analysis/risk management in food inspection and control systems. The DFTQC has a mandate for safety of processed meat and milk products. It is DFTQC's responsibility to mobilize facilities and staffs for providing those services. There

Table 4.3: Stakeholders' views on sharing of incremental costs of compliance between the private and public actors

	Various improvements identified	Cost sharing (private: public %)	Comments (public support)
1	Modern cement shed/fence	45:55	Subsidy
2	Farm and milk recording system	100:0	
3	Quality assured feed	75:25	Feed quality testing
4	Water quality testing	0:100	Free testing by GoN
5	Personnel hygiene practice	100:0	
6	Animal shed - well ventilated , non-slippery	100:0	Probably, some soft loan
7	Use of milking machine	100:0	Probably, some soft loan
8	Type of can for Milk collection	30:70	Subsidy on steel cans
9	Use of higher antibiotics in animals	100:0	
10	Withdrawal of milk for at least 9 days	50:50	Cost sharing
11	Use of hormones	100:0	
12	Separate keeping of new animals	30:70	Subsidy on sheds
13	Cost of transportation to collection center	30:70	
14	Type of can for Milk collection	100:0	
15	Preservation by using	50:50	Electricity subsidy
16	Chilling van	50:50	Chilling van subsidy
17	Cold chain facility - diesel generator	50:50	Subsidy generator
18	Holding time at Collection center	50:50	Subsidy for IB Tank
19	Continued electricity availability	50:50	Electricity subsidy
20	Modern storage technique	50:50	Subsidy IBT
21	Maintenance of milk sample testing on arrival	50:50	Kits from GoN
22	Pasteurization facility in place	50:50	Replacement grant
23	HACCP: Temp. control system applied in the plant	50:50	

Source: Author, as compiled at the dairy supply chain stakeholder seminar at Chitawan organized for this study. Various improvements identified for GVPs and incremental costs were presented in Table 4.2.

is also the need for more collaboration between the DFTQC and DLS in providing biosecurity related services. The NDDB is at a vantage point to take a number of initiatives – it could take the lead in drafting national biosecurity policy for milk and milk products and the dairy subsector as a whole; it could play a lead role in amending existing policies, acts, regulations or standards applying to the entire dairy chain. It could also propose to the GoN a dairy development plan to be implemented in public-private partnership, and also provide a coordinating role among dairy stakeholders in implementing biosecurity policies.

Both the DDC and private **dairy entrepreneurs** should play a proactive role in ensuring that they follow good practices and guidelines so as to win the trust of consumers by assuring quality. **Dairy farmers** do have considerable responsibility in adopting and internalizing GAPs and GVPs. They should ensure the use of hygienic practices on dairy husbandry including the use of only prescribed drugs, feeds, forage and fodder materials and marketing including milking, storage and transportation of milk. It is not expected that they do all these for free – the principle is that they improve the standards while consumers through the market pay for the extra cost. One issue that often hits the headline in Nepal is the withdrawal of milk during and at least four days after the completion of the treatment of the milking cows or as described in the code of practice, on which they need to follow the prescribed guidelines. **Milk collector and cooperatives** (assuming that cooperatives also perform collection function) have also responsibility in ensuring that farmers are following good practices. Perhaps a greater challenge for them is to find ways to fund investments in cold chains in various steps of the food chain. As this costs money, they should explore innovative ways to differentiate milk and dairy products by charging different prices based on quality and certifications.

It is desirable that **chilling centres** maintain cold chains continuous, as is the case in advanced developing countries. The chilling centre would always test samples before receiving milk from collectors or farmers, at least for adulteration, especially for sodium hydroxide (NaOH), formalin, hydrogen peroxide, phenolic compound and antibiotic residues using quick test- kits. In addition, the centre needs to apply a house-keeping plan to maintain sanitation and hygiene as per the applicable code of practices.

Traders and transporters have the responsibility for maintaining appropriate equipment or facilities and vehicles for ensuring safety and quality of food in the supply chain. Guidelines prescribe that transporters need to always use chilling vans/truck for transporting milk and milk products. And lastly, **dairy processors** are required to be aware of and knowledgeable of regulatory provisions for food safety and quality. They need to communicate this information to traders, transporters and even farmers, if necessary. They should follow the procedure for proper registration of the processing plants and be aware of the requirements of system certification (GMP/GHP/ HACCP/ ISO22000 etc.). They also need to be involved in capacity building activities as part of the public-private partnership and take lead in establishing integrated value chain approach from farm to fork.

4.4 Concluding remarks

The paper reviewed and assessed biosecurity issues for the livestock sub-sector. The purpose was to raise issues, identify gaps and discuss options for moving forward towards a more biosecure livestock sub-sector in Nepal. In addition to animal health and welfare, the focus of the assessment is on value chains of two key food products - diary and meat.

Biosecurity in the livestock sub-sector is conceptualized as an integrated management process designed to minimize the entry and spread of infectious agents onto the livestock farm and beyond to the food chain and the final food products. Analytically, the main focus of the study was on the assessment of gaps between what is desirable for biosecurity and what the current situation is. As per an FAO guideline, assessments were made at two levels: the system level (policy, legislation and organization); and value chain level (essentially, issues related to the adoption of various good practices).

Assessment of the issues/gaps at the sectoral/value chain level was undertaken first by reviewing gaps under six categories of management: i) management of a livestock farm; ii) transport, marketing and retailing; iii) veterinary drugs, supplements and feeds; iv) pesticide and other residues in foods; v) import and export system at borders; and vi) legislation,

strategy and policy. In all, 37 gaps were documented. As in other sectoral studies on biosecurity, large-scale interventions and investments are not required in many of these cases to close the gaps. Indeed, many of them could be closed with modest interventions such as raising awareness, enforcing existing rules and regulations and a modest enforcement of the control and compliance system. Many of the gaps noted relate to shortcomings at the system level – i.e. policy, legislation and organization.

Recommendations are not listed in this section for reason of space as this would simply repeat what has been clearly said in various sections, notably in Sections 4.3 and 4.4. For example, there is a suggestion or recommendation implicit in each of the gaps or shortcomings identified in Section 4.4.

Stakeholder consultations were found to be effective in eliciting views on the gaps or shortcomings, cost of compliance and the sharing of these costs among the public and private actors. When the three elements – gaps, costs and sharing – are discussed together, stakeholders tend to be more responsive and articulate in expressing their positions as they see the complete picture. In such forums, there is often a tendency initially for private actors to expect more from the government, e.g. subsidies. But when these interactions take as a basic principle that the government provides public goods while private actors invest in good practices and later recoup the cost from the market by supplying safer and quality foods, the respective role of the two groups and the sharing of responsibilities are more balanced.

There is a need for more work towards designing innovative schemes that incentivize the private actors to invest in good practices and recoup the cost from the market. Such schemes could include limited targeted subsidies from the government. One example would be exploring how limited subsidies or other incentives might induce dairy farmers to observe the required withdrawal period (e.g. 9 days) during and after a treatment of the cattle. Another example could be establishing a scheme of separate premium prices for certified dairy and meat products. Another could be to support dairy/ meat processors to implement certification and meet the certification costs for a couple of years till benefits are realized. Very little analytical work seems to have been done in Nepal on this subject. There could also be a lot to learn from similar schemes operating elsewhere in the world.

As a final point, Nepal needs to formulate without any delay its own series of good practices for biosecurity (such as GAP, GVP, GMP and so on). There is no dearth of global public and private standards, as well regional and national, from which to learn, borrow and adapt to Nepal's requirements. In the literature on trade in live animals and livestock products, there is a plea to give due weight to the standards of regional trading bodies (e.g. SAARC) and neighbouring countries.

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CHAPTER 05

BIOSECURITY ASSESSMENT FOR THE FISHERIES SECTOR

Rama Nanda Mishra

Abstract

The paper reviews and assesses biosecurity issues for the fisheries sub-sector, essentially aquaculture in Nepal's case. It finds that a number of the ongoing trends in the fisheries sector point to increased risk of hazards and threat to biosecurity. It analyses gaps between the current practices and good biosecurity practices and lists over ten such gaps at three stages of the supply chain - production inputs and practices, diagnostic, surveillance and quarantine capacity, and third, fishing environment and biodiversity. The paper also presents some fresh analysis of the incremental cost needed to bridge the gaps and the sharing of the cost between the public and private sectors of the supply chain. The study advocates for the formulation of a strategy and framework for biosecurity in aquaculture, consolidating current fragmented efforts.

5.1 Introduction

Nepal's per capita production and consumption of fishery products are very low. But this is anticipated to change as demand has been surging in recent years. Although aquaculture is among the fastest growing food sub-sectors in Nepal, growing at around 8.5 percent per year, demand exceeds production and so imports have been growing rapidly. The high growth rate points to immense scope for import substitution by addressing supply-side constraints. Most of the aquaculture takes place in the Terai area but this is also extending to the hills particularly cold water aquaculture.

Fish is a safe and nutritious food when harvested in a clean environment and handled hygienically until consumption. But, the ground reality can be very different in many developing countries. Unhygienic practices, insufficient refrigeration and sub-standard manufacturing practices have been the source of many outbreaks of fish-borne illnesses in recent years. Increased trade has also been a source of elevated risk of disease worldwide.

Biosecurity in aquaculture can be conceptualized as a strategy and action plan that brings together a range of institutions and tools for the prevention, control and eradication of infectious disease and the preservation of human, animal, and environmental health. A biosecure approach adds value over the traditional compartmentalized response system by being able to reach the entire aquaculture production chain, including farms, processing plants, hatcheries and feed mills. In terms of components or programs, there are several – good practices and control system at the farm, border controls, import certification, disease surveillance and monitoring, improved aqua-veterinary education and better management of disease outbreaks.

With the expected increases in production in response to surging demand, aquaculture can be anticipated to intensify and also extend to newer areas, including the hills. This, together with increased imports as well, will elevate the risk of hazards. As a result, biosecurity management will increasingly become crucial for Nepal. Most of the cultured aquatic animals in Nepal are introduced and new species and activities are being pursued. This trend in aquaculture, notably fed aquaculture with

carnivorous species, also poses a threat to biodiversity and thus requires fresh analyses, reflections and responses. The spread of trans-boundary diseases is also a growing threat due to trade. All these require timely, preventive responses now. These include, for example, formulation of effective policy and regulatory frameworks and guidelines – essentially a biosecurity strategy for aquaculture, capacity for risk assessment and risk management, and adequate quarantine inspections at the border.

The purpose of this paper is to undertake an assessment of the biosecurity status for the fisheries sub-sector, essentially aquaculture in the Nepalese context. The study is based on literature review, expert opinions and limited field visits and stakeholder meetings. It should be taken as a preliminary stocktaking exercise rather than a comprehensive analysis of the topic. Not only is biosecurity a relatively new subject and thus not much is written on this but also that there are fewer writings on fisheries in Nepal than on, say, crops and livestock.

The paper is organized as follows. The next section provides a brief on the concept of biosecurity in aquaculture, i.e. the approach, its essentials and scope. Having this at the outset helps subsequent discussions. Section 5.3 presents the assessment, discussing aquaculture issues for Nepal related to biosecurity. The purpose is to understand the current gaps, including those on policy, legislation and institutions. Section 5.4 presents cost-benefit considerations in adopting good aquaculture practices. Section 5.5 gives the concluding remarks.

5.2 Concept and Essentials of Biosecurity in Aquaculture

Biosecurity in aquaculture has been defined variously in the literature but there is a common understanding of the concept, goal and scope. To illustrate, Yanong and Erlacher-Reid (2012) define biosecurity in aquaculture as practices that minimize the risk of introducing an infectious disease and spreading it to animals at a facility and the risk that diseased animals or infectious agents will leave a facility and spread to other sites and to other susceptible species. They add that the most effective way to ensure biosecurity at an aquaculture facility is to develop a written biosecurity program that includes the following: i) a thorough *risk assessment* to determine which areas or factors may cause the spread of pathogens; ii) *risk management*, whereby a prevention plan is developed and carried out; and iii) *risk communication* to make sure all employees, suppliers, visitors and others who may enter the facility are educated about the plan and cooperate with it. Elsewhere it is said that biosecurity is an essential group of tools for the prevention, control, and eradication of infectious disease and the preservation of human, animal, and environmental health.

If one were to give a concrete example, Australia's AQUAPLAN, the *National Strategic Plan for Aquatic Animal Health*, seems to fit the concept and characterization of biosecurity in aquaculture. Indeed, AQUAPLAN is frequently mentioned in the literature as one of the few comprehensive systems that seem to accord with the concept of biosecurity.

The objective of the AQUAPLAN is to improve the productivity and sustainability of Australia's fishery and aquaculture industries. It incorporates a range of programs that include good practices, border controls, import certification, disease surveillance and monitoring, improved veterinary education, and better management of disease outbreaks – all supported by detailed operational plans. These operational plans, under its AQUAVETPLAN, are in a series of manuals that have been prepared outlining Australia's approach to national disease preparedness, and proposing the technical response and control strategies to be activated in an aquatic animal disease emergency.

Trade plays an important part in all aquaculture operations. Some trade is essential for all farms for various inputs, such as broodstock, post-larvae/fingerlings, manures and feed. These inputs represent potential pathways by which new pathogens can enter farming systems. In the absence of appropriate regulation, trade (commercial exchange) in high risk commodities has continued with little or no risk management because of commercial pressures, despite the relative lack of knowledge of disease and pest risks, and often without regard to the known risks. Therefore, trade controls feature prominently within biosecurity.

As in other sub-sectors, the core building block of biosecurity would be what may be called Good Aquaculture Practices (GAqP), the equivalent of GAP for crops. As with the GAP, the focus of the

GAqP is on fish farm itself, including post-production processes at the farm. As in crops or other sub-sectors, there are best practices or control systems for the rest of the supply chains, e.g. Good Handling Practices (GHP) and Good Manufacturing Practices. Individual countries seek to develop their own GAqP and other good practices. For this, they have rich references to draw upon which are– various inter-governmental and private global standards for best practices. The general trend is to adapt for the GAqP the global standards as far as possible because this harmonizes standards and facilitates trade. Such global practices and references include the standards from the three inter-governmental bodies - Codex Commission, IPPC and OIE – as well as standards set by private bodies such as the GlobalGAP, Best Aquaculture Practices (BAP) and Good Management Practices developed by Global Aquaculture Alliance (GAA). Then there is the food safety management systems based on the principles of the Hazard Analysis and Critical Control Points (HACCP), which has contributed considerably to improving the standards of post-harvest handling and processing of fish and fishery products.

Among the three international standards (Codex, OIE and IPPC), it is the Codex and OIE standards that are relevant for fisheries. There are several standards in the Codex that are applicable to the fishery products. A search of the Codex database reveals that there are 21 documents in the "Fish and Fisheries Products" category. *Inter alia* there are 18 standards, two guidelines and the Code of Practice for Fish and Fisheries Products, which also cover the aquaculture sector.

The OIE's activities on aquatic animal health are largely coordinated by the *Aquatic Animal Health Standards Commission* which, in addition to promoting aquatic animal health globally, is also in charge of developing generic and specific disease chapters for the Aquatic Animal Health Code and the Manual of Diagnostic Tests for Aquatic Animals. Then there are other standards - the Aquatic Animal Health Code and the Manual of Diagnostic Tests for Aquatic Animals. The standards deal with a number of subjects: aquatic animal disease diagnosis, surveillance and notification; risk analysis; quality of aquatic animal health services; disease prevention and control; trade measures, import and export procedures and health certification; veterinary public health; welfare of farmed fish; diseases of crustaceans; diseases of fish; and diseases of molluscs.

As regards various codes of conducts and guidelines, the FAO Code of Conduct for Responsible Fisheries (FAO CCRF) is dedicated to fisheries. This non-mandatory code of conduct is primarily concerned with sustainability of the fisheries sector and establishes principles and standards for the conservation, management and development of fisheries. Over the years the CCRF has been voluntarily adopted by several countries and it has, in some cases (such as Thailand), inspired the development of national certification programmes for aquaculture commodities.

As an example of a successful country in fisheries, Thailand stands out in having made marked improvements on quality and safety, both at home and export markets. The implementation of the quality and safety "Q" certification programme played an important role in this. Under the scheme, "Q" logo is given to certify food safety at each step of food production (crops, livestock and fisheries). The Department of Agriculture grants several certificates including Q GAP, Q Packing house and Q Shop, among others. Under the Q-GAP scheme, three levels of certification are given for on-farm production: level 1 - pesticide-residue safe; level 2 - pesticide-residue safe and pest free; and level 3 - pesticide-residue safe, pest free and with premium quality. There is a lot for Nepal to learn from this innovative approach used in Thailand.

For Nepal, one high priority project is to develop its own NepalGAqP. For this work, there is a lot to learn from the experience of other countries, not just advanced countries like Australia and New Zealand, but also developing countries successful in the fisheries sector, such as Thailand and China. Then there are approaches, standards and detailed manuals from global inter-governmental and private bodies to draw upon, as noted above.

5.3 Background – Nepal's Fisheries Economy and Governance Framework

5.3.1 The fisheries economy

Nepal's fisheries sector is small but growing rapidly. The sector makes up about 1 percent of the GDP and 2.6 percent of the agricultural GDP. Total fish

production in Nepal is estimated to be about 54,000 tonnes, of which 40 percent comes from capture and 60 percent from aquaculture (DoFD, 2012). In capture fishery, both rivers and irrigated paddy contribute about 33 percent of the total, followed by 28 percent from *ghols* and 6 percent from lakes and reservoirs. Some 86 percent of the total aquaculture catch comes from ponds. Aquaculture is one of the fastest growing (8.5 percent per year) food sectors in Nepal. The fisheries sector is estimated to provide income and employment to some 550,000 people, with capture fisheries providing primary livelihood for 24 traditional fisher communities and employment to some 500,000 people (DoFD, 2012). There are 26,036 ponds and around 25,000 farmers involved in pond aquaculture with an average farm size of 0.28 ha. Aquaculture is limited to pisciculture in the southern part of the country, with pond aquaculture with polyculture of carps the dominant activity. Gradually, it is expanding to hills and mountains as well.

With 26.5 million population in 2011 and 54,000 tons production, Nepal's per capita fish production comes to 2 kg/year, which is much lower than India's 9 kg/year and Bangladesh's 18 kg/year. Given the low per capita production and surging demand, growth potential is substantial and the GoN's plan is to produce 94,000 tons of fish by 2017 (FPP, 1997) and 1,55,000 tons by 2027 (WECS, 2005). To achieve these targets, the GoN has for some years now a special program called "Mission fish". It provides *inter alia* incentives to farmers for area expansion and intensification of aquaculture.

As regards trade, imports are rising strongly as Nepal's demand for fish is growing faster than production, although statistics are weak on trade due to the porous border. It is reported that as much as 80 percent of the fish in the Kalimati market and 60 percent in other urban markets could have been imported (Edwards, 2013). Likewise, approximately 3.3 million numbers of fish seed, mainly of carps and some catfishes, and 11,158 numbers of aquarium fish were imported in the fiscal year 2010-11 (CAQO, 2011). In addition, dried fish are also imported from India, mostly as feed ingredients. Apart from these, marine frozen fish products are also imported by supermarkets. Large scale imports of fish, seed and feeds are a drain of foreign exchange but have also been a matter of concern from sanitary and biosecurity angles.

5.3.2 Institutional, policy and legislative frameworks

Institution-wise, besides the MoAD, the most important agency for fishery development in Nepal is the Directorate of Fisheries Development (DoFD) of the DoA. The DoFD is responsible for central level policy issues, planning and programming, monitoring and supervision, etc. It also coordinates with national and international institutions with focus on research, marketing, credit, input supply, etc. The most substantive development activities in fisheries are implemented under the Fisheries Development Programme, one of the several commodity development programmes in agriculture.

Other major institutions that work under the DoFD are: i) National Inland and Aquaculture Development Programme, responsible for pilot initiatives and execution, database and feasibility, monitoring and coordination; ii) Central Fish Laboratory (CFL), mainly responsible for disease diagnosis, support services, and monitoring and coordination of the activities related to disease iii) Fisheries Development and Training Centre, responsible for training and awareness, input supply, technical support services and monitoring; and iv) Fisheries Development Centres (FDCs), responsible as resource centres for fish seed and technology. In addition, there are a Fisheries Research Division within the NARC for fisheries research, a Nepal Fisheries Society for technical partnership, and a Fish Growers Association for enhanced production and promotion.

Fish disease surveillance and reporting system - There is a system of regular reporting on fisheries from the field to central level. At present, the FDCs are discharging the role of regional fish disease diagnostic centres and send reports of fish disease occurrence in their respective farms and command areas on a monthly basis. The CFL (National focal point for aquatic animal disease) makes a national report based on these reports and sends to Network of Aquaculture Centres in Asia and Pacific (NACA) and the OIE through OIE national delegate.

Laboratory services - Laboratory facilities for diagnosis of fish disease have been set up at the CFL, Balaju with a capacity of level-II. The FDC*s* at various places have the diagnostic capacity of level-I. The CFL coordinates the fish disease diagnostic and control of fish disease in the country. It has emergency fund to

address disease problems in addition to its regular budget for disease diagnostics and surveillance. The service of level-III is obtained from AHRI, Bangkok through the NACA. However, due to the limited number of qualified and trained manpower, the work on fish health management is very limited and scanty.

Quarantine system - Live aquatic animals and unprocessed aquatic products undergo through animal quarantine system in the country to minimize the risk of importation of diseases and pests. There are national guidelines for live fish importation, with only recommended species allowed to be imported by obtaining prior permit. Also *fish seed standard* and *seed packing and transport standard* have been set. The importer needs to follow the standards and produce certificate of origin and international health certificate in the OIE format. Despite all these, the quarantine offices lack a critical set of facility and knowledge to undertake risk assessment.

As regards **policy**, it is generally held that there are no specific policies for aquaculture in the country and fisheries are often seen as an integral part of agriculture. Fragmented policies related to biosecurity do exist across various sectors but no integrated policy exists on biosecurity. Agricultural or related policies that concern fisheries as well as related biosecurity issues include the following: i) National Agriculture Policy 2004; ii) Agribusiness Promotion Policy 2006; iii) Agriculture Bio-diversity Policy 2007; iv) National Water Plan 2003; and v) Trade Policy 2009.

As for the **legislative framework**, the GoN has not as yet formulated or enforced specific legislation on aquaculture production and development. In 1997, an act from the 1960s - the Aquatic Animal Protection Act (1960) – was revised and amended. It clarified some aspects such as its scope and definition of different terms specified in the Act. Other provisions included: restrictions on certain methods of killing and capture, punishments, citizen's obligations, role and responsibility of local authority and technical authority, etc. concerning aquatic life and its conservation. The Act is not yet in operation because regulations are in the process of being approved. Thus, overall, there is a feeling that Nepal needs an integrated legal framework for biosecurity in the fisheries sector, as well as sectorial legislation to ensure biosecurity in the country. In addition, it is also felt that there is much more to be done in incorporating or domesticating international standards and practices into national laws.

5.4 Issues and Assessment of Gaps in Aquaculture Biosecurity

This section takes stock of various issues and assesses current status on biosecurity in aquaculture. One key question asked in this context is on the gaps, i.e. the gap between what is desirable and the current status. In the literature, these gaps are reviewed typically at two levels – practices at the farm and along the value chain, and gaps at the level of policy, legislation and institutions. Such an analysis provides the main basis for identifying response measures. The next section on compliance costs and public-private role also includes some aspects of the gaps. For presentational clarity, the 12 topics covered below are organized in three categories.

5.4.1 Production inputs and practices

Fish seed is one important source of potential hazard and thus a concern for biosecurity. There is no wild collection of seed in the country and hatchery seeds are the only source for aquaculture. Carp and trout seeds are produced in sufficient quantities and some tilapia seeds are also produced. The seeds of all other exotic species are generally imported from India. There are 14 public and 54 private hatcheries established in the country of which 11 and 33 respectively are in operation. All hatcheries function as isolated and genetically closed units raising their own brood stocks and provide seed to nurseries and grow-out farmers. There is a growing concern that the poor growth performance in grow-out operations may be due to degraded genetic quality of seeds resulting from genetic degradation and poor management of broods along with its weak disease resistance capacity (Mahapatra and Rai, 2007). Currently, there is no regulation on fish seed production and distribution. Legislation on this has been drafted and is awaiting approval.

Feeds are also highly pertinent to biosecurity. The quality and freshness of feed ingredients, and storage and handling practices all impact on the health of the fish produced as well as on the cultured environment. Feeds are provided to carps only as supplementary feed in the polyculture system of production where natural food production is encouraged. The feeds

provided are obtained locally and mostly based on cheap ingredients, posing threats to environment and fish health. Recently, fed aquaculture has also increased with trout and catfish farming. Some major disease problems observed in trout farming are due to poor feed quality. There are no dedicated commercial feed factories for fisheries; the same cattle or poultry suppliers also provide feeds for aquaculture. Some fresh investments have been made on fishery feeds and so things should improve in the coming years. Standards for feed ingredients as well as feed manufacturing practices are missing, along with the standards for other inputs used in fish production. Regular monitoring mechanism needs to be put in place.

Drugs and chemicals used in aquaculture is another source of hazard. Currently, there is neither any drug store exclusive to fisheries nor registered in the name of fisheries. No drug has as yet been registered in Nepal as aqua-vet drug or chemical. However, there are some feed additives exclusively available for fish like fishmin. All drugs and chemicals used seem to be safe so far, but abuse could occur. The use of antibiotics is also very limited.

Post-harvest management is an important component of a biosecure supply chain. Post-harvest losses are high in Nepal and fish quality suffers considerably due to poor handling at this stage of the supply chain. The reasons are well known - lack of ice at the production site, lack of or very poor landing and collection centres, unavailability of proper packing materials and refrigerated transport facilities (ACEPP, 2010). Most fish in Nepal is marketed fresh. A new and positive trend is investment in vacuum packing facility and delivery of frozen fish for the marketing of high-value fish like rainbow trout. While higher trout prices provided that incentive, it is worth exploring if some incentive scheme, including on a cost sharing basis, exists for inducing the rest of the fish farmers also to invest on modern post-harvest facilities.

Fish disease takes its toll by causing significant losses in fish output every year, estimated to be about 15-20 percent of fish output and 30-40 percent of seed output, valued at about NPR 150 million annually (Mandal, 2010). The diseases are caused by parasites, fungi and bacteria as well as poor water quality and hygiene. The disease incidence is most common in areas where intensive package of culture is practiced. Surveys in trout growing areas show occurrences of bacterial, parasitic and nutritional diseases. Among non-infectious diseases, water quality and nutrition related problems were behind the high mortality of fingerlings, table fish and brood fish. On a positive note, no zoonotic fish disease has been reported in Nepal while Nepalese cooking method keeps away most of the pathogens and parasites.

5.4.2 Diagnostic, surveillance and quarantine capacity

Surveillance, monitoring and reporting, and disease list - Mandatory reporting system for fish disease needs to be developed along with improvement in national capacity to comply with the OIE World Aquatic Animal Health Information System (WAHIS) (national and regional reporting and feedback systems). Preparation and updating of a national aquatic pathogen inventory will also help in emergency preparedness capacity.

Diagnostic and fish health services - The components of a national aquatic animal health strategy are well recognized (e.g. FAO/NACA, 2000). These include for example a national pathogen list, disease diagnosis, health certification and quarantine measures, disease zoning, disease surveillance and reporting, contingency planning, import risk analysis, national strategies and policy frameworks and national and regional capacity building. Furthermore, diagnostic capacity of the fish disease laboratory needs to be strengthened at the field level. Training on quarantine protocols for aquatic animals is also required.

Strengthening the quarantine system - The risk of a serious disease outbreak due to an exotic pathogen or strain will remain high as long as live aquatic animals are imported. The proper response is an effective quarantine system at borders. The state of fisheries quarantine along the long and porous Nepal-India border is weak. Currently, fish quarantine work is also carried out by animal quarantine offices. Field visits for this study revealed that the quarantine offices at Birgunj and Bhairahawa lack laboratory and holding facility for fish quarantine. As a result, certificates are typically provided based on visual observation, but then clear guidelines and training are lacking even for this. Quarantine can also be made more effective by improving statistics or records on fish imports specifying species, size and origin among others. Capacity for risk assessment is essential. This requires

higher studies, specialized training, interactions and workshops, and information sharing to all concerned stake holders.

Establishment of reference laboratory – There is a need for establishing an equipped central fisheries laboratory as a reference laboratory for aquatic animal health diseases with a view to minimizing risk and improving risk bearing capacity. It should be able to work as level III laboratory for aquatic animals (e.g. for sample processing, pathology, molecular analysis).

Interventions for maintaining fish quality - Monitoring of the quality of fresh fish is currently undertaken in an *ad hoc* manner by municipalities, consumer forums and the DFTQC. The state of quality varies greatly depending on factors such as the quality of collection centres, availability of ice packs, suitable packing materials, proper transport facilities, and display of the product for sale at retail outlets.

5.4.3 Fishing environment and biodiversity

Aquatic pollution and residues are environmental hazards caused by leakage into the aquatic environment of the chemicals used in industries, agriculture, livestock or humans. In particular, the increasing use of insecticides in paddy farming has significantly impacted on fish production in rice fields. Rivers too are getting polluted by city sewerage. There are GoN's *Nepal Water Quality Guidelines for the Protection of Aquatic Ecosystem* and *Nepal Water Quality Guidelines for Aquaculture*. Unfortunately, hardly anything is found in the literature on the effectiveness on ground of these guidelines, a serious lacuna in the Nepali literature.

Biodiversity - Nepal is rich in terrestrial as well as aquatic biodiversity. While it occupies only 0.1 percent of the global fresh water resource, it supports 2 percent of the global fresh water fish diversity. It is estimated that there are nine species of crab, 30 species of aquatic mollusks and 232 species of fresh water fish in the water bodies of Nepal. Among the fishes, 217 are indigenous to Nepal and all these species belong to the single subclass Actinopterygii. These indigenous fish species have high economical as well as biological values as most of them are foods for the people and 15 of them are endemic to Nepal (Rajbansi, 2012). Some of them are threatened species.

On the whole, it is generally held that there are more gaps to be closed in the fisheries sub-sector because there are fewer acts, regulations, standards etc. that are dedicated to the fisheries sub-sector and issues, in contrast to say for crops or even livestock. Most of the gaps were discussed above, but it may be worth summarizing some of them again in the following form.

a) There is a need for a dedicated biosecurity framework for the fisheries sector, which would then be a source for dedicated policy, legislation, standards and guidelines.
b) There are gaps in clearly defining the roles and responsibilities of various fisheries institutions in addressing biosecurity issues; current capacity needs enhancement and some reorganizing of responsibilities is needed.
c) The current aquatic animal protection act does not address the biosecurity of wild fish as there is no restriction on haphazard release of fish into water bodies.
d) There is no legal provision for the registration of aquaculture farms or carrying out fish and fisheries related activities.
e) There is an urgent need for regulations on fish seed production and distribution (an act and regulations for this has been drafted but enactment is pending).
f) There is as yet no defined Good Aquaculture Practice (GAqP) in Nepal.
g) Use of risk analysis for the protection of biosecurity is almost missing.
h) Also missing is standards for drugs and disinfectants for aquaculture and fish health management in Nepal.
i) The technical capacity of both the veterinarians and fisheries professional is inadequate to cope up with emerging biosecurity-related hazards.
j) There is a lack of standards and operational procedure for post-harvest operations and marketing of fish and fisheries products.
k) Disease surveillance system is not adequate in its coverage of the country and disease reporting is not mandatory.

Some "overlaps" were also noted during the course of this study. Thus, the aquatic animal protection Act recognizes fisheries professionals as technical officers for the implementation of the Act but this overlaps with the responsibilities of officers working with the conservation of wild life. Likewise, the animal health

Act has given responsibility for aquatic animal health to veterinarians, who lack knowledge of aquatic pathology. Similarly, the DLS has the mandate for the animal health Act but fishery professionals are working under the DoA (it is the DoFD which is the main GoN agency for fisheries sector and implements almost all activities of fisheries and aquaculture).

5.5 Compliance Cost and Public-private role

The cost of implementing biosecurity measures can be significant. This will depend on a number of factors, notably the gaps between the current and best practices. The discussion on gaps above showed that some of the gaps may be just the result of the lapses – things that could have been easily done but not done – and could be closed with small interventions at fairly low cost. Others, e.g. quarantine laboratories, could cost huge sums of money. Closely related to this matter is the question of who bears the cost, also importantly how the costs are shared between the public sector and various private actors along the supply chain.

However, while costs are mostly tangible, the benefits are not always so. There are two categories of beneficiaries of a biosecure aquaculture – farmers and other actors in the supply chain, and the rest of the society, including environment etc. The general principle would be that the private actors invest in their business and recoup the costs from the markets, at the same time generating positive externalities in the society. Then there are public good such as products that also need to be produced and for which society or the public sector needs to invest. There is a rationale for public-private sharing of cost in the former case also because some of the improvements done by the private actors benefit society at large.

A good illustration of the type of quantification that is needed to establish a sound basis for discussing cost of compliance issues for policy purpose is given in Annex 5.1 and 5.2. Annex 5.1 shows for Thailand, Bangladesh and India investment and maintenance costs for implementing HACCP and the resulting per unit cost of processing fish (in US$/kg). It shows that the cost of investment ranges from US$ 277,000 per facility in Bangladesh to US$ 405,000 in Thailand. Including maintenance cost as well and dividing the total by the volume of fish processed, the cost of processing comes to about 0.01 $/kg for Thailand, 0.06 $/kg for Bangladesh and 0.25 $/kg for India. Thailand's per unit cost is a fraction of the other two and most likely indicates the highly efficient Thai processing of fish. Annex 5.2 compares for India the unit cost of processing fish with and without HACCP. It shows that per unit cost with HACCP is more than twice the cost without. Larger plants are found to be much more efficient (lower per unit cost). This gives an insight for the design of a pro-poor policy in that smaller entrepreneurs are disadvantaged.

As noted, cost of compliance data can be insightful for policy purpose, e.g. for ascertaining the nature and size of the public support, targeting the assistance etc. Unfortunately, no such analysis exists for Nepal and it was beyond the scope of this study to do that. Instead, what has been done here is to put together a broad picture of the costs of and benefits from making the fisheries supply chain much more biosecure than now. As shown in Table 5.1, the costs are collated from many sources, including actual investment and programme costs. The benefits are very difficult to quantify and go beyond the simple economics of margins and prices to quantifying better health and hygiene and such positive externalities as environmental benefits. There is a strong public good argument here – given the nature of the benefits, there is a case for strong public support and/or subsidies in meeting a good part of the cost.

A preliminary exercise was also undertaken for the public-private sharing of the total compliance cost (Table 5.1). Needless to say, these are rough and preliminary numbers elicited based on limited discussions with farmers in the field, notably at a final stakeholder seminar. What was interesting was that farmers were not always asking for full public support or even large shares; they came up with large shares for themselves in several activities. This perhaps owes itself to the efforts made at the stakeholder and other meetings explaining the benefits the private sectors can reap by adopting good practices. A more in-depth assessment of this nature is desirable as this type of information helps identify areas where public support, or subsidy, could be crucial and where private sector needs to be incentivized to invest without a subsidy.

5.6 Concluding Remarks

The paper reviewed and assessed biosecurity issues for the fisheries sub-sector, essentially aquaculture in Nepal's context. The purpose, together with similar

Table 5.1: An overview of the cost of improving biosecurity and its benefits

Particulars	Cost involved (NPR)	Private sector's share	Benefits
Seed support/farmer	1,250	75%	Quality seeds will be stocked
Feed/farmer	24,000	75%	Factory produced quality feed will be used
Collection centres/pocket	2 million	25%	Food fish quality will improve
Transportation van	5 million	50%	Improved food safety
Packing material/collection centre	1.5 million	50%	Longer life, better quality supply
Adoption of GAqP/farmer	180,000	75%	Improved biosecurity
Wholesale market establishments	50 million	-	Better food quality
Retail market development	1 million	-	Better hygiene
Capacity building (farmers)	12,000		Improved awareness and improved aquaculture
Capacity building (service providers)	12,000		Improved awareness and improved aquaculture
Capacity building of technical staff	20,000		Improved support services
Lab strengthening	4 million		Better health management
Lab establishment	10 million		Better health management
Emergency response	1 million		Risk management
Product certification	10,000	50%	Quality insurance
Disease surveillance	15 million		Better risk management
Risk communication	1 million		Increased awareness and preparedness
Technical support services	2 million	20%	Improved biosecurity situation

Source: Author – based on field visits, stakeholder meetings, expert views and literature.

background status reports for other products (crops, livestock and forestry), was to identify issues and gaps and, based on these, policy response for a biosecure agriculture sector in Nepal.

A number of ongoing trends in the fisheries sector point to increased risk of hazards and threat to biosecurity. These trends include the introduction of new species in aquaculture, the rapid growth of fed aquaculture, elevated risk of the spread of trans-boundary diseases due to increased imports of seed, feed and fishery products, mostly from India, and the ever growing distance and reach of fresh fish markets within Nepal in an environment of poor hygiene, refrigeration etc. While risk analyses are yet to be undertaken, these factors - in isolation or combination - are threats to food safety, environment and aquatic habitat. Strong and urgent response is needed, starting ideally with a strategy and framework for biosecurity in aquaculture.

Section 5.3 on issues and the assessment of gaps in particular contains many suggestions, which follow from the analysis of gaps between the current and good practices. A total of 12 elements related to biosecurity were reviewed there under three headings - production inputs and practices, diagnostic, surveillance and quarantine capacity, and fishing environment and biodiversity. The overall message was that the gaps, mainly related to Good Aquaculture Practice (GAqP) along the fisheries supply chain, are wide in many areas. However, not all gaps necessarily require large investments and much can be accomplished by finding innovative solutions to incentivize farmers and other actors in the chain to adopt better practices. Thus, developing a GAqP and its enforcement is also an essential first step to make progress.

The paper also discussed compliance cost and views on sharing of the incremental cost by the public and private sectors. It was noted that some of the gaps could be easily closed with small interventions and low costs, e.g. effectively implementing the guidelines in a typical GAqP. Some other gaps would require large investments, e.g. for quarantine laboratories and capacity building for control and surveillance system. A preliminary exercise based on stakeholders' perceptions was found encouraging in that farmers and other private actors do not necessarily ask for

or expect the public sector to meet all the cost but are willing to invest and share the costs generously, provided that an environment is created whereby they can recoup the costs from the market in terms of higher price for better quality and safer products.

On the whole, the study finds that there is a strong rationale for the formulation of a strategy and framework for biosecurity in aquaculture. Such a framework paves the way for developing GAqP and its implementation plan and projects, including such essentials as the capacity for risk analysis. The important point is that the GAqP needs to be grounded on such a holistic framework.

This study was limited in scope and was meant to be a preliminary assessment of the current status. This was accomplished but what became clear is that there is a high pay-off to a more in-depth assessment of some of the topics covered, notably the identification of the gaps, the estimation of the compliance costs and innovative ways to share the costs between the private actors and government. As biosecurity is also a public good and generates positive externalities in the society, there is a case for increased public support, as well as targeted subsidies.

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Annex 5.1: Cost of investing in HACCP plants in selected countries of Asia

Cost categories	Thailand	India	Bangladesh
Total investment of a plant ($'000)	381-405	309	277
Maintenance cost of a plant ($'000/year)	4 -71	41	35
Cost of fish processing ($/kg)	0.010-0.014	0.21-0.28	0.033-0.090

Note: HACCP = hazard analysis and critical control point, na = not available

Sources: Cato JC, Santos ALD. 1998. European Union 1997 seafood safety bans: The economic impact on Bangladesh shrimp processing. Marine Resource Economics, 13, 215-227; and field surveys. as mentioned in the policy brief of the world fish Centre (2008)

Annex 5.2: Cost of processing fish with and without HACCP compliance, India

Plant capacity	Without HACCP compliance ($/kg)	With HACCP compliance ($/kg)
Small (<10 tons/day)	0.142	0.331
Medium (10-15 tons/day)	0.095	0.226
Large (>15 tons/day)	0.072	0.167
Average	0.093	0.216

HACCP = hazard analysis and critical control point

Source: Field Survey as mentioned in the policy brief of The World Fish Centre (2008)

CHAPTER 06

BIOSECURITY ASSESSMENT FOR THE FOOD PRODUCTS OF FOREST ORIGIN

Narendra Chand

Abstract

Forests provide several food products which are particularly valuable for low income communities living near the forests. These products are also increasingly demanded in urban areas and export markets. The literature on these food products is very thin. This paper, based on stakeholder meetings, literature review and expert views, discusses three main biosecurity concerns with these food products: (i) safety and quality for consumption; (ii) commercialization through processing and trade; and (iii) sustainable harvesting. The study identifies a number of biosecurity gaps both in production and post-production stages. It finds that these products receive much less attention from the government in terms of surveillance, policy and programmes, in contrast to the attention received by timber, medicinal plants and other forest products. A number of recommendations are made, including the need for articulating a policy framework that responds to the three biosecurity concerns noted above.

6.1 Introduction

Forests have traditionally provided a range of food products that have been valuable for food security of the people living around the forests, mostly low-income and marginalized communities. These foods play crucial role in meeting supplementary dietary requirements during lean seasons when other food sources are scarce and expensive. The relative importance of these foods varies across the country. Several Nepalese food products of forest origin (FPFOs) can be identified easily – various yams, edible nuts, mushrooms, fruits, spices and condiments, resins, edible plants, edible oils, edible animal products and so on. Studies have documented these foods for various regions of Nepal, with the number count ranging from 40 to 70.

The literature on FPFO is found to be thin. In contrast, a great deal of attention is given to other forest products, notably timber or wood and medicinal plants. The FPFO is a sub-set of a well-recognized category called Non-Wood Forest Products (NWFP) which includes all biological materials other than timber and which are extracted from forests for human use. Medicinal and aromatic plant (MAP) is another important sub-category. In many writings, the FPFO and MAP are discussed together, with the MAP receiving greater focus in studies on industry and trade while FPFO receives more attention while discussing food security and livelihoods. But that division is thin as the former studies also cover basic food such as mushrooms in view of the trade potential.

Biosecurity is conceived as a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) for analysing and managing relevant risks to human, animal and plant life and health, and associated risks to the environment. It covers topics such as food safety, introduction of animal and plant diseases and pests and the introduction and management of invasive alien species. While most countries do have policies, legislations and standards for the safety of food, animal, plants etc., their formulation and implementation is typically scattered across

government agencies, leading to fragmentation of effort, waste of resources, duplications and the risk of lapses within the system. This is where a national biosecurity framework adds value by responding to the challenges in a holistic manner.

What would be the framework and scope of biosecurity in the case of the FPFO? This study takes a broader view of the scope by considering that there are at least three aspects when it comes to the biosecurity of the FPFO – safety and quality of the FPFO themselves; processing and trade aspects related to commercialization of the forest products; and sustainable exploitation of these products. These aspects are inter-related and so require a more holistic response, e.g. a surge in exports impacts on the access of the poor to the FPFO as well as the sustainability of the harvest itself.

The study is based on a review of literature on Nepal and elsewhere, expert opinions and limited field visits to some districts. The literature on FPFO is very thin and so this study should be taken as a preliminary stocktaking exercise and not a comprehensive analysis of the subject.

The rest of the paper is organized as follows. Given some ambiguity about the term FPFO, the next section asks a basic question - what are food products of forest origin? Section 6.3 presents a framework and scope of biosecurity of the FPFO. Based on this, Section 6.4 makes an assessment of the selected issues on FPPO biosecurity in five sub-sections. Section 6.5 gives the concluding remarks.

6.2 What are Food Products of Forest Origin?

The literature on issues related to the sub-category called "food" of forest origin is very thin. Most writings tend to focus on the category called Non-Wood Forest Products (NWFPs). The term NWFP encompasses all biological materials other than timber and firewood which are extracted from forests for human use. The term NWFP, which excludes all wood differs from another commonly used term, non-timber forest product (NTFP) which includes wood for uses other than for timber, although there are still grey areas on the coverage.

In Nepal, many papers also focus on medicinal and aromatic plants (MAP) (and essential oils extracted from them) as this sub-category of forest products holds immense potential for processing for industrial use and exports. The MAP in these studies also includes foods that are staple or basic to poor people living around the forests, such as yam and mushroom, but also other food items that are both consumed and used in other foods.

FAO's 1992 definition of NWFP had included both goods and services, but services were excluded in the 1995 revision of the definition. Forest services include ecosystem services like ecotourism, grazing, bioprospecting while forest benefits (also excluded from the definition) cover benefits like soil conservation, soil fertility, and watershed protection. This revision also excluded all woody raw materials such as timber, chips, charcoal and fuelwood, as well as small woods used for tools, household equipment and carvings. An important clarification made was that it included in the definition products derived from both natural forests and plantations (which are included in the FAO definition of forest). This means that the NWFPs would include the traditional forest products cultivated and produced outside a forest environment, which is also called "domesticated" products. Schippmann et al. (2006), Bharucha and Pretty (2010) and Daudet (2012) provide good overviews and analyses of forest foods and related issues of food security and resource management.

Several Nepalese FPFOs can be identified easily – various yams, edible nuts, mushrooms, fruits, spices and condiments, resins, gums, edible plants, edible oils, edible animal products, wildlife products and live animals, fish and aquatic invertebrates and even edible insects. Several others are not food products in the strict sense of the term - herbs, aromatic plants, fibres, plants for exclusive use of cosmetics, medicinal products, rattan, bamboo, cork, and ornamental plants. Several studies have documented these foods for various parts of Nepal, with the number count ranging from 40 to 70. Thus, for example, Shrestha and Dhillion (2006) have recorded 62 wild food plants belonging to 36 families, Acharya and Acharya (2010) altogether 67 plant species belonging to 41 families and 57 genera being used as sources of fruits, vegetables, pickle etc. in one district of Nepal, and Bhattarai et al. (2009) identified 41 wild edible plant species used for food in the Mustang district.

Perhaps the only one study in the literature that is fully focused on basic foods, rather than the broader categories of MAPs and NWFPs, is a Li-Bird study by Limbu and Thapa (2011). This study documents forest foods used by the Chepang communities for their livelihood. These communities are among the most food insecure in Nepal, depending for survival on shifting cultivation (*Khoriya*) in marginal lands and forest foods. Being the only study found with so complete a listing of these foods, it is worth copying them here for this paper. This is done in Table 6.1. The Limbu-Thapa study provides brief profiles for each of the 30 listed foods including their nutritive values.

6.3 Framework for Biosecurity of Food Products of Forest Origin

It is desirable that at the outset there is some discussion and clarity on the question of what constitutes biosecurity when it comes to the FPFO? A framework and its scope are helpful in organizing the subsequent discussions.

In the literature, FPFOs and MAPs are often presented as two main sub-categories of the much broader term, NWFPs. The FPFOs are primarily associated with food consumption while the MAPs are more prominent as export products. However, not all papers discuss the two sub-categories separately but as one single NWFP. While the FPFOs and MAPs may be different products to some extent, their fate is intricately linked for a number of reasons – there is a significant overlap of individual products and thus one could talk of food intake and trade for both sub-categories, both share the same habitat or place of origin and thus their sustainability is linked, and both could be made equally valuable for income and livelihood of the poor people who traditionally depended on this resource. Wild fungus is a case in point - it is both a food and a product with export potential (see Box 6.1 for a brief on wild fungi). So in this broader view, there are at least three angles to the development of the FPFO, MAP and hence NWFPs: i) use of forest products for subsistence, notably the FPFO; ii) commercialization of forest products through processing and trade, notably exports, including both FPFO and MAP; and iii) the sustainable utilization of these products.

The FPFOs - The FPFOs are foods primarily consumed by the poor and marginalized communities living next to forests. Although there are other issues associated with this component such as the access of the communities to the foods, food safety is a topic directly concerned with the scope of this paper. According to FAO estimates, globally around one billion people use wild foods in their diet while forests provide livelihoods and food for some 300 million people in the form of non-timber forest products (NTFPs). The diversity of the species of forest foods is also very large – typically in the range of 90-100 species in various countries. For Nepal, a study puts this number at 62 (Shrestha and Dhillion, 2006).

The importance of these foods for food security of the local communities was noted earlier in the case of the Chepang communities of Nepal. Although similar studies are lacking, very few would disagree that there are similar case for other similar communities in Nepal. That study (Limbu and Thapa) provides brief profiles for each of the 30 listed foods including their nutritive values. This is a seminal contribution. What

Table 6.1: List of foods from forests used by Chepang communities

List of foods (1)	List of foods (2)	List of foods (3)
1. Aerial Yam/ Air Potato	10. Kong Orchid	21. Indian Gooseberry/Amla
2. Wild Edible Yam/ Chinese Yam	11. Wild Asparagus	22. Local Mango
3. Deltoid Yam	12. Garlic Pear	23. Nepal Butter Tree
4. Asiatic Bitter Yam/ Intoxicating Yam	13. Indian Plum/ Indian Jujube	24. Water Cress
5. Greater Yam/Fingered Yam	14. Monkey Ladder Vine	25. Broom Corn Millet
6. Himalayan Nettle	15. Box Myrtle	26. Indian Chestnut
7. Yellow Himalayan Raspberry	16. Orchid Tree	27. Barnyard Millet
8. Fiddlehead Fern	17. Giant Swamp Taro	28. Buck Wheat
9. Purple Camel's foot/ Hong	18. Foxtail Millet	29. Finger Millet
	19. Indica Purple Taro	30. Rice bean
	20. Stinging Nettle	

Source: Limbu and Thapa (2011), a Li-Bird study.

Box 6.1: Wild edible fungi for food security and domestic and export trade

Nepal is considered rich in mushroom floral diversity with over 800 mushroom species identified so far, of which 228 are edible, 66 poisonous and 75 medicinal. Besides the direct food security role, collection of wild edible fungi has provided substantial contribution to rural livelihoods in areas with limited income generating possibilities. Yet, wild edible fungi remain unexploited, both for consumption and sales to the domestic and export markets. Many species of wild edible fungi, over 50, are used for local consumption and domestic sales. Fungi consumption is restrained by the fear of poisoning, although this perception is often overstated. One challenge is to respond to this perception by analyzing and cataloguing safe and unsafe fungi, and raising awareness through posters etc. For market sales, a certification system is desirable.

There are very few varieties that are harvested for exports. Morels is one such variety. It is mainly collected in the western high hills and has been exported for decades, mostly to Europe. It is held that Nepal has the potential for capturing the large global demand for wild edible fungi. Quality is one key factor, which depends on good practices in collection, drying, transport, storage etc. Sustainability of the harvests of wild edible fungi is another important consideration while thinking of boosting exports. The literature seems to agree that the resource base does not seem to have been negatively impacted so far because in large part the quality of the forest in the high hills still remains preserved. But the threat of over-exploitation is real, and indeed would increase rapidly if domestic and export demand surge, as expected by trade policy document. Therefore, it is essential that guidelines for good practices be developed and implemented. These guidelines should include a system for monitoring harvests and stress on sustainability. The guidelines should also be followed by user groups of community forests.

Source: Based on Adhikari (2009), Aryal and Budathoki (2012), Pandey (2008), Christensen et al. (2008), Christensen and Larsen (2005).

is missing in the context of this paper is information on the safety and quality of these foods. Being non-marketed and consumed in remote areas, monitoring etc. of these foods falls outside the reach of the GoN's safety checks.

Income generation through industry and trade – This is the second element of the framework for biosecurity. There is a consensus in the literature that Nepal has substantial potential for exporting many NWFPs, most notably MAPs and their oils. The Nepal Trade Integration Strategy (GoN, 2010) has also identified MAPs and essential oils as one of the 19 high potential products for export promotion. The emphasis is on processing and value addition as bulk of the current exports is in raw forms, thus losing considerable amount of export earnings. There is a need to encourage value adding industries as well.

The local communities are assumed to benefit considerably from the new value chains created and the gains from trade, as they hold a relative advantage in experience in the collection and harvesting of the NWFPs. The increased incomes lead to improved food security as they can now afford to make increased purchases of foods from the market. This is a reasonable assumption to make, although there is always some risk that the local communities may not be able to gain as much benefits as expected. So some form of impact monitoring would be desirable.

One finds in the literature different views on the extent to which poor people and local communities manage to gain from new supply chains and exports. Drawing upon the literature on the distribution of income gains from supply chain and trade, one argument made is that the poor and the locals get marginalized as others capture the most gains from such commercialization. In the case of natural resource-based products such as the FPFO, it is further argued that the locals stand to lose as a surge in exports leads to unsustainable exploitation of the resource. On the other side, the same literature also shows that in numerous cases the distribution of income gains from supply chains and trade is not uneven as held and all participants stand to benefit, including small farmers and local communities. Most likely, the distribution of gains is context-specific and it is desirable that the government monitors the impact on the poor and makes corrective responses for safeguarding their due participation in the supply chain. Given the importance of trade in FPFOs, it makes sense to devote some more space to trade issues. This is done in section 6.4.1.

Sustainable management of the NWFPs - Historically, the focus of forest management has been on timber, thereby marginalizing the management of other products. This changed considerably in Nepal's case with community forestry where communities are involved in managing a host of forest products. Yet, one could still make a claim that the management of the FPFO has received much less attention than it deserves. This also means that there has been a lack of institutional attention to community-level livelihoods – i.e. on the local people and their dependence on a variety of NWFPs for subsistence and enterprise.

The issue is one of sustainable management of FPFO. There is a sizable literature on sustainable management of common resources but unfortunately this is very thin when it comes to the types of FPFO as those used by the Chepang communities as listed in Table 6.1. The issue here is to what extent the FPFO are managed sustainably. Generally, sustainable harvest management requires information on various aspects, such as: degree of ecological sustainability of extraction; ease of vegetative or regenerative propagation; ease of cultivation under different environmental conditions; and ease of stimulating production by technological means.

Increased commercialization and trade, very much promoted by the GoN in the case of MAPs in particular, could be a threat to the sustainable use. It is generally the case that where species have traditionally been harvested sustainably, the entry of the market and the commercialization of species hitherto used exclusively for local subsistence can also result in over-harvesting. This is another important angle that needs to be brought into the discussion on sustainability.

Domestication of the species, i.e. commercially growing them commercially outside the forests, has received considerable attention in the above contexts. This is often presented as a way out to lessen pressure on the wild populations and thus prevent the destruction of the species and, at the same time, meet the export demand. There are also views from the other side. Thus a concern has been expressed that commercialisation could, inevitably, lead to a loss of control and even a loss of access by poorer people (Belcher, 2003). Belcher argues that people with better resources (including access to land, investment capital and labour) could appropriate the resources for their own benefit, displacing the resource poor who relied on open access extractive resources. It is also said that the domestication of wild-harvested products can lead to genetic homogenisation, thus reducing the economic value of wild systems and lead to transfer of benefits from one group of stakeholders to another.

6.4 Assessment of the Selected Issues on FPFO Biosecurity

6.4.1 Exports of the food and other NWFPs

According to UNEP (2012), more than 100 NWFPs are collected annually from different parts of the country. These are both high and low value products. Crude forms of these products are generally exported to India, with only about 10 percent used for processing in Nepal. The bulk of this trade takes place with India for two main reasons. First, Indian regulations are not as stringent as regards quality requirements, and thus it is easy to export to India. Second, Nepalese traders lack capacity to transact with traders from other countries. This has encouraged traders to focus more on the Indian market, thus reducing the potential gains from trade as well as restraining the growth of processing and value addition in Nepal itself.

While this is the situation currently, most studies agree that Nepal has large potentials for exports to the overseas markets also. Demand for Nepal's MAPs is believed to be strong, from both the western countries and fast growing Asian economies. These products are also valued for their natural and organic quality and healing power. Nepal Trade Integration Strategy (GON, 2010) claims that export of the MAPs reduce poverty in rural areas, notably among those poor who collect and harvest them and the poor regions such as the western mountain areas. It may also happen at times that the small and the marginal may be squeezed out of the process and thus could actually lose. So some caution in safeguarding their role in the chain is essential.

A much more worrisome outcome would be: i) crowding out the marginalized groups from access to NTFPs; and ii) over exploitation of the resources. The former can occur if traders or processors monopolize the resources (e.g. right to harvest) and marginalized groups lose access. This could also occur through the

market process without losing the legal right of access. For example, traders may hire outside harvesters at the cost of the local people. These are sensitive matters and so cannot be ignored. An example of the likely scenario could be the case of the crusher industry in the Chure hills of Nepal, where a surge in export (and domestic) demand for construction materials (stone, pebble) intensified quarrying activities to the extent that the environment that provides food and water to the locals is deteriorating rapidly. Those who stand to lose are the locals who depend on the resources for their livelihood.

The basic premise in UNEP (2012) is that BioTrade contributes substantially to the local and national economy of Nepal and can make the forests sustainable and environmentally-friendly with all its positive services. That study has a substantive chapter on this subject. Table 6.2 summarizes the main challenges based on the UNEP study.

A SAWTEE study (Sharma and Shrestha, 2011) provides analyses and offers a complete set of recommendations for promoting the export of the MAPs and essential oils. Recommendations are made under four categories: collection and cultivation; processing; exports facilitation; and R &D. Some highlights of the many suggestions made there are as follows: awareness and training programmes for collectors, market information, demonstration and transfer of appropriate technologies, trainings on GAPs and GMPs for processors/manufacturers, invest on testing and certification facilities, establish collective mark to promote essential oils as Nepal's unique products, maintain database of MAPs and essential oils, allocate more funds and human resources to strengthen R&D, in partnership with the private sector.

6.4.2 Standards, guidelines and good practices for FPFO

As NWFPs cover both foods for direct consumption and medicinal plants and herbs, the two relevant international standards are the Codex and IPPC. In addition, guidelines from WHO on medicinal plants are also relevant. Then there are standards and guidelines developed by some other countries that are also relevant here.

The IPPC is the main international agreement on plant health. It aims to protect cultivated and wild plants by preventing the introduction and spread of pests. The Commission on Phytosanitary Measures, which is IPPC's governing body, adopts International Standards for Phytosanitary Measures (ISPMs) to prevent pest introduction and spread. One objective is to facilitate trade. There is a provision in the IPPC for designating a national organization to protect natural resources including forest from pest invasion. The organization is collectively called National Plant

Table 6.2: Challenges to developing the trade in MAPs

Five challenges	Elements/details
1. Over-harvesting, exploitation of forest resources	Bad harvesting practices, vicious cycle of demand (due to high price/smuggling) causing over-exploitation, inability to control illegal harvesting, limited cultivation for regeneration, slow maturity of high-value plants.
2. Information gaps	Lack of resource-mapping/statistics, virtual lack of records on what/how much is being extracted and how much is left, where, etc – essentially little basis for sound response measures (e.g. policy, legislation); Lack of awareness amongst harvesters; and Lack of information amongst local traders.
3. Lack of value-adding and quality control mechanisms	Hardly any processing worth value takes place, and most products shipped to India for processing; poor or non-existent quality control.
4. Market and marketing challenges	Poor infrastructures (e.g. electricity, road), permit and royalty system not supportive; lack of credit, and common market information to all stakeholders; in case of community forests, ambiguous rules/guidelines on marketing/sales.
5. Tariff and non-tariff barriers	Typically tariff is an issue with India while NTBs with western countries; India's sharp escalating tariff discourages processing and value addition in Nepal; too many/stringent NTBs (SPS requirements) in western countries.

Source: Adapted by author from Chapter 6, UNEP (2012).

Protection Organization (NPPO). The NPPO works with IPPC to develop ISPMs and uses the ISPMs as the basis to develop national phytosanitary regulations.

The WHO has developed a series of technical guidelines relating to quality control of herbal medicines of which the principle one for medicinal plants in the WHO Guidelines on Good Agricultural and Collection Practices (GACP) (WHO, 2003). The guidelines provide a detailed description of the techniques and measures required for the appropriate cultivation and collection of medicinal plants and for the recording and documentation of necessary data and information during their processing. In WHO (2003), there are separate sections on good agricultural practices (GAP) for medicinal plants; good collection practices for medicinal plants; and common technical aspects of GAPs for medicinal plants. In addition, the document has annexes on China's GAP for Traditional Chinese Medicinal Materials and Japan's GACP for Medicinal Plants. Individual countries are encouraged to develop their own guidelines for the quality control of medicinal plants based on the WHO guidelines.

The 1992 Convention on Biological Diversity (CBD) has given much more prominence to the FPFO than was the case before. The CBD has 3 main objectives: i) the conservation of biological diversity; ii) the sustainable use of the components of biological diversity; and iii) the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

The CBD gave a legal framework for biodiversity, Good Forest Practices (GFP) being part of this global biodiversity. The CBD allowed the launching in 2006 of the UN "Cross-cutting initiative on biodiversity for food and nutrition", with participation of various UN agencies, universities and research centres and the Standing Committee on Nutrition of the UN (SCN). It recognizes the importance and value of traditional food systems and the need for interdisciplinary approaches to document biodiversity for food and nutrition. It also proposed a framework for action: i) developing and documenting knowledge; ii) integration of biodiversity, food and nutrition issues into research and policy instruments; iii) conserving and promoting wider use of biodiversity for food and nutrition; and iv) public awareness. Key documents have been published, such as Nutrition Indicators for Biodiversity, for food composition and food consumption. The document calls for using these indicators as an advocacy tool to promote awareness of the importance of food biodiversity, including wild, indigenous and traditional foods while contributing to nutrition security and the conservation and sustainable use of food biodiversity.

Bioversity International (formally IPGRI) is another body relevant for FPFO. It has field experience in documenting food systems and in preserving biodiversity (either through seeds banks or field conservation). It also has experience in the domestication of forest products (e.g. in Latin America).

6.4.3 Policy and legislation

The government's Nepal Biodiversity Strategy (GoN, 2002) is an overall policy framework for the conservation and sustainable use of biodiversity in Nepal. It recognizes NTFPs as the wealth of the country and highlights concerns in relation to their collection and marketing, the cultivation of MAPs and the development of industries based upon NTFPs. In the Strategy, it is said that the main components of the NTFP programmes include: (a) immediate measures to solve problems regarding collection, marketing, and related concerns, (b) cultivation of medicinal and aromatic plants and other selected NTFPs, and (c) development of industries based on medicinal and aromatic plants and other NTFPs. Subsequently, the GoN formulated its Implementation Plan (2006-10) as a framework for translating the vision of the Strategy into practical action for biodiversity conservation, sustainable use and poverty reduction.

NTFPs are one of six forestry programmes in the *Master Plan for the Forestry Sector 1988*, where seven marketed NTFPs were singled out for promotion. These were medicinal and aromatic plants, *Lokta* paper, pine resin, *katha* (*Acacia catechu*), sabai grass, cane and bamboo. The Master Plan highlighted the need to increase the supply of medicinal plants and other minor forest products and to facilitate their conversion into useful commodities for local and foreign markets.

The Nepal Environmental Policy and Action Plan (NEPAP I) advocated that forestry research should address the utilisation of lesser-known forest species, which would include non-timber products. NEPAP

II 1998 was the first policy document to recognize that previous policies had more or less ignored the important role of NTFPs as a source of income for rural communities. NEPAP II and the Ninth Five-Year Plan (1997-2002) recommended that community-owned land that is suitable for purposes other than forestry be utilised under community management for the production of non-timber products.

The Herbs Production and Processing Company Ltd., undertakes special programmes for promoting NTFP cultivation and management in the remote districts, although it processes only a small fraction of the total harvest in the country owing to inadequate human resources and small capacity. Humla Oil Pvt. Ltd. has been established to ensure the sustainable management of Jatamansi and equitable sharing of benefits amongst the local people in Humla district, who are benefiting from the local processing. Marketing links are being developed and user groups have been established as the first step in managing this resource in the wild.

The Department of Plant Resources (DPR) under the MoFSC is the central body to issue quality certification for exports of the MAPs and oils. Needless to say, the DPR's capacity is weak, including for certifying the quality of products with the requisite trust of importers. As a result, many importing countries do not accept the quality report provided by it for the products. The DPR has been using the same laboratory facility for a long time (Sharma and Shrestha, 2011). Importing countries typically demand specific pest data for each MAP, which, however, Nepal cannot provide for lack of such data. This has hampered the exports of many medicinal plants. To overcome that, exporters sometimes send samples of the products for quality checks to the Indian laboratories.

As regards legislation, the major legal documents which regulate trade of plant and plant products that are used for food, whether these originate in farming or forest, are Plant Protection Act (2007) and Plant Protection Rule (2010). Their major objectives are to protect national or regional fauna by preventing introduction, establishment, prevalence and spread of pests through trade (GoN, 2010). Enforcement of the Plant Protection Act comes under the jurisdiction of the DoA. Pest surveillance, pest risk analysis and management of plant quarantine check posts are major activities of DoA in ensuring the safety of plants.

6.4.4 Selected issues on good practices along the value chains

The food products of forest origin go through different stages of the supply chain, and therefore it is essential to understand the prevailing provisions, practices and shortcomings regarding biosecurity at different stages. Food products which originate from forests are diverse and different communities use the products for food in many different ways, complicating food safety and biosecurity even more. As there are no specialized guidelines on forest health practices, the guidelines, codes and rules which are used for other commodities are also generally applied to forest based food products as well. What follows highlights the present state of issues on requirements, gaps and overlaps in biosecurity at eight different stages of the supply chain of the FPFO.

Management at source - The first and crucial point to note for this discussion is that there is virtually no surveillance or intervention from the government side that takes place regarding safety or biosecurity of foods originating from forest. This is in contrast to the attention given to non-food forestry products such as timber and herbs. Another potential paradox or anomaly could be that while the DoA is the competent authority for plant protection, through the NPPO, the NPPO itself does not have the mandate over the health of the FPFO at its source. Many studies have reported unregulated collection of food products from forest (e.g. Banjade and Pudel, 2008; Pandit and Thapa, 2003); health of forest food products is not seriously taken into consideration while managing forests (Christensen and Larsen, 2005).

Harvesting – As above, there is no separate guideline on harvesting of forest food products, unlike the case with other food products for which guidelines exist, e.g. the Guide to the Implementation of Phytosanitary Standards in harvesting of forest products that prescribes procedures for example to contain pests from spreading from the harvest location. In Nepal, wild fungus is an important food from forest. Currently, only some traditional practices are followed. For example, harvesters grade wild edible fungi depending on the size, maturity and general condition. Many people die in rural areas by mistakenly taking poisonous fungi in place of edible mushroom. Grading reduces to some extent the health hazard of poisonous fungi and diseased

products. Drying is another process that reduces the risk of health hazards. Christensen and Larsen (2005) have recoded the practice of sun drying of wild edible fungi to reduce transportation cost as well as health hazards.

Handling, Storage and Packaging - The International Standards for Phytosanitary Measures (ISPM) (2005), the ISPM Guideline and the Guide to Implementation of Phytosanitary Standards in Forestry all provide detailed guidelines and procedures for post-harvest management of forest products. As in many other countries, Nepal has a long way to go in adopting these guidelines. One of the reasons for this could be that traders, or even the DoF staffs, may not be informed of these phytosanitary measures for forest products. However, farmers do follow some indigenous practices. For example, *Chiraito* is air-dried and plants are bundled and stored in dry place to reduce the risk of fungus infestation. They also follow specific practices for sun-drying other food products such as *Harro* (*Terminalia chebula)* and *Barro* (*Terminalia bellirica).* One way forward would be to formulate Nepal's own guidelines based on a scientific evaluation of these traditional practices.

Transportation – There are standard international guidelines, e.g. Guide to Implementation of Phytosanitary Standards in Forestry, for maintaining the phytosanitation of the FPFO during transportation. In Nepal, the Plant Protection Act and its Rule do not prescribe much on phytosanitary measures regarding FPFO during transportation. According to the act and rule, the exporter should indicate the means of transportation only. The main inconsistency is that District Forest Officer, which functions under the MoFSC, issues the release order for the entire forest products (issued as per the Forest Act (1993) and Regulation (1995)), but then these instruments do not have any provision on phytosanitary measures for transportation. Therefore, harmonization of forest and agricultural policies related to biosecurity is essential.

Quarantine - The DoA with the NPPO under it undertakes quarantine activities in Nepal. There are seven quarantine check posts in different parts of the country while there are 27 border crossings for trade with India along the long border. This, i.e. far fewer quarantine posts, has been a matter of constant complaint in the Nepali literature on this subject. Hopefully, this issue will be gradually addressed in the coming years with increased budgetary allocation to agriculture, as promised in Government statements. In the context of forestry products, it was noted during this study that quarantine checks and monitoring of forest products, including food, does not get as much attention as food and agricultural products due to NPPO's traditional orientation towards the latter products. Therefore, one suggestion here would be to sensitize the agricultural staffs of the NPPO on the importance of quarantine checks of forest products as well. Regular communication between plant protection officers in the DoA and DoF would also help improve the situation considerably.

6.4.5 Compliance cost and public-private role

Estimation of the incremental cost of complying with good practices and the sharing of this cost between the public and private actors in the supply chain, as perceived by stakeholders, are topics addressed by all five sub—sectoral background studies on biosecurity (Chapters 3-7 of this volume). This analysis, however, is relatively weak for the FPFOs, despite similar efforts made as for the other papers. One reason for this was that there was hardly any information available on this subject in public domain, including for other countries, which would have been the basis for further work. Nevertheless, this is an important subject and so deserves some discussion. What follows summarizes the assessment made based on field visits, stakeholder workshop and expert consultation. As for other categories of foods, one conclusion was that accurate assessment of the costs and benefits of adopting biosecurity measures is context specific, i.e. depends on the specific forest food, location, length of the supply chain etc.

Benefits of compliance – The main benefits of good practices along the supply chain are higher prices of the products in the domestic and export markets, the expansion of the market size itself, increased value addition along the supply chain generating incomes and employment, and sustainable harvest and environmental protection to the benefit of all. A biosecure environment for the FPFO and other forest products also ensures reduced risk of disease and pest. On the other side, typical costs include – for the private sector, the cost of setting the value chains, adopting new technologies and processing facilities etc., and, for the public sector, R&, awareness and information programmes as well as subsidy and/or

lost revenue from incentives, if any. The valuation of these costs is not easy. The valuation of the benefits is even more difficult - indeed, even impossible for some benefits.

While there are claims of substantial benefits from modern processing methods and international product certification, there are costs too. Current processing techniques are sophisticated and so are expensive to purchase and maintain. Given the current state of facilities in Nepal, major investments are needed for establishing new quality testing laboratories and improving existing laboratories (Sharma and Shrestha, 2011). Currently, most of the quality testing is carried out in India – which also costs additional sum. Given the current status of traded foods of forest origin, it is widely acknowledged that Nepal is unable to make full benefits from the export market.

It is also held that revenue losses (or benefits) due to a product not meeting safety standards in domestic markets are large, and even larger in export markets in many cases. Although there is no study for Nepal on the estimation of benefits from higher safety standards for FPFO, the overall perception based on analyses elsewhere in the world is that a country could reap large benefits by investing on product standards.

An illustration of the type of analysis that helps to set priorities and formulate appropriate responses would be the benefit cost analysis in UNEP (2012) of cultivating plant products that are exported to India and developed countries. Table 6.3 shows this for four forest products that are consumed as food. The benefit-cost ratios exceed unity in all four cases, indicating high rates of return to investment.

Note that this analysis does not take into account either increased price following improved biosecurity measures or the incremental costs associated with adopting the measures. The report seems to claim that additional benefits most likely exceed incremental costs by a large margin. Currently, substantive amount of the potential export earnings is not realized for reason of poor food safety and quality. On top of this "static" gain, one needs to add further, dynamic gains as market itself expands following improvements in food safety and quality, especially in export markets. Market expansion is typically a dynamics process.

Analysis such as this that provides an order of magnitude of the benefit-cost ratio provide guidance for allocating more resources (not just the private but also public) to improve the SPS standards of the products concerned. Therefore, one recommendation of this study is to initiate some cost of compliance studies as well as benefit-cost analysis of this nature for 2-3 food products of forest origin. Such studies would be seminal for Nepal and could pave the way for more attention to biosecurity.

Articulating, programming and managing biosecurity measures are complex processes and therefore require collaborative efforts between departments of the government, scientific community, and the **public and private sectors**. What follows presents brief thoughts on this collaboration, focusing on the following four segments of the supply chain: production, processing, transport and storage and certification.

Production – Needless to say, there are large gaps in compliance with good harvesting practices that are consistent with a biosecure framework. There could be at least two reasons why there are gaps on the part of the farmers or villagers who access the products. One could be simply lack of awareness of the benefits of compliance (e.g. quality products, sustainability). Knowledge gap is also explained by this. The second reason could be that they are aware of the benefits but lack the means (e.g. capital and technology) for adopting good practices. The requisite upgrading of practices, which may or may not cost extra money,

Table 6.3: Cost benefit analysis of farming forest food products (on per hectare basis)

	Non-timber forest products	Crop cycle period	Production cost (NPR)	Revenue (NPR)	Benefit-cost ratio
1	Satawari	2 years	34,600	340,400	9.84
2	Tejpat	4 years	43,200	114,700	2.66
3	Amala	4 years	41,300	65,500	1.59
4	Matricaria chamomilla	Seasonal	38,100	20, 830	1.37

Source: UNEP (2012).

is simply not taking place. To find out why this may be happening requires some research on the ground. Such studies do indeed provide insights for the design of response measures, e.g. some public investment to influence private behaviour or targeted subsidies. The middle hills and high mountain regions of Nepal in particular provide good potential for private-public partnership in such measures because these areas are linked to larger markets which have the ability to provide incentives to farmers and other actors in the supply chain to invest and recoup the benefits from the market.

Processing - Nepal is a leading supplier of the NWFPs (including FPFOs, MAPs, oils) to India and other countries in the region. More importantly, bulk of the exports take place in raw form, i.e. with little processing, despite potentials. Adding value by processing the products in Nepal has been a long-standing challenge. Reasons often given are lack of technology, difficulty in accessing the products in remote areas, phytosanitary issues, and so on. While this is not a new issue – the same is said of ginger for example – what is worrisome is that not much does happen on processing. There is a need for a series of feasibility studies to identify investment opportunities, as well as policies and measures that incentivize the private sector to move to this rather non-traditional area of investment.

Transportation and storage - Safe and documented transportation and storage of food is essential to meet the SPS and other requirements of both the domestic and export markets. Modern modes of transporting and storing food products can be expensive as these often require special facilities such as refrigeration, fumigation chambers and modern warehouse. Much of these extra costs can be recouped from the market and therefore the private share of the cost would be much higher here. Many countries have overcome these constraints and therefore Nepal needs to learn from the institutional innovations from Asia and elsewhere for identifying appropriate modes of cost sharing for transport and storage of food products along the value chain.

Certification – In Nepal there are three main government agencies for the certification of the FPFO – the DoF, Department of Plant Resources and the DoA. The strength and capability of these agencies have been commented many times. These reviews show that on their own they lack, and will continue to lack, funding and human resources to meet the growing demand for their services for biosecure agriculture. There is no alternative to sharing technical resources between the government and private agencies. For example, while government bodies could perform the inspection and oversight functions, the private entities could utilize government facilities for diagnostics and certification activities with some fee to recoup their costs (FAO, 2007).

6.5. Concluding Remarks

This paper discussed biosecurity issues for *food products of forest origin* (FPFO). Forests have traditionally provided a range of food products that have been valuable for food security of the people living around the forests, mostly low-income and marginalized communities. In addition, the FPFO and their close cousins in the same environment - the medicinal and aromatic plants (MAP) - are also considered to be potentially valuable resources for income generation through industry and trade. The purpose of this paper is to stocktake issues, identify gaps and discuss options for moving forward towards a more biosecure environment for the FPFOs and related products.

To identify the issues, a framework for biosecurity in the FPFO sub-sector was conceived as one consisting of three main components: i) safety and quality of the foods themselves; ii) income generation through value addition to FPFO and related products and their exports; and iii) sustainable utilization of the FPFO and related products. A number of development concerns are inherent in these three components: food security of the marginalized communities, safety and quality of the FPFO, harnessing of the industry and export potentials of the FPFO through value addition and supply chains, and protection of the NWFP environment from hazards and unsustainable use.

The literature on FPFOs was found to be meagre in terms of statistics, surveys, consumption pattern, quality and safety, and policy, legislation and government support. Where there were surveys, they show that these foods have been crucial for marginalized groups living around the forest, such as the Chepang communities. In contrast, the literature on non-food, commercial and export products such as medicinal plants and essential oils is substantive.

One recommendation is to bridge this gap, because public response tends to be weak where essential information is missing.

While the private sector is expected to take lead in harnessing commercial potentials of the food and medicinal forest products for domestic industry and exports, the public sector needs to pay greater attention to the second element of the above framework – the sustainable use of the forest resources. There is a sizable literature that highlights this threat. It is held, based on similar experiences elsewhere in the world, that commercialization could lead to over-harvesting and deplete the resource base, undermining food security of vulnerable communities, biodiversity and an important source of positive externalities. The key recommendation here is to develop good practices for Nepal by studying Nepal's own successful experiences and adapting models and guidelines available internationally, and developing implementation capacity.

There is also a need for articulating a policy on domestication of the species, i.e. growing them commercially outside the forest. This topic has received considerable attention in the literature, and so there is much to learn from the experiences of other countries. To start with, the government could commission some fresh analysis on this subject with a view to inform policy articulation.

Analysis of the cost of compliance to good practices and the public-private sharing of the incremental costs provide valuable insights and evidence for formulating policy, legislation and implementation guidelines. Unfortunately, such information is scarce. This study provided some preliminary insights on these subjects, but not adequate for policy formulation. Therefore, it is highly desirable that efforts to generate such information through field research are continued.

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CHAPTER 07

BIOSECURITY ASSESSMENT FOR THE FOOD INDUSTRY SUPPLY CHAIN

Ganga Prasad Kharel and Krishna Prasad Pant

Abstract

While the focus of the previous four papers was on biosecurity primarily at the stage of food production, this chapter discusses biosecurity issues related to the food industry, or the supply chain, as a whole. Vertical coordination from production to retailing is becoming popular in Nepal as well and so policy on food safety and quality needs to be framed taking into account the supply chain as a whole. The goal should be to prevent or minimize the entry of harmful biological and/or chemical agents at all the stages of the supply chain. The paper reviews several food chains in Nepal, including restaurants and street food. It analyses gaps between the current situation and desirable practices in various segments of a supply chain. Some recommendations are provided to the government for improving biosecurity along the supply chain. Public-private collaboration is crucial for improved biosecurity because a food chain is essentially a private sector activity.

7.1 Introduction

Four other papers (Chapter 3 to 6) in this volume discuss issues related to biosecurity in food production: field crops and vegetables; livestock; fishery; and foods of forest origin. This paper differs from them in that its purpose is to discuss biosecurity issues related to food industry as a whole or the supply chain, i.e. not just primary production but also safety and quality issues along the chain. While that was the intention, it turned out to be that there was very little in the literature on the analysis of safety and quality issues along the chain as a whole, i.e. beyond the primary production stage. To some extent, this could be because there are far fewer vertically coordinated food industries in Nepal that are becoming prominent in many other developing countries. For example, only one study could be found that analyses food safety for a substantially large segment of the supply chain using the HACCP method, for the famous *momo* or dumpling (Thapa et al., 2008).Therefore, the paper needs to be taken as a preliminary exercise on these issues.

All over the developing countries, vertical coordination (VC) is becoming increasingly popular among firms along the supply chain of a food industry. The form and intensity of this coordination varies considerably across countries, industry and food type. Some form of formal contract is used to manage the VC. Besides the competitive pressure of lowering the cost and price, the other major reason for the popularity of coordinated supply chains seems to be food safety and quality. There seems to be a consensus that a coordinated supply chain results into more safe and quality food than otherwise because such a system prevents or minimizes the entry of harmful biological and/or chemical agents at earlier stages of the supply chain. For Nepal, too, there is a need for better understanding how biosecurity concerns are impacted by various modes of vertical coordination. Nepal's recently formulated Agricultural Development Strategy (ADS) places high hope on commercialization of farming through coordinated supply chains including contract farming.

The concept of biosecurity as a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) that analyse and manage risks in the sectors of food safety, animal life and health, and plant life and health, including associated environmental risk, resonates very well with the new mode of production noted above. A coordinated supply chain too is a strategic and integrated approach to producing and supplying safe, quality, suitable and affordable foods.

The study is based on limited field visits and stakeholder meetings, literature review and discussion with experts in various areas. Given the focus on supply chains, attempt was made to contact actors in the supply chain – farmers, collectors, processors and traders. Officials in the districts also provided valuable information on issues on the food chain and government activities in those areas. As said, the study was considerably constrained by lack of studies on food supply chains that also looked into food safety and quality aspects, as the focus of most such studies was on economic aspects (cost and margins along the chain). Value chain practices vary greatly across the country and so the few cases reviewed can only reveal so much of this diversity.

The paper is organized as follows. The next section presents a brief note on vertical coordination in food supply chains and how biosecurity issues may be related to this new and emerging mode of supply. Section 7.3 discusses food safety and quality issues in Nepal with briefs on a number of food products. Section 7.4 is a synthesis of the main issues or gaps in food safety and quality. Section 7.5 presents a discussion on compliance cost and the public-private sharing of costs and responsibilities. Section 7.6 concludes.

7.2 Biosecurity in Vertically-coordinated Food Supply Chains[14]

Vertical coordination (VC) was the main mode of production and supply (including processing, marketing, trading, supplies of inputs and credit etc.) in the erstwhile centrally planned economies but these were led and controlled by state-owned food industries. To some extent, similar arrangements were also fairly common in many developing countries where state enterprises controlled processing, marketing and trade. Following privatization and liberalization since the early 1990s, parastatal monopoly virtually disappeared and the VC has been increasingly led and managed by private actors (besides farmers, these include traders, retailers, agribusinesses, food processing companies etc.). Formal contracts are increasingly used to manage VC, but its intensity varies considerably by country and industry type. But the overall trend is very clear.

Increasing demand from richer and urbanized consumers for products with safe and quality standards is among the 2-3 crucial factors behind the growth of the private VC. Export demand is also a factor for the same reason. On the supply side, farmers and others are also attracted to VC because supplying the high-value segment of the market brings higher profits. But the capacity of a vast majority of farmers for supplying to this market is limited as this segment requires advanced technology, good inputs, financing, management, etc. In the meantime, farmers continue to face supply constraints due to market imperfections and poor and inadequate support from public institutions. They will thus increasingly require alternative means of support, which the private sector is capable to provide.

The VC helps the food industry to be more biosecure. Food safety and quality of the final product depends on biosecure practices at various stages of the supply chain. A coordinated supply chain helps prevent or minimize the entry of harmful biological, chemical or physical agents at all stages of the supply process because the chain makes all participants partners and thus more responsible. This way, costs and negative externalities are reduced and safer food products delivered. A vertically coordinated chain not only lowers cost, and thus the price, and supplies safe and quality foods, but also is more flexible when it comes to adjusting and adapting to rapidly changing technologies and new and higher food safety standards.

Coordination is typically achieved through written contracts that regulate the relationship between upstream and downstream firms. Contract farming is both widespread and growing especially in developed countries. For example in livestock feed mills, feed is frequently heat-treated to prevent the

[14] This brief draws upon several sources, the notable ones being Swinnen and Maertens (2006) and Gulati et al. (2005), in that order.

spread of any bacteria to livestock and poultry. At the grow-out house, strict biosecurity measures, pest management control and the "all in all out" concept controls the spread of diseases. In such chains, records are maintained for all vital processes such as testing, vaccination schedules, sanitation protocols etc., thus considerably reducing the probability of risk of a hazard and the overall damage in an event of a hazard. Applying safety measures along the chain, such as following the HACCP process, controls most potential hazards.

As part of the process of VC, companies at different stages of the supply chain are increasingly resorting to horizontal coordination also to develop and adopt common voluntary standards (e.g. GlobalGAP). Such standards also often involve a combination of vertical and horizontal coordination. These collective standards have become more common in recent years, and they show that the industry collectively takes responsibility for food safety in the supply chain, often using business-to-business approaches where the efforts are not communicated to consumers.

7.3 Case Studies of Selected Food Supply Chains

Nepal's agrarian economy is dualistic in the sense that on the one hand there is a vast majority of farmers growing food for subsistence while a new class of farmers and industry is commercializing rapidly driven by market demand from the urban centres. The typical food chain for the former is very short while for the latter this varies with food products. For example, supply chain of perishable products like vegetables, milk and fresh meat can be relatively shorter than that of less perishable farm products like potato, onion, mango and grains.

As said at the outset, the focus of this paper is on safety and quality issues in the context of supply chain or food industry. A food industry provides a much more holistic framework for understanding where in the chain food-related hazards (microbiological, chemical and physical) enter the system and may propagate in the journey through the food chain. This sub-section discusses food safety and quality issues for a number of food products: tomatoes, poultry, other meat, *momo* (HACCP analysis), cereals, legumes and oilseeds, ginger and tea and coffee; and two places of eating: restaurants along the highway and street food. These are in no way in-depth analyses of the chains but briefs on issues related to food safety and quality by covering several food products. It is hoped that a good range of these issues are identified.

Tomatoes — Two crucial food safety and environmental issues are health hazards of pesticide residues in the final product and environmental hazards of the pesticides. The use of pesticides in vegetables in Nepal is high relative to other crops. Sharma et al. (2012) reported an average use of 1,450 g a.i./ha pesticide in vegetables compared with the national average of 142 g a.i./ha for all crops. One reason may be the growth of commercial off-season tomatoes farming (with new cultivars) that required relatively more pesticides compared to seasonal tomatoes. One issue on pesticide residues in tomatoes is farmers not observing a "waiting period" (time interval between pesticide application and harvesting) due to higher frequencies of harvesting. In field visits, some cases were reported where farmers harvested tomato for market even on the day following the spray. Pesticide residues in tomato pass on to the processed products.

There are four mandatory food standards for processed tomato products, namely tomato juice, tomato sauce and tomato ketchup, two of them are physico-chemical and two others are microbiological standards.

During field visits, it was observed that farmers are compelled to use chemical pesticides to protect crops due to the unavailability of alternative methods. Bio-pesticides may be desirable but may not substitute chemical pesticides due to their slow effects and less effectiveness. There was a widespread lack of knowledge on the right type of pesticide and the timing of application. Farmers lacked knowledge of different pesticides suitable for different pests and their chemical and physical properties along with toxicity especially during field application. Non-availability of appropriate pesticides, including botanicals and bio-pesticides, in nearby shops is a major factor. Here is a role for public support to promote IPM (integrated pest management) technology and incentive measures for local shops to carry eco-friendly pesticides. The recent impact evaluation of Nepal's IPM programme (NDRI, 2014)

recommends measures to facilitate easy access to bio or safer pesticides, reduce current levels of tax on bio and organic pesticides, and strengthen local agro-vets and monitoring of pesticide markets and market provision on IPM products. An impact evaluation of the IPM technology in tomato in India (Gajanana et al., 2006) found significant positive effects on yield, lowering the cost of cultivation and raising profits. Besides, it helped in managing insects and diseases with the overall farming environment much better as the technology used more of eco-friendly inputs.

Poultry —The commercial poultry sub-sector in Nepal is believed to be growing at a much higher rate, about 17-18 percent per annum, driven by the growth in market demand, as elsewhere in the world. The potentials are high for both poultry production and in the development of ancillary industries.

A latest FAO study on Nepal's poultry sub-sector (FAO, 2014) has a separate chapter on biosecurity issues titled *veterinary health, public health and bio-security measures* consisting of four sections: i) highly pathogenic avian influenza (HPAI); ii) other major poultry diseases; iii) biosecurity measures adopted; and iv) biosecurity action plans. This study pointed out that several factors can aggravate in the effort of eradicating HPAI in Nepal: i) the repeated occurrence of HPAI in the bordering Indian state of West Bengal and in the northern parts of India that has made Nepal vulnerable to HPAI; ii) illegal imports through the numerous porous border points that are very difficult to control; iii) presence of wild/migratory birds; and iv) other socio-cultural factors such as people along the border areas doing grocery in weekly markets (Haat-bazaars) in India. On migratory birds, there are many wetland areas in Nepal that are ideal homes for migratory and wild birds. In addition, Nepal is on two routes for migratory birds, which are known to be potential carriers of the disease. A total of 34 migratory bird species visit the country every summer for breeding purposes along with the winter migratory birds from Siberia and Eastern Europe that come here in search of favourable temperature. It is going to be difficult to manage the risks of disease transmission from the migratory birds.

A previous FAO study (FAO, 2010) of the sub-sector also touches on bio-security. Apparently, a survey was undertaken because it is reported that 66 percent of the respondents did not adopt routine bio-security measures. The adoption of biosecurity measures was very low (10 percent) at the backyard level but 27 percent at the commercial collector level. Likewise, around 28 percent of commercial poultry farmers reported following biosecurity practices to prevent diseases.

The Government of Nepal (GoN) is also implementing some surveillance activities in vulnerable districts (FAO, 2014). For monitoring purpose, risk has been defined based on the degree of threat that a district possesses. Using defined parameters, 26 districts mostly in the Terai are categorized as high risk districts followed by 18 medium risk and 31 low risk districts. Scores are used for these parameters which include access to border, to highways, poultry and duck population, entry of illegal birds/eggs, proximity to wild life and water resources, previous incidence of HPAI, closeness to national parks, high consumption centres and link roads to those centres. While enforcing a ban on informal trade is an exceedingly difficult task, these control mechanisms are essential as they will reduce the problems considerably.

Meat — Meat flesh is a potential source of significant health risks due to the ease with which pathogenic microorganisms and other zoonotic disease agents can grow. In Nepal, primitive and unhygienic methods of slaughtering are rampant. The slaughtering stage is the main source of contamination. It can occur from multiple sources: hide and skin, feet, viscera, cutting knives, washing water, holding containers; and wound, nasal, oral infections from operators. Water used in washing is not potable and therefore heavy microbial contamination often occurs at the time of de-skinning, deboning and cutting with faecal *E. coli* and other pathogenic and spoilage microorganisms. The manner in which meat is currently produced and supplied in Nepal is challenging for providing safe and quality meat and meat products to the consumers.

Nepal's Animal Slaughterhouse and Meat Inspection Act (1999) aimed to address two major objectives, firstly, to prevent adulteration and contamination of meats during and after slaughtering, and secondly, to ensure that the animal being slaughtered is healthy. The law has a mandatory provision of *ante mortem* inspection of animals by qualified meat inspector before slaughter. It is also said that animal carcass should be certified by the inspector as being safe.

Enforcement of the law has been challenging, even in municipalities where slaughter houses were constructed because the facilities were not utilized by meat entrepreneurs. Lastly, despite there being over 100 food standards in Nepal; there is only one standard (luncheon meat) for meat product.

The government policy is to promote agribusiness and presumably supply chains and vertical and horizontal coordination. Such practices should encourage essential investments in infrastructure and facilities to upgrade safety and quality. The current trend is increasing participation of such private actors such as agro-vets, veterinary pharmaceuticals, feed industry and hatcheries.

Cereals, legumes and oilseeds — In the case of cereal grains, oilseed and legumes, pesticide residue is not considered to be a major problem in Nepal. Farmers generally apply pesticides or weedicide no more than 1-2 times at least a month before harvest (the waiting period). However, pest infestation does occur often in stored grains but this is easily disinfested by using aluminium phosphide (permitted in Nepal but restricted in India from 2001 except for quarantine purposes). Benzene hexachloride (BHC) is already banned in Nepal and India. Pesticide residue is further reduced during processing such as dehusking, winnowing and washing (wet flour milling) operations.

Mycotoxin residue in cereals, legumes and oilseeds is a public health concern. Aflatoxin producing fungi grow and produce aflatoxin in stored products such as maize, oilseeds and peanuts. Aflatoxin production in stored products due to the growth of molds has been a serious problem especially in the tropics. Higher temperature, relative humidity and moisture content of grains are the main factors for mold growth. The GoN has given less attention to its monitoring for lack of capacity.

The GoN has set mandatory standards for cereals, legumes and oilseeds to maintain quality and safety of the products. There are a total of 24 mandatory standards for cereals, pulses and their products, and 16 mandatory standards for fats and oils. There are seven physico-chemical parameters set for the following products: whole wheat flour, wheat flour, semolina, bread, biscuit, noodles and instant noodles. There are also 17 physico-chemical parameters set for the following products: food grains, whole green gram, split green gram, dehusked split green gram, red gram, whole black gram, split black gram, whole Bengal gram, split Bengal gram, whole lentil, dehusked lentil, Bengal gram flour, wheat, maize, fortified wheat flour and *maida*, corn flakes and rice. For these there are also standards set for mycotoxin and maximum pesticide residues. And lastly, there are 16 physico-chemical parameters set for the following products: mustard oil, imported rapeseed oil, soybean oil, palm oil, palm kernel oil, palmolein, groundnut oil, coconut oil, sesame oil, corn oil, sunflower oil, olive oil, safflower oil, refined oil, hydrogenated vegetable oil and bakery shortening.

Ginger and tea —Nepalese ginger production is organic in nature. Rarely any inorganic fertilizer and pesticides are used in its production. Pest infestation is not a significant problem except rhizome rot. The mother rhizome (*mau*) is removed in July to August and then sold, although this practice varies across locations. Some ginger farmers do not remove the mother rhizome because of their understanding that this causes risk of infection during removal. During the field visits, the rot problem was found to be quite widespread throughout the ginger growing belts.

As for tea, protecting the tea bush from pest and disease is a difficult task. A lot of pesticide is sprayed on tea farms, particularly on the CTC tea in tropic. During field visits, farmers reported that CTC tea production is virtually impossible without pesticide sprays. Sharma et al. (2012) reported higher (2,100 g, a.i./ha) pesticide application rate in tea farms, some 15 times, more than the national average rate of 142 g, a.i./ha. Besides pesticides, plant growth hormones along with micronutrients have been used by farmers. Experts hold that pesticides use in the CTC tea farms is not likely to come down unless alternative effective measures are accessible. It is also held, for some reason, that the GoN has not given priority to help adopt the IPM practices in tea farms. A farmer interviewed said that pesticides are sprayed even to remove snakes in Terai CTC tea farms at the time of cultural operations. Therefore, a serious review is needed of the current practices as well as perceptions of tea farmers and economics of pesticides use. Such analyses need to be comprehensive enough to also look into the adverse impact of chemicals on drinking water, biodiversity and applicator himself.

***Momo* (dumpling) supply chain HACCP analysis** — Thapa et al. (2008) report the results of a study applying the hazard analysis critical control points (HACCP) method for a large segment of the food chain of the *momo*. In order to determine the sources of contamination and the critical control points (CCPs), samples were collected from eight restaurants in Kathmandu for different stages of the preparation of *momo* (covering both chicken *momo* and buff *momo*). The analysis covered all raw materials, final products and their subsequent stages. Laboratory microbiological analyses were done for pickles, spices, raw *momo*, mixture of minced meat with spices and raw meat, measuring counts of a number of organisms such as total aerobic mesophilic count (TAMC), yeast and mold count, and coliform count.

The results showed the presence of various organisms at varying levels. These organisms originally present in the raw materials were transmitted to the subsequent stages. The main finding was that following the steaming of the final product, both types of *momo* were made free from microorganisms. Thus it was concluded that steaming was the main critical control point (CCP), which if done for proper time and temperature can eliminate all the microbial hazards. Information is not available on the post-process contamination of *momo* through plates, spoons and cleaning water.

Restaurants along the highway — The GoN has started inspection of food services in hotels and restaurants in 20 points along the Kathmandu-Narayangarh highway since 2013. Monitoring and grading are done based on general sanitation and hygienic conditions at various places, viz. kitchen, store, dining area, refrigerator, premises, water supply and toilet facility. The quality of the raw materials used for preparing foods including their expiry date and storage condition, are also taken into account in grading. Indeed this operation has facilitated, grading of highway hotels and restaurants. Following the inspection, hotels are grouped into four different grades and coloured stickers with safety logo pasted in front of the hotels so that everyone can see them before entering to eat. Restaurants were graded on a scale of 0 to 100, with ranking as follows: over 90 scored as good standard; 70-90 scored as medium standard; 50-70 scored as minimum standard and less than 50 scored as bad (i.e. need to shut down). The results show that 154 of the 181 restaurants (85 percent) scored medium standard, 7 restaurants (4 percent) good standard, 20 restaurants (11 percent) minimum standard and none falling into bad standard (i.e. those that need to close). Overall, a conclusion can be drawn that the hotels and restaurants along the busiest highway in Nepal are not in a satisfactory condition.

Street foods— Food habit in Nepal differs from that in many other countries. Heavy meal is taken in the morning around 9:00 am before office time. In the midday, people take light snack (*khaja*) in a convenient public place such as tea or coffee shop or *khaja* house around work places, hospital, offices, bus station or other mass catering services in school, university etc. Street food vendors are also increasingly important source of food at lower prices and in a convenient manner. These food services are considered to be a source of food hazard especially in summer months due to better ambient conditions (high relative humidity and temperature) for microbial growth and pollution of supply water. Recently, DFTQC has started mobile inspection and testing of foods in a mobile laboratory van at the spot.

Food processing industries — Food processing is aimed at rendering food safe, control contaminations and prevent re-contaminations during or after processing. But, food processing enterprises can also be sources of contaminations producing unsafe food. For quality control of processed foods, DFTQC provides production permissions for food processing enterprises in Nepal and does regular quality monitoring of the products. Limited capacity of the department to monitor food processing plants regularly and limited adoption of system certification create challenges on quality control of food safety. Survey of manufacturing establishments (CBS, 2012) reports establishments for processing and preserving of meat (3 in number), processing and preserving of fruit and vegetables (7), manufacturing vegetable and animal oils and fats (36), dairy products (56), grain mill products (575), bakery products (112), sugar (54), cocoa, chocolate and sugar confectionery (17), macaroni, noodles, couscous and similar farinaceous products (16), and other food products n.e.c. (67). Similarly, there are firms manufacturing animal feeds (40), distilling, rectifying and blending of spirits (29), manufacturing wines (2), malt liquors and malt (3), soft drinks, mineral waters and other bottled waters (54) and tobacco products (30). The strength of the DFTQC is not adequate enough to monitor the quality

of all these manufacturers and those small enterprises operating without notice to the departments. System certification and third party certification can help to control the quality of the processed food products.

Imported food products — Nepal imports a wide range of food products. In addition to live animals, meat, fish and dairy products, these also include raw and processed food products. Increased imports are of course associated with higher risks of various hazards. Raw agricultural products are important sources of risks of quarantine disease and pests, in addition to food safety risks due to pesticide and veterinary drug residues and contaminants. Processed agricultural products have much higher levels of food safety risks such as those from adulterations, additives, contaminants and deteriorations. Imports of a large range of processed food products and the diversity of their sourcing have posed challenges of monitoring the quality and safety of the products. For example, in 2011/12 Nepal imported sugar confectionery (not containing cocoa) from 27 countries, sweet biscuits from 26 countries, chocolate in blocks, slab or bars from 22 countries, juice from 19 countries, uncooked pasta from 15 countries, waffles and wafers from 13 countries, and chewing gum and cocoa power each from 12 countries (MOAD, 2013). Testing the quality of the products from each source is really a cumbersome job. As testing capacity is weak, consumers cannot be fully assured of the food additives that are in these products.

Likewise, for the same reason, i.e. challenges in testing for new hazards like radioactive and heavy metal contaminations, and GMOs, Nepal also faces the risk that low quality and contaminated foods that cannot be sold in other countries may be dumped in Nepal. Increasingly, food supplements are traded in the form of capsules, pastilles, tablets, pills and other similar controlled dosages (Eberhardie, 2005). But Nepal does not have adequate legislation to regulate the import of these products.

7.4 Food Standards in Nepal — Gaps, Requirements and Overlaps

The focus of this sub-section is on gaps, i.e. the gap between what is desirable and what is the current status. The assessment is based on a review of literature, interactions with stakeholders during field visits and expert views. This sub-section, at the end, also includes a brief on mandatory and voluntary food standards in Nepal. Note that identifying a gap also tells something about the corrective response needed (or recommendation) – these are two sides of the same coin. Thus, analysis of the gaps provides the basis for identifying response measures. The next section on compliance costs and public-private role also includes some aspects of the gaps.

For presentational clarity, the gaps are grouped into 10 different areas – principally, the segments of a supply chain. Before discussing these gaps, what follows is a table of reasons for and sources of substandard foods

Table 7.1: Reasons for substandard foods - results of food sample analysis by Nepal's CFL

Food products analysed	% substandard (and in brackets, reason for)
Honey, sugar and sweet products	Honey 5.8% (moisture); confectioneries 2% (starch); sugar 0%
Fruits and vegetables (raw and processed)	Fruits and vegetables 2% (low TSS and high SO2); carbonated beverages (foreign matter)
Feed and cereals	Feed and cereals 7.5% (less protein and more moisture)
Fats and oil	Ghee 23% (high R.I and F.F.A and low R.M.V); vegetable ghee 15% (low R.I and high A.V.)
Cereals	Different cereals 5.8% (high moisture and high alcoholic acidity)
Milk and milk products	In chemical test, 6.4% for milk and milk products (low fat and low SNF) and 8.4% for condensed milk (low SNF); in microbiology test, 47% (microbiologically unsafe).
Tea and spices	Tea and spices 1.8% (low volatile oil, high moisture and high total ash)
Water analysis	Mineral water 57% (low or high pH.; processed drinking water 45% (high Total Plate Count, coliform, faecal coliform, E. coli, Baacillus sp., suspended insects, and suspended green algae)
Contaminants	Various food types for detection of Aflatoxin B1 - 19.7% (contaminated with Aflatoxin B1); and for fish 0% formalin contamination

Source: Table prepared by the Author based on information in DFTQC Annual Report, 2068.

in Nepal, based on the results of food sample tests by Nepal's Central Food Laboratory (Table 7.1). The information in the table is self-explanatory and so does not need further comment.

Gaps in agricultural practices—The key to safe and quality food production is good agricultural practices (GAP) and good veterinary practices (GVP). Based on the review of literature, field visits and expert consultations, four categories of gaps in particular are considered crucial at the level of a farm at this stage: i) pesticides and veterinary drugs; ii) infected seeds and animals; iii) sub-standard water; and iv) undecomposed manure. The GAP provides guidelines and prescriptions for a judicious application of pesticides, among other things. IPM is a popular response. Likewise, adoption of botanical and bio-pesticides as complementary measures to control pests and reduced use of chemical pesticides should be promoted through awareness, extension and incentives if appropriate. As regards pesticides and veterinary drugs, the way ahead is dissemination of the GVP. The GVP prescribes OIE-consistent guidelines on aspects such as use of quality inputs (breeds, feed etc.), herd environment, water for animal use, veterinary drugs, waste disposal, personal health and hygiene, etc.

Gaps in post-harvest operations—Four categories of gaps in particular are found notable in post-harvest operations: i) lack of proper washing, cleaning, grading and packing; ii) lack of good storage practices; iii) use of banned chemicals; and iv) improper fumigation. Very briefly, the first gap exists for the simple reason that most of the freshly harvested foods contain soil, dirt, pesticide residues and microorganisms that need to be removed by cleaning. As vegetable growing in green house is limited, washing water plays an important role. The second gap has to do with the lack of modern storage as well as cold storage facilities. The third problem is due to the use of banned chemicals, e.g. formalin for fish and mushroom preservation, baking soda or caustic soda for neutralizer in milk. The fourth gap can occur, for example, due to an overdose of fumigation even when the fumigant is permitted, e.g. aluminium phosphide, and the diffusion of phosphine gas to the environment. Desired responses to the four gaps are, respectively: proper washing, cleaning, grading and packing; good storage practices; use of permitted chemicals only; and good fumigation practice.

Gaps in food processing—Six gaps are identified here. First, use of non-permitted food additives, which have sharply increased in Nepal, is a serious issue. Proper monitoring can be a major response. Second, excessive and improper use of permitted additives is feared. There are standard responses for this including using additives as per the Codex guidelines. The third gap is inadequate sanitation and hygiene, for which the main response is to adopt GHP, GMP and HACCP. Fourth, there is reluctance in adopting food safety management systems (notably GMP, HACCP). It is especially necessary in Nepal that the GMP and HACCP guidelines are adopted in the processing industries of milk, meat, fruit and vegetable products. The fifth gap is improper thermal processing and packaging, for which the main response is HACCP and good packaging for maintaining food safety and quality. And the sixth gap is inadequate pollution control and waste management which increases contamination in processing plants and thus hurts employees' health and overall environment. Additional related concerns are microbial contamination in water since water enters into all stages of food processing. In all these cases, while raising awareness is an important task, innovative responses are required so that processors are self-motivated to adopt better practices.

Gaps in wholesaling and export/import — Four categories of gaps are identified in this area and the responses noted. First is the improper storage practices that deviate considerably from Good Storage Practices (GSP). Second, there is a considerable use of illegal ripening agents for which the appropriate response is to use the universally accepted ethylene gas. For example, in Nepal, calcium carbide (CaC_2) or smouldering wood has been used by wholesalers for fruits ripening instead of ethylene gas. This bad practice still exists in Nepal as in some other developing countries. Third, there are significant gaps in good sanitation and hygiene. The response is monitoring to ensure proper cleaning, sanitation and hygiene. Fourth, quarantine checking is grossly inadequate, the main reasons being limited laboratory facility and weak staffing. The response is both more investment in facilities with modern equipment and sufficiently trained manpower.

Gaps in food preparation and consumption— Four gaps are identified here: i) use of contaminated

water; ii) poor sanitation and hygiene; iii) improper storage and disposal facility; and iv) insufficient training. Water quality is crucial for most operations (microbiological, chemical as well as physical). There are standards set for various categories of water but it is not easy to enforce them. Even for bottled drinking water, about half of them were found below microbiological standards in a recent survey by DFTQC. As regards sanitary and hygienic conditions in places of mass eating and drinking, in response to unsatisfactory conditions, the DFTQC has initiated surveillance and grading of food service places along the highways. Likewise, street food is becoming popular especially for the masses in large cities, and thus requiring urgent attention.

Gaps in food inspection and monitoring — Gaps are identified for three categories of inspections: of food manufacturing industries; of food products in the market; and of inspection of food service centres. The fourth gap is insufficient training and manpower. Currently, inspection is performed for 112 food items that have legal standards as well as in catering services like hotels and cafeterias. It is well recognized that preventive approaches (e.g. GHP, GMP, HACCP) are much more cost-effective than end-product testing and penalties.

Gaps in laboratory facility and manpower—Gaps in laboratory facilities and expertise have been well recognized for many years now. In response, investments have also been made continually but still facilities remain grossly inadequate. For example, the Central Food Laboratory of the DFTQC has been equipped with modern instruments such as GC-MS, HPLC, AAS, spectrophotometer, etc. in a new building and the laboratory is also recently accredited by NABL, India. Yet these instruments have not come into full operation due to the limited trained personnel. There are also five regional and four quarantine laboratories under the DFTQC, and yet there are constant complaints that these facilities have limited reach as well as capability (e.g. being unable to analyze biological and chemical contaminants).

Gaps in FBI monitoring or FBD system—Database on food borne illness (FBI) or food borne diseases (FBD) from around the country is an important basis for responding to food safety problems, e.g. with national policy and area-specific interventions. This requires close collaboration with hospitals, including private hospitals and nursing homes as these facilities expand rapidly. Experts have recommended that this requires "FBI surveillance software" to record the incidence as these occur and such recording needs to be made mandatory and be updated on a monthly basis.

Gaps in harmonization of standards—Nepal has now enforced a total of 120 product standards (112 for food and 8 for feed). Then there are the Codex standards, or target country specific standards that need to be met for exporting products. What follows are some illustrations. Thus, volatile oil specification of the Nepali dried whole ginger is not less than 1.0 percent (v/w) on dry basis whereas it is no less than 1.5 percent on the same basis in the Indian standard. Likewise, acidity standard for tomato ketchup has 1.2 percent (w/w) acidity as acetic acid for Nepal versus 1.0 in the Indian standard. India has banned #3 artificial colouring matter (coal tar dyes) and #5 natural colours but those are still in the permitted list in Nepal. Similarly, for pasteurized milk and milk products, Nepalese food standard has a minimum of 3 percent fat versus two standards in India, 6.0 percent milk fat (e.g. in West Bengal) and 5.0 percent fat (e.g. in Andra Pradesh). The present standard specifications for many residues (e.g. pesticide, veterinary drug), foreign matters and microbiological and/or chemical contaminations in foods and food products do not always comply with the Codex standard. For example, maximum residual limit (MRL) for aldrin and dieldrin is 0.01 ppm for all foodstuffs in the Nepalese standard whereas the Codex MRL is specifically set as 0.006 ppm in milk and 1 ppm in garden peas. In view of this, there is a need for revising standards for pesticides, veterinary drug and microbiological and/or chemical contaminant standards etc. for Nepal Food Law so as to harmonize with Codex standards.

Gaps in Act formulation and amendment — One can count a total of 36 acts in Nepal directly or indirectly related to food safety: 12 directly related to food safety, 7 for plant health, 6 for animal health and 7 for environmental protection (see Chapter 2 for details). In addition, there are 4 acts related to food safety. As regards the formulation of acts, Biotechnology Act and Laboratory Accreditation Act need to be formulated and enacted. The former is required to address GMOs and related issues in agriculture,

forestry, food and medicine. The latter is necessary to regulate and monitor food, chemical and veterinary drugs, and plant, and animal quarantine laboratories. As for the amendments of current acts, Food Act 1966 and Food Rules 1970 need amendments so as to harmonize them with the Codex standards. Likewise, MRL for pesticides, veterinary drugs, mycotoxins, contaminants and food additives need to be reset for specific food products. Delays in these measures have hindered the exports of Nepalese agro-food products.

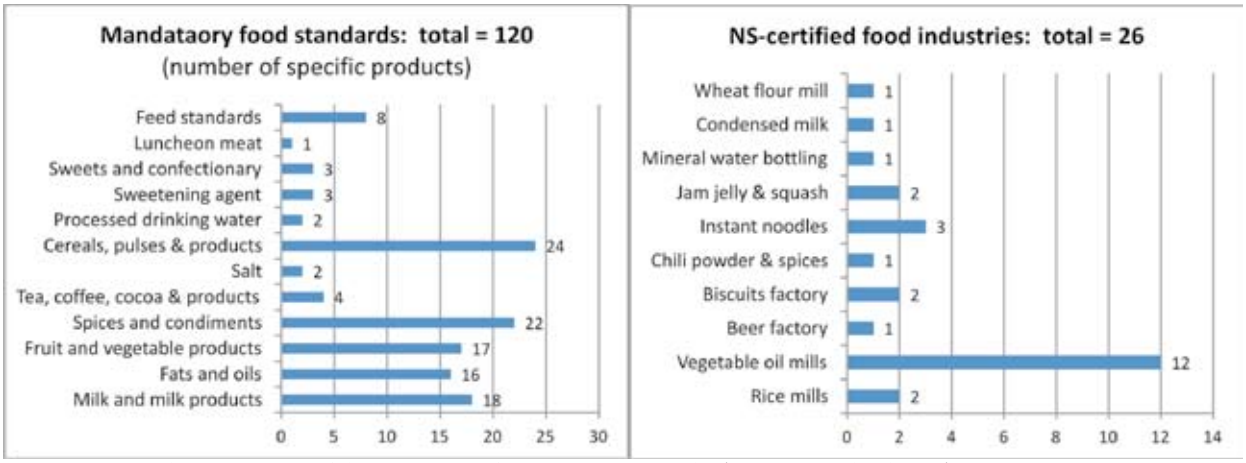
Overlaps in food-related acts — Various reviewers have noted overlaps in the functions of several acts, notably the Food Act (1966), Consumer Protection Act (1998), Nepal Standards (Certification Mark) Act (1980), Animal Slaughterhouse and Meat Inspection Act (1999). Food Act (1966) is implemented by DFTQC whereas Consumer Protection Act (1998) by the Department of Commerce (DOC) under the MoCS. The DOC has neither food technologists nor laboratory facility. Likewise, there is a strong view that compliance of both the voluntary and mandatory standards of foods should be entrusted to only one organization, namely the DFTQC as it is the main agency for food/feed safety. Currently, mandatory food and feed standards are monitored by DFTQC while voluntary standards even for food are monitored by the Nepal Bureau of Standards and Metrology (NBSM). And lastly, in a similar spirit, it has been suggested that quality control of meat and meat products, being food products like other foods, should also be brought under the same umbrella (i.e. DFTQC).

Mandatory and voluntary food standards — The formulation and adoption of these standards are important for strengthening the capability of the food industry to deliver safe and quality foods. In Nepal, there are two bodies for food standards: one for mandatory and other for voluntary standards. First, under Food Act, there is a Food Standardization Board (FSB) that formulates draft and recommends to the government of Nepal for approval of food standards, principles and guidelines based on international practices and principles, basically Codex. Second, there is a Nepal Bureau of Standards and Metrology (NBSM) that formulates voluntary standards for *Nepal Standard* (NS) certification and recommends the National Council for Standards (NCS) for approval.

Figure 7.1 shows the number of these standards for Nepal's food industry. The left panel of the Figure shows the number of food products under various food categories with mandatory standards issued through the FSB. The total is 120 standards of which 112 are for food products and 8 for feed. The right panel shows the number of food industries with NS certification which total 26. These 26 are a sub-set of the over 200 standards that have been implemented in all food and non-food categories. The NBSM standards cover various industrial and consumer products, test methods, management system, basic standards etc.

In closing this section, it is pertinent to note here that there are two other important organizations on standards. One is the South Asian Regional

Figure 7.1: Food industries with mandatory standard and Nepal Standard certification



Source: Statistics from SMTQ Nepal. http://smtqnepal.org/smtq/statistics.php (statistics as of end-2010).

Standards Organization (SARSO), established in 1999, for formulating regional standards for food and food processing methods. Nepal is of course its member. Then there is ISO of which Nepal became a full member in September 2013 with membership effective from January 2014 (previously, Nepal was a correspondent member since 1991). This paved the way for Nepal to formulate standards as guided by the ISO and issue certification to interested companies, using the ISO logo and standards. This means that the domestic companies need no longer reach to foreign agencies to get international certification. A private company "National Certification and Management Nepal" established in 2009 claims itself as an ISO certification body in Nepal[15].

The ISO 22000 is a family of International Standards to address food safety management. These standards help food enterprises to identify and control food safety hazards and reduce the risks of food borne illnesses. Nepal's drive for export promotion can be assisted considerably by adopting international standards. The ISO/TS 22002-1:2009 contains specific prerequisites for food manufacturing. It provides a relevant standard that helps the food industry demonstrate adherence to food safety principles for customers and consumers. But, very few companies in Nepal are ISO certified and the precise data are not available. HACCP certification is also not popular among the food enterprises.

7.5 Compliance Cost and Public-private Role

This section continues with the earlier assessment of gaps by discussing two related topics: the cost of compliance with biosecure practices in food supply chain; and the sharing of the incremental costs and responsibilities among the public and private actors in the supply chain.

There are numerous food chains which vary considerably by food product, region, scale of operation, level of commercialization, length of the supply chain and so on, and thus it does not make sense to speak of the costs of compliance in a generalized manner. This is also what the literature suggests – most studies on compliance cost for other countries are context specific, e.g. mango export supply chain from Senegal or cut flower export supply chain from Kenya. Thus, for precise policy and programme interventions, context-specific estimates of the incremental costs are needed.

All five sub-sectoral papers under this study on biosecurity (crops and vegetables, livestock, fishery, forestry and this one) have some estimates of the incremental cost and private-public sharing. This information was collated from interviews during field visits, notably a final seminar with stakeholders, but also literature review and experts/officials. In some cases, it was possible to elicit/collate fairly good numbers for many areas of compliance. In others, it was hard to get the estimates beyond subjective views. This was also the case with this paper. For example, when the exercise was initiated, a total of 33 individual origins of hazards, or/and weaknesses in adopting good practices, in six different areas of the supply chain (as discussed earlier in the "gaps" section), were identified for information on cost. However, no concrete cost estimates could be pinned down in most cases, the typical responses being that variable cost depends on the product and scale of business, and the type of the food industry. Table 7.2 illustrates some responses on compliance cost.

Tighter, or demanding, food safety regulations in low-income countries also have limitations. In a popular paper, Azevedo and Bankuti (2002) describe an experience in Brazil where tighter regulations led to the rise of informal markets because while large establishments could adopt the regulations and absorb the compliance cost, a large segment of the small farmers and businesses could not and had no option but to supply to the informal markets. This resulted into more "unsafe" food being sold in the market, for which there was demand because poorer people tend to be more sensitive to price than quality. Azevedo and Bankuti (2002) also describe some positive experiences: while those tighter federal regulations turned out to be of value for the export sector, other, more lenient, regulations were introduced at state and municipality levels for sales to these levels only. This gave rise to supply chains and foods produced according to different hygiene standards for the domestic market, and in the process substantially reduced the share of the informal market as a whole – thus raising the overall level of food safety in the country.

[15] http://natcmnepal.com/

Table 7.2: Illustration of the costs and benefits of adopting biosecure practices in food supply chain

SN	Origin of hazards	Intervention	Cost (NPR)	Benefits
1.	Pesticide residues	IPM training through farmers' school	20,000/training /20 farmers	Safer and quality products, consumers' health risk decrease, environmental pollution decrease and ease for export and market access
2.	Veterinary drugs residues in milk and meat	Lab. Testing	600/test	Assurance of safety as above
3.	Lack of cleaning, washing, grading, packing	Cleaning, washing, grading and packing	Variable cost depends on produce and scale	Cleaner and safer produce, uniform quality, good packaging, ease of marketing, value addition (ca 10 % more price)
4.	Inadequate pollution control and waste management	Pollution control and waste management	Depends on type of food industry	Less in-house contamination, environmental friendly, help adopt FSMS, useful by-products
5.	Illegal use of ripening agent	Use of permitted ripening agent	~2500/L Ethryl	Uniform ripening, food safety, compliance with regulations, positive psychological effect, environmental safety

Source: First Author, based on field visits, stakeholders' seminar and literature.

Information on stakeholder views on the sharing of the incremental costs and responsibilities between the *public and private actors* along the supply chain was also collected from the same source as above, as well as on the government support measures required for improving the state of biosecurity.

The overall impression from the responses was broadly consistent with the basic underlying principle that the government provides support and services of a public good nature for creating an enabling environment for private sector investment. It was also noted that the private sector would not support bearing the incremental costs if that resulted in higher market price of the products or services. For this reason, a case was made for the government, or some other agency, to provide limited and targeted subsidies in the form of incentives where a biosecure practice produces relatively large positive externality which the private actor cannot recoup from the market in the form of higher price. In view of these views and claims, it seems that some applied field research on cost of compliance and subsidy would be very useful for policy response.

Table 7.3 summarizes the main findings on cost sharing. These are of course very preliminary and reflect a fact that it is not simple for anyone in interview/seminar to articulate more concrete numbers. It is encouraging to see that the private sector is willing to share many responsibilities and incremental costs. This is the right analytical approach to follow for identifying specific proposals and policy measures but that requires consultations with the private sector, but only after generating some sound evidence based on context-specific in-depth assessments.

7.6 Concluding Remarks

This paper, while also on food as the other four studies in the series on biosecurity (crops and vegetables, livestock, fishery and foods of forest origin), differs in that the focus here was on biosecurity issues related to *food industry* or *supply chain* as a whole. Food industries all over the world are increasingly being based on vertical coordination, typically with some form of contract among the actors in the chain. There seems to be a consensus among analysts that a coordinated supply chain is relatively more effective in providing safer and better quality foods than otherwise because coordination helps prevent or minimize the chance of entry of harmful bio or chemical agents into various stages of the supply chain.

There is a paucity of research on benefits and costs of improving food safety at the chain level. The majority of the existing studies on costs tend to focus on some specific stage of the chain, typically on the production or processing stages. As hazards in one stage are affected by hazards in others, and thus cost or benefit someone else in the chain from an action of others, food safety analyses (cost and benefits) for the entire chain are useful for policy.

Table 7.3: Public-private sharing of responsibilities and incremental costs

SN	Action	Cost sharing % (private: public)
	Role of public sectors	0:100
1.	Formation and amendment of legislations (policy, rule, standard, etc.)	
2.	Regulatory duties (inspection of foods, control of food adulteration and misuse of additives/chemicals)	
3	Public expenditure (water supply, marketing research, agri-produce market place and storage)	
4.	Risk assessment and management (development of FBI surveillance database to gauge the incidence of various food supply chain hazards	
5.	Awareness building for various stakeholders in the food supply chain (organize tailor-made training for good sanitation and hygiene for storage, ripening, fumigation, etc.)	
6.	Infrastructure and facilities building (change of institution for better food control system and establishment of accredited lab).	
7.	Education, research and collaboration (Incorporation of topic of biosecurity, food safety, sanitation and hygiene into curricula of school, college and university)	
	Role of private sector	100:0
8.	Adopt GAP, GVP in production and GMP, HACCP and ISO in processing of food products	
9.	Pollution control and waste management	
10.	Incorporation of traceability in food supply chain in order to trace source of hazards and manage product recall	
11.	Establishment of accredited lab in private sector	
12.	Organize training, workshop and advisory services	
13.	Alert government in food safety and quality concerns in food supply chain	
14.	Establishing enterprises of government interests	
	• Private regional accredited labs and agri-produce marketing centres	60:40
	• Slaughterhouse (abattoir)	40:60
	• Cold storage, and agricultural products cleaning and pack houses	60:40

Source: First Author, based on field visits, stakeholders' seminar and literature review.

While the main intention was to synthesize evidences on food safety along the food chain and to discuss response measures, it turned out that very little analytical work has been done in Nepal on how food chains facilitate, or hinder, the adoption of biosecure practices. Only one study was found that analysed food safety for a large segment of the chain using the HACCP method (for the famous *momo* or dumpling). This could be, partly, because there are far fewer coordinated food industries in Nepal in contrast to many other developing countries. Nepal's new Agricultural Development Strategy gives high priority to developing coordinating food chains. In view of this, one recommendation of this study is for the GoN, research agencies and development partners to commission studies and review food safety statistics from the standpoint of the risk of food hazards in vertically coordinated food industries. Such analyses can provide insights on policy response in terms of the specific points in the food chain for intervention.

Mirroring the dualistic structure of Nepal's agrarian economy, food chains are also very dualistic. On the one hand, the chain in the subsistence economy is both very short and relatively much more biosecure. In contrast, there are food safety challenges with high risk of hazards in the case of commercialized food chains. A system of collaboration and coordination needs to be developed among all the primary food production related departments, food processing related department, food trade related department and food quality control department. It is also important to focus on infrastructural aspects such as establishing cold storages to maintain cold chain, test facilities, strengthening manpower at various governmental levels and other stakeholders. The challenge of harmonising standards both with international and within the country needs to be addressed and the recognition of private certifications in legislation so as to reduce the burden on government resources.

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CHAPTER 08

COST OF COMPLIANCE OF AGRO-FOOD SUPPLY CHAIN TO BIOSECURITY:
SOME EMPIRICAL EVIDENCES FROM CROP AND DAIRY FARMS IN NEPAL

Krishna Prasad Pant

Abstract

Compliance to biosecurity standards involves costs. Compliance can be incentive-compatible only when the cost involved is covered by increased revenue from selling the safe produce. There are very few studies on the costs of compliance (COC) to good practices but this information is very useful for developing regulations. This paper estimates COC to good agricultural practices in ginger and tomato production, and good veterinary practices in milk production by smallholder farmers in Nepal. Using a partial budgeting method, the incremental COC for ginger, tomato and milk production are estimated to be NPR 9.60/kg, NPR 6.39/kg and NPR 8.83/litre, respectively. This means that if the farm gate prices of these products increase by at least 26 percent, 38 percent and 31 percent, respectively, the adoption of the good practices will be incentive compatible to farmers. For smallholder farmers in particular, the incremental COC are on the higher side and so they need some support to reduce the COC and be competitive during the early phase of the adoption of the good practices.

8.1. Introduction

Biosecurity is conceived as a strategic and integrated approach that encompasses the policy and regulatory frameworks for analyzing and managing relevant risks to human, animal and plant life and health, and associated risks to environment based on recognition of critical linkages among them (FAO, 2007). These risks are being addressed by governments all over the world through policies, legislations and standards. Based on the experience of the past 2-3 decades it is now widely accepted that the formulation and implementation of these measures are scattered across government agencies and their respective instruments, including legislations under their mandate, leading to fragmentation of effort, waste of resources, duplications and the risk of lapses within the system. An evolving view is that the way forward to make these efforts effective is to have a national biosecurity framework that responds to the problems in a holistic manner.

Compliance with higher standards costs to both the private sector and the government. For the private actors, the additional expenses typically include costs for the adoption or upgrading of new technologies, changing farming or production practices, certification costs, etc. while for the public sector the typical costs include establishment of quality assurance system, information provision, tracking and tracing systems, testing laboratories, formulation of legislations and codes, etc. Besides meeting the mandatory national standards, themselves largely based on international standards such as those set by the Codex, IPPC and OIE, there is an increasing trend across the world whereby food businesses are required to follow standards set by private agencies such as the Global GAP for global trade especially a requirement of supermarkets[16] in individual

[16] Though the private standards are voluntary, these standards have three major problems—first, these are not set through inter-governmental agreements and yet these must be met for accessing export markets; second, their standards are higher than national and internationally accepted standards, thus considerably increasing the COC; and third, they cannot be challenged in the WTO Dispute Settlement process.

countries. While voluntary, these have become essential for accessing domestic markets and external trade. It is reported that for achieving allocative efficiency of available resources an appropriate combination of response activities needs to be developed for different biosecurity threats (Department of State Development Business and Innovation 2008). The same report also requires that incentives provided to private enterprises should be aligned with the public good generated by the enterprises. Any incentive provided to the actors of agro food supply chain including the farmers is expected to generate public welfare through creating employment and producing safe food to consumers.

There are very few studies on cost of compliance (COC) for the Nepalese food industry, but this is generally so for other countries as well. The COC is defined as the incremental cost incurred by a private entity and government in adopting good practices (standards) essential for making the particular production process and supply chain biosecure. What is learnt from the literature is that the COC can be significant enough to affect the adoption decisions, implying that market price could rise markedly if the full set of essential standards are adopted since the extra cost has to be recouped from the market by way of higher price for safer and better quality products, unless increased efficiency and public subsidy cover full or part of the cost. Analysis of the COC can help to understand cost implications of biosecurity regulations to producers and consumers and thereby knowing the trade-off involved between the extra cost and an appropriate level of protection (ALOP)[17]. The basic principle is that knowing the costs of compliance is necessary before setting any variation in standards of farm commodities or other products. Knowledge of the COC helps to compare the COC with possible increases in revenues from the products, which informs whether the regulations are incentive-compatible or not to each of the supply chain actors. Business operators and farmers will obviously comply with such regulations if revenues exceed the costs. Thus, a good COC analysis not only quantifies the extra costs but also raises, and answers, questions such as who in the supply chain bears the cost, how to fairly share the cost across the supply chain, and what can the government do to make the upgrading process effective and efficient, including through public budgetary support and targeted subsidies.

It is not just the safety and quality of foods for the domestic markets, the major challenge for Nepal in export promotion also lies on the capacity of the public and private sectors to comply with the exporting market's technical regulations and standards relating to food safety, plant and animal health and environmental sustainability. Meeting public regulations and standards of the destination country is mandatory for exports while complying with private standards has also become necessary for being competitive. Biosecurity's contribution goes beyond that of SPS – while the SPS provisions are attracted for all the trade-related risks to human, animal and plant health and life, biosecurity covers both the SPS measures for trade and all other measure that ensure food safety for the domestic markets as well. For this reason, it is said: "*Costs of compliance on individual stakeholder groups (e.g. farmers, fishermen, exporters) and society as a whole affect international trade competitiveness, innovation and sector growth*" (FAO, 2007).

The focus of this paper is on COC. It reviews literature, discusses related issues, provides an analytical framework, and quantifies COC for three food products and discusses the results. The three food products, selected taking into consideration factors such as commercial value, export potentials, high potential hazards and high exposure to the people (including infants), are ginger, tomato and milk. Note that based on the conceptual framework developed for the biosecurity project and reported in this chapter, all other five sub-sectoral assessments (crops and vegetables, livestock, fisheries, forest foods and food industry in Chapters 3-6 in this volume) also have sections on gaps in standards and the compliance cost to bridge the gap.

The remainder of the paper is organized as follows. Section 8.2 describes the framework and methodology used. Section 8.3 presents the results while the findings are discussed in Section 8.4. Section 8.5 concludes.

[17] The SPS Agreement defines Appropriate Level of Protection (ALOP) as the level of protection (or acceptable level of risk) deemed appropriate by the Member establishing a SPS measure to protect human, animal or plant life or health within its territory.

8.2 Methodology

The study is based on review of literature and field data collected by biosecurity assessment studies in crops, livestock and food safety (chapters 3, 4 and 7 of this volume). In the absence of farm level record keeping, the COC is estimated through discussion with farmers and other stakeholders. Data were collected through interviews with key actors of the agro-food supply chain and public agencies engaged in SPS compliance aspects. These studies also identified the present status, requirements and the gaps for biosecurity. The field data were supplemented with information in publications of the relevant ministries and departments (notably MOAD, DOA, DLS and DFTQC). As the biosecurity policy is not yet approved by the GON, the SPS measures are taken as the reference for compliance by farmers. Nepal accessed to the WTO in 2004 and is fully committed to comply with the SPS Agreement. In addition, the study also uses OIE and IPPC standards as the benchmarks to estimate micro-level COC. Both establishment and operations costs of the farmers are taken together.

The estimation of the COC involved five major steps—(i) identifying quality standards and SPS measures necessary for domestic and export markets; (ii) analysing key requirements of these standards; (iii) assessing the gaps; (iv) identifying the measures necessary to meet the requirements; and (v) quantifying the costs necessary for installing the measures and their operationalization based on farm level data collected by assessment studies. The COC to biosecurity includes direct and indirect costs at the macro as well as micro levels[18]. The direct costs[19] are those incurred for necessary technological changes in order to comply with changed regulations, private standards, codes of practices, and auditing requirements of certifying agencies. The indirect costs[20] are those incurred in establishment of quality assurance, communication, tracking and tracing systems and laboratory operations. Among the indirect costs, those associated with the risks of rejection in international market are the major ones for exporters. The COC to biosecurity measures include the costs incurred by public institutions and private supply chain operators for adjusting various activities in the supply chain in order to conform to the measures.

The compliance costs are estimated for three farm products - ginger, tomato and milk. As said earlier, the considerations taken for selecting these products include market potentials and risks of human, animal and plant health and life and environmental problems. Ginger is a major export crop of Nepal. It is grown in 20,256 ha throughout the country except in 11 mountain districts. However, the major commercial production pockets are concentrated in the eastern and mid-western hills. The total annual production is 255,208 tons with yield rate of 12.60 tons/ha (MOAD, 2012). Ginger is a crop suitable for upland and can even be grown in slope land that is typical of the land owned by the poor. It is grown in small scale by a large proportion of small farmers in the country. Most of the produce is exported to India, sometimes informally. For example, the formal or recorded export was 62,843 tons in 2012/13 while only 24 tons in 2011/12 with similar level of production. As regards safety and quality aspects, as ginger is mostly sold immediately after harvest, there is little chance of contamination in transport and handling. The use of chemical fertilizer is very low and the use of pesticides is mainly limited to seed treatment.

Similarly, tomato is grown in 16,416 ha of land and produced throughout the country. However, the major production pockets are in peri-urban areas and districts around the large cities. Annual production is 282,481 tons with yield rate of 17.21 tons/ha. Although tomato is considered to have high export potential to neighbouring countries, actual exports are low. For example, only 27 tons of exports to India were recorded for 2011/12 (MOAD, 2012). Some commercial farmers are applying large amounts of chemical inputs and fertilizers while many farmers are also showing interest in tomato production using IPM technology.

Milk is a major livestock product in Nepal. Annual milk production is estimated to be about 1.6 million tons in 2011/12, from 1 million milking cows and 1.33 million buffaloes, which means milk yield of 0.80 metric tons per annum per animal. . Though only 50 tons of fluid milk and cream are reported to be exported from Nepal, exports of milk products are sizable: 563 metric tons of milk fats, 13 metric tons of

[18] In this paper, the cost incurred by private entrepreneurs and farmers is called "micro cost" and those by the public sector the "macro cost".
[19] The direct costs also include quality and safety control and staff training for compliance.
[20] The indirect costs also include the costs due to delays in export processing, risk of losing customer credibility, risk of export bans due to repeated failures to comply, costs of market repositioning and credibility regain.

butter and 9 metric tons of cheese in the year 2011/12 (MOAD, 2012). Thus, except for some cross border trade, milk is not as yet an export commodity.

For all these three products, the COC are estimated for what may be called ideal or desirable farm or herd sizes in Nepal's context. Thus, for ginger and tomato, the ideal farm size for smallholder farmers is considered to be 0.10 ha, although the average farm size in Nepal is 0.68 ha, and for dairy the ideal herd size is considered to be a unit of 10 cows.

Partial budgeting technique is used for cost estimation. As the changes to be made are incremental to the current infrastructure and practices at the farms, partial budgeting is a proper tool as it helps farm owners to evaluate the financial effects of the incremental changes. This method includes only those inputs and resources that will be change following compliance, but does not consider the farm resources that do not undergo any change. The evaluation helps to determine whether the changes made thus raise or lower farm incomes and costs. The net impact of the adoption of certain good practices will be the positive financial changes minus the negative financial changes. A positive net impact indicates that not only farm income increases following the adoption, but also that the proposed change is incentive-compatible, and vice versa (not incentive-compatible) for a negative net outcome.

For investments on durable items necessary for the compliance, a linear depreciation method is used. Depreciation indicates how much of an asset's value has been used up in one year. Under the linear (or straight line) method of depreciation, the asset value is spent uniformly over the life of the asset. This is estimated by subtracting the salvage value of the asset, if any, from the cost of the asset and the remainder is divided by the useful life of the asset. The useful life of such an asset is determined in consultation with experts. For costing the laboratory tests, the rates of the fees charged by the government laboratory under the DFTQC are taken as the reference.

There are some limitations of the study. The empirical cost estimates serve the purpose of case studies; the examples being for specific conditions. The micro-level COC are location and industry specific. The estimated COC is influenced by many factors - the nature of the business, present status of biosecurity, point of control, environmental conditions, resource endowments of the farms and their capacity, and ALOP or acceptable level of risk.

Table 8.1 maps the likelihood of exposure to a hazard and its level of health consequences. The consequences of the exposure can be adverse health effects with different levels of severity and degree of economic and environmental impacts. For example, negligible risks as indicated in the table can be acceptable, but the "very low risk" or "low risk" may or may not be acceptable depending on the situation of the country and afford ability of the people. But the non-availability of reliable data makes such ranking difficult in real life.

Risk analysis, preparedness and emergency management affects the COC to the farmers. Data

Table 8.1: Acceptable level of risks

	Consequences of Exposure to hazards						
Likelihood of exposure to the hazards	Impact / Exposure	Extreme	High	Moderate	Low	Very low	Negligible
	High	Extreme risk	High risk	Moderate risk	Low risk	Very low risk	Negligible risk
	Moderate	Extreme risk	High risk	Moderate risk	Low risk	Very low risk	Negligible risk
	Low	High risk	Moderate risk	Low risk	Very low risk	Negligible risk	Negligible risk
	Very low	Moderate risk	Low risk	Very low risk	Negligible risk	Negligible risk	Negligible risk
	Extremely low	Low risk	Very low risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk
	Negligible	Very low risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk

Source: Adapted from Biosecurity Australia's risk estimation matrix.

availability is very limited for estimating the costs of risk assessment[21], management and communication and their impacts on COC. Some sort of emergency management systems are developed in Nepal for some zoonotic diseases like bird flu. For food safety and quarantine control, no clearly articulated emergency management plan is available. For food safety[22], plant and animal diseases some ad hoc emergency programmes are launched as per the need of the moment. Planning and preparation can help better management of emergencies. These emergencies may arise from outbreak of diseases or release of pathogens, chemicals or irradiations. Emergency preparedness[23] helps to respond to the problem quickly, effectively efficiently and in a coordinated manner, thus reducing the COC. Reference for emergency preparedness may be made to the FAO/WHO framework for developing national food safety emergency response plans. Higher level emergency preparedness, though it increases the costs of preparedness, decreases the costs of emergency response (Figure 8.1). The point of intersection between the costs of preparedness and cost of response to the emergency is the optimum level of preparedness, thus increasing the effectiveness and efficiency of the response. However, necessary data are not available or/and inadequate to empirically estimate that optimum level of preparedness.

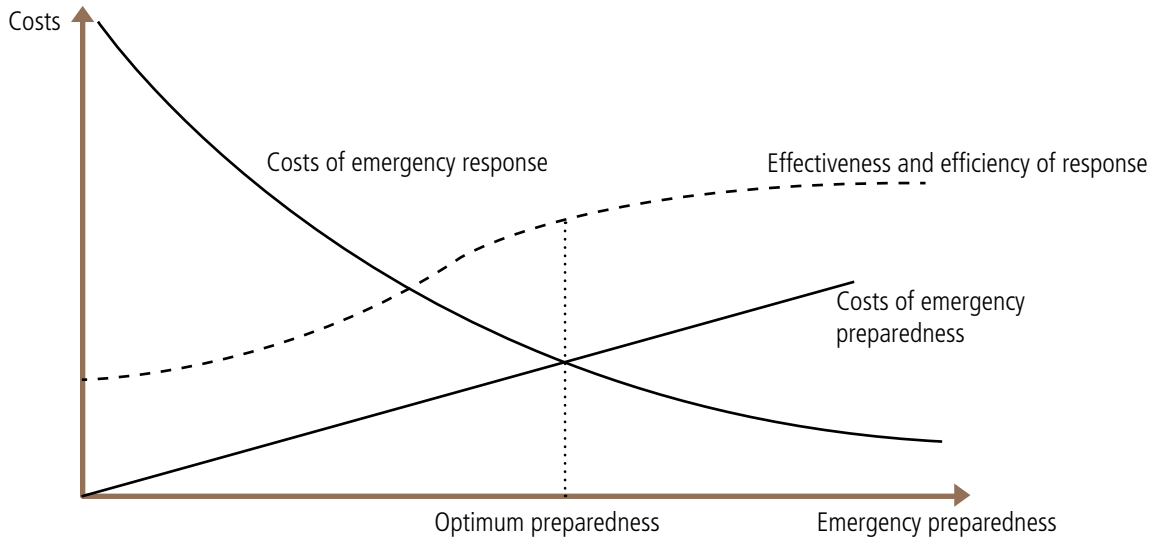
8.3 Results

The results of the study are presented in five sub-sections. First, the quality standards and SPS measures necessary for domestic and export markets are identified and discussed. Second, the key requirements of these standards are delineated. Third, gaps between the necessary standards and existing practices are outlined. Fourth, the measures necessary to meet the requirements are explained. Fifth the costs of compliance are quantified and discussed.

8.3.1 Identification of the quality standards and regulations

Considering rising global concerns with food safety and quality, several standards have emerged nationally and internationally. The international

Figure 8.1: Costs and effectiveness of emergency preparedness



Source: Author

[21] The process for risk assessment involves hazard categorization, assessment of the probability of occurrence and assessment of potential consequences.

[22] Food safety emergency is a situation, whether accidental or intentional, that is identified by a competent authority as constituting a serious and as yet uncontrolled food-borne risk to public health that requires urgent action (Codex, 1995).

[23] Identification of major hazards and risks along with assessment of vulnerabilities and possible influences can help in emergency preparedness. The preparedness includes dividing responsibilities, developing practices and processes and formulating implementing plan on the basis of identified organizational and other resources and capacity. A contingency plan needs to be developed for each major identified hazard with detail operational concepts and resource assessments.

agreements related to trade and standards emerge from the SPS and TBT Agreements of the WTO. The SPS agreement recognizes Codex Alimentarius Commission (Codex), IPPC and OIE as international standard setting organizations while the TBT Agreement recognises other standards setting organizations the main one being International Standardization Organization (ISO) which lays down standards in both food and non-food sectors. In addition to these international standards, importing country requires to meet regional legislations of the European Union. In addition, private standards such as GlobalGAP and British Retail Consortium (BRC) also apply to food imports into European countries. The BRC Global Standard covers packaging standard providing safety and quality guidance for manufacturers of packaging materials and food materials (WTO, 2007). Legislation obliges producers to ensure the suitability of their packaging for food safety. The standard provides a common basis for the audit of companies supplying packaging for food products. In addition, many other importing firms' requirements, consumers' preference, international conventions, code of conduct/guidelines, and schemes of individual firms, regional collective, national and collective regional and international are emerging in different parts of the global market (see Table 8.2 for further details). Among these national, regional and international standards and regulations, those under the SPS and TBT are mandatory for trade whereas all others are voluntary.

8.3.2 Analysis of key requirements of standards

These requirements are different for micro or enterprise level and at macro level. At the enterprise level, requirements include adoption of various standards, farm record keeping, ensuring

Table 8.2: Major standard setting institutions and their standards

Type	Institution	Standards
International agreements related to trade and standards	WTO	Agreement on SPS and Agreement on TBT
	Codex	Codex Standards, guidelines and Codes of practice
	IPPC	International standard for phytosanitary measure (ISPM)
	OIE	OIE Standards and guidelines for animal health
	ISO	ISO standards on: Agriculture, food technology, packaging and distribution of goods
Importing country rules	European Union	Legislation on food safety; Legislation on crop protection products; Legislation on phytosanitary requirements
	EUREPGAP	European retailer's protocol for Good Agricultural Practices
	BRC	BRC Protocol, Packaging standard safety and quality guidance
Importing firm's requirements	Other retailer's protocol	Global Food Safety Initiative (GFSI); Assured produce scheme (APS); Mark and Spencer's farm to fork; Tesco's nature choice; Shoprite
Consumers' preference	Fair-trade labeling	Fair-trade Labeling Organizations International (FLO) Standards
International conventions, code of conduct, guidelines	EU/USA/FAO/ CODEX	Hazard Analysis Critical Control Point (HACCP)
Individual firm schemes		Tesco Nature's Choice; Carrefour Filière Qualité
Collective national schemes		Assured Food Standards; British Retail Consortium Global Standard – Food; QS Qualitat Sicherheit; Label Rouge; Food and Drink Federation/British Retail Consortium Technical Standard for the Supply of Identity Preserved Non-Genetically Modified Food Ingredients and Product
Collective international schemes		GlobalGAP; International Food Standard; Global Food Safety Initiative; ISO 22000: Food safety management systems; ISO 22005: Traceability in the feed and food chain and Safe Quality Food (SQF) 1000 and 2000.

Source: Adapted from WTO, 2007

traceability[24], using quality inputs, potable water and laboratory compliance and audit (Table 8.3). This also includes standards for cleaning of packaging crates and their storage under cover. Other requirements are training of new workers, bathroom cleaning, pre-harvest checks, and sterilizing harvest equipments. All food contact surfaces should be clean, smooth, non-porous and non-toxic. Harvest technique needs to be improved. Efforts are needed to remove dirt or mud from the products being harvested. Packing houses need to be enclosed and securely closed while not in use. Notable standards developed and supported globally include GAP, GVP, GMP, HACCP and QM. At the country level, either these standards are adopted as they are or appropriate standards are developed based on these popular standards. Importantly, products need to be inspected, tested and certified for residues, contaminants and microbiological content. These standards require additional costs of expert services, increased labour, more expensive inputs, better handling of inputs and outputs at micro level. Other micro level cost items include costs for administrative control, inspection, testing and certification, changes in production technology, reduced volume of marketable product due to sorting and delays in marketing caused by the compliance procedures, particularly waiting period. It is obvious that the micro cost varies from farm to farm.

The macro-level requirements mostly fall under the domain of the public sector. These requirements include suitable legislation and standards, provisions for registration, and licensing and monitoring. Also required are the declaration and maintenance of pest or disease-free areas and verification and certification of biological materials. Basic and long term research is also the responsibility of the public sector. Laboratory accreditation, quarantine control, epidemiological surveillance, and notifications to international bodies are further responsibilities of the public sector for food and agriculture quality improvement. Additional costs are incurred in conforming to valid regulations of importing countries such as the costs of enacting legislation, developing and upgrading physical infrastructures, training of staffs, inspecting and testing of process and products, and applying quality and quarantine control mechanisms necessary for compliance.

Table 8.3: Micro and macro costs of compliance

Micro (enterprise level) requirements	Macro level requirements
a) Standard adoption, recording for traceability, laboratory compliance and audit, laboratory accreditation	a) Develop appropriate legislation and standards
	b) Inspect and provide license to food establishments
	c) Register and control feed, agro-chemicals, antibiotics, hormones
	d) Monitor application of GAP, GVP, GMP, HACCP, QM and traceability by farm and enterprises
b) Apply GAP, GVP, GMP, HACCP, and QM (costs of expert services, increased labour, more expensive inputs, better handling of inputs and outputs).	e) Develop and maintain pest or disease-free areas
	f) Verify and certify biological materials (seeds, semen)
	g) Verify and certify agro-food imports and exports for risks
	h) Report possible hazards to trading partners
	i) Conduct basic research, diagnosis, and analysis
	j) Accredit laboratories and veterinarians and other third party entities for official duties
c) Establish and maintain traceability.	k) Develop and apply quarantine procedures, including for emergency situations
	l) Carry out epidemiological surveillance and information management
d) Get the products inspected, tested and certified for residues, contaminants and microbiological content.	m) Notify WTO and trading partners on new SPS measures
	n) Participate in international standard-setting processes
	o) Establish information, surveillance and alert systems to monitor pests, diseases and pesticide residues, and outbreaks of food borne diseases and food borne contaminations.
e) Deal with non-complying products including recalls, rework, destruction, etc.	p) Early warning and surveillance systems enable to detect problems in time so that food borne diseases and contaminants are prevented from spreading along the food chain.
	q) Develop and maintain recall systems to deal with incidents and emergencies.

Source: Author's compilation

[24] All produce units leaving the farm must be traceable by date, farm name and harvest location.

8.3.3 Assessment of gaps

Table 8.4 summarizes prominent gaps – and hence the source of hazards – for three selected products - ginger, tomato and milk. Gaps are listed under four categories – food safety standards, animal health, plant health and environmental pollution. Similar tables are useful for other food products also. These gaps in food safety and quality, animal health, plant health and environment emanate from several identified and unidentified hazards. The major food safety hazards from ginger and tomato are pesticide residues and mycotoxin exceeding the maximum residue limits (MRL). Rhizome rot is a major threat to plant health of ginger. Similarly, the major food safety hazards from milk are residues of hormones and antibiotics exceeding the MRL and adulteration and contaminants. Transboundary and other animal diseases are the major hazards for animal health. The environmental gaps originate from hazards of pollution through pesticides and other chemicals. All these gaps require response measures and interventions.

8.3.4 Measures for responding to the gaps

Several farm level measures are suggested to close the gaps between what are desirable, i.e. the biosecurity requirements, and the existing practices. These measures include farm registration, record keeping, traceability system development, changes in production and handling practices and laboratory testing. Also needed are personnel hygiene and training of farmers and farm labourers. For crops like ginger and tomato, additional measures include using well decomposed manures and respecting "waiting periods" for harvesting after the application of pesticides. In addition, careful harvesting and handling, grading the produce, use of right packaging materials and laboratory testing for pesticide residue are other essential responses.

For milk, in addition to the general measures above, animal identification is necessary for traceability and insurance. There is a need for a provision of quarantine to newly procured animals. Improvements are needed in housing and fencing. Similarly, herd health management and ectoparasite control are necessary. For all this, the dairy farmer should have a disease control plan at the farm. For quality control of milk, a milking machine, milk cooling and water quality testing facilities are required. The milk from sick or animals treated with antibiotics needs to be withdrawn during the course. Laboratory testing of milk for residues of antibiotics and other veterinary drugs helps assure consumers of the milk quality.

8.3.5 Quantification of the costs of compliance

The COC are presented below on per unit of production basis. The results are presented separately for crops and livestock.

8.3.5.1 Costs of compliance to GAP in crops

The estimated COC and its breakdown are presented in Table 8.5 for ginger and tomato. The farmers in Nepal generally grow ginger and tomato is small areas. For the purpose of estimation of the COC, an area of 0.10 ha of land is used as the basic unit for each crop. Under this area, based on the national

Table 8.4: Gaps observed in selected products at the farm level

Product	Gaps on food safety standards	Gaps on plant health	Gaps on animal health	Gaps on environmental pollution
Ginger	MRL of rhizome treatment pesticides on harvested mother rhizome; Mycotoxin tolerance levels; Produce traceability requirements	Rhizome rot control		Contaminants including soils
Tomato	MRL of pesticides; Contaminants; Mycotoxin tolerance levels; Produce traceability; requirements	Fungi control		Pesticide residues and leaching of chemical fertilizers
Milk	MRL of antibiotics and hormones; Milk withdrawal; Adulteration for altering pH level; Control of zoonotic diseases; Microbiological standards; Produce traceability requirements		Disease surveillance; Control of animal diseases (FMD, rabies, etc); Control of Transboundary Animal Diseases (TAD); Quarantine diseases	Effluent from dairy plants

Source: Author's compilation

Table 8.5: Costs of compliance for biosecure production of ginger and tomato

	Biosecure measures	Life (year)	Present status	Present costs (NPR)	Additional costs of compliance to GVP (NPR)	Ginger additional costs (NPR/kg)	Tomato additional costs (NPR/kg)
1	Farm registration (fee and other costs)	1	Not applied	0	500	0.40	0.29
2	Using well decomposed manures and tested urines	1	Partially	0		0.10	0.10
3	Crop loss due to safe use of pesticides @5%	1	Not applied	0		1.85	0.84
4	Wait for harvesting after the application of pesticides	1	Not applied	0		0.00	0.22
5	Additional labour costs for careful harvesting and handling @10%	1	Not applied	0	400	0.32	0.23
6	Cleaning the produce	1	Not applied	0		0.90	0.45
7	Discarding products contaminated with animal and bird feces	1	Not applied	0		0.01	0.01
8	Grading and withdrawal of deformed produce @2%	1	Not applied	0		0.74	0.34
9	Use of right crates and other packing materials	1	Not applied	0		0.13	0.13
10	Dedicated transportation to market	1	Not applied	0		0.50	0.50
11	Product certification	1	Not applied	0	2500	0.20	0.15
12	Traceability (farmcode and product code)	1	Not applied	0	1,000	0.79	0.58
13	Proper farm record keeping	1	Not applied	0	500	0.40	0.29
14	Irrigation and cleaning water quality testing and quality keeping	1	Not practiced	0	2,000	1.59	1.16
15	Training of farmers and farm laborers	1	Farmers trained, not the workers	0	1000	0.79	0.58
16	Pesticide residue tests (2 samples)	1	Not practiced	0	2000	1.59	1.16
17	Total additional costs					10.30	7.04

Data sources: Acharya, 2013; USAID, 2011; MOAD, 2012; DOA, 2013.

average production, a total of 1,260 kg of ginger or 1,721 kg of tomato can be produced (MOAD, 2012). In 2012/13, farm gate prices of ginger and tomato were NPR 37.00/kg and NPR 16.87/kg respectively. Likewise, the average costs of production for ginger and tomato were NPR 24.21/kg and NPR 5.30/kg respectively (DOA, 2013).

The table shows that the COC for ginger is NPR 9.60/kg, which accounts for 40 percent of the average cost of production. Similarly, the COC for tomato is NPR 6.39/kg which is much higher than the cost of production (NPR 5.30/kg). The major costs are crop losses due to safer use of pesticides, testing for pesticide residues and providing clean water for irrigation and washing. It means that the biosecure

ginger and tomato can be sold at much higher price than in the baseline case. Using partial budgeting method, it can be said that the biosecure ginger can be sold at 26 percent higher price and tomato at 38 percent higher price. Considering the higher threat of pesticide residue in tomato, the larger increment in the case of the biosecure tomato price looks reasonable. Farmers need supports in establishing a system of traceability so that they can easily adopt it.

8.3.5.2 Costs of compliance for biosecure milk production

Following the recommendation of the DLS, a minimum economic size of a dairy farm chosen for the analysis here is a farm with 10 cows. This unit is used for estimation of the COC of milk production to GVP standards. Average milk production per cow as reported from field survey (Chapter 4) is 9.8 litres per day which is much higher than the national average (about 3 litres) because the farms visited in the survey are of a commercial nature. Assuming that a cow on average gives milk for 300 days in a year, the total milk production is 29,400 litres per annum. With the average farm gate price of milk of NPR 29/litre, the annual gross revenue of the dairy farm is NPR 852,600. As said, this analysis is based on partial budgeting, i.e. additional cost to comply with the GVP standards, and not the costs and benefits of the whole dairy farm.

Compliance to all these standards increases the cost of milk production and handling. The estimated cost per litre of milk is presented in Table 8.6. It shows that the total cost of compliance is NPR 8.83/litre, or 30.5 percent of the price of milk. Discussions with dairy farmers gave an impression that this seemed to be unaffordable to them. However, note that 50 percent of the COC is from the cooling device, Ice Bank Tank (IBT). If the public sector can support dairy processing plants to establish chilling centres in accessible distance, the IBT can be avoided, reducing the COC to NPR 4.39/litre, which is only 15 percent additional cost of the present milk price. In other words, if the dairy farmer adopts the GVP, his cost of milk production will increase by this amount and, assuming everything else remaining the same, consumers pay 15 percent more for biosecure milk.

8.4 Discussions

Compliance by smallholder farmers in Nepal is much more challenging than those by large commercial farmers. Farming in Nepal is essentially small scale, for a number of reasons such as small land holding (0.68 ha per farm), fragmentation of holdings (3.2 parcels per holding), heterogeneous land properties and undulating topography. The COC analysis above essentially shows that the adoption of international standards is clearly unaffordable by individual smallholder farmers. Still, the fact remains that smallholders also must somehow comply with safe production processes and related SPS measures and standards. In a supply chain context, it becomes essential that good practices are followed at the farm level for improving standards in subsequent stages of the chain. Thus, the basic reality of the market is that smallholders do also need to invest for compliance at the farm level.

The estimates of the COC show that compliance increases the costs of production somewhere from 40 to 100 percent depending on the product. This means substantial rises in farm gate prices. Literature shows that growers face high initial investment costs in constructing and upgrading basic structures such as toilets, stores, shelters, offices and pesticide stores that need to meet set specifications (UNCTAD, 2005). In the literature on compliance, one concern expressed across the developing countries is that increased SPS standards which invariably adds to cost, lead to a cost-price squeeze of smallholder farmers, elevating the risk of their exclusion from the rapidly growing higher-segment markets, which include export markets. It is not just the mandatory import regulations/standards (e.g. the SPS) but also, and increasingly, voluntary standards of supermarkets and importers.

What is important for financial sustainability of compliance is that the increased quality of the products should be able to fetch higher prices to the farmers. If market price does not increase to sustain the good practices, small farmers become more uncompetitive. Nepalese farmers are disadvantaged in that market price may not rise due to the porous border with India and free trade across the border. The same is the case with exports, especially exports to India as the price Nepalese farmers receive is given by that market. Thus, it is very important that there is a market mechanism that ensures that the biosecure products are somehow certified and sold as differentiated and better products at premium prices. Price transmission to the farm gate price

Table 8.6: Costs of compliance for biosecure milk production (for a farm of 10 cows)

	Biosecure measures	Life (years)	Present status	Present costs (NPR)	Additional costs of compliance to GVP (NPR)	Additional costs (NPR/Litre)
1	Farm registration (fee and other costs)	1	Not applied	0	500	0.02
2	Animal identification (tagging)	5	Not applied	0	2,000	0.01
3	Traceability (farmcode and productcode)	5	Not applied	0	1,000	0.01
4	Provision of quarantine to newly procured animals	20	Not applied	0	500,000	0.85
5	Housing/shed	20	Not proper	118,000	232,000	0.39
6	Fencing and gate	20	Not proper	300,000	400,000	0.68
7	Herd health management (vaccination, treatment and fees to technicians)	1	In practice, but not enough	3,680/per case	13200	0.45
8	Ectoparasite control	1	In practice	2,000/animal/year	0	0
9	Diseases control plan in the farm	1	Only vaccination done	10/animal+ fees of technician	1000	0.03
11	Personnel hygiene (specific clothing and footware in the farm)	1	Not practiced	0	2,500	0.09
12	Proper farm recording keeping	1	Only milk recording	200/year	2,050	0.07
13	Forage and fodder	1	In practice	20/kg	0	0
14	Balanced/concentration feed	1	In practice	27/kg	0	0
15	Milking machine	10	Not in use	0	150,000	0.51
16	Milk cooling (Ice Bank Tank 1000L, shared use, 75% capacity utilization)	10	Traditional methods used	0	1,000,000	4.44
17	Regular water quality testing and quality keeping	1	Not practiced	0	2,000	0.07
18	Withdrawal of milk for 9 days from the cows treated with higher antibiotics (if each cow is treated once a year)	1	Not in practice	0	35,280	1.20
19	Training of farmers and farm laborers	3	Farmers trained, not the workers	0	1000	0.01
20	Lab Testing of milk (2 samples/year)	1	Not in practice	0	1300	0.04
21	Total additional costs					8.83
22	Total additional costs without IBT					4.39

Source: Basic costs data from Sedai 2013.

needs a competitive market. A competitive market with large number of buyers of the farm products can transmit the premium price to the farmers. Enough compensation for covering the COC makes the biosecurity measures incentive compatible to the farmers and other agro-food supply chain actors. Participatory Guarantee System (PGS)[25] developed by International Federation of Organic Agriculture Movements (IFOAM) can be used as a mechanism to develop confidence among the consumers and make direct linkages between the producers and consumers in local market. This locally administered mechanism reduces the costs of certification and makes the adoption of biosecurity practices incentive compatible encouraging farmers for their adoption.

[25] PGS is a locally focused quality assurance system which certifies producers based on active participation of stakeholders and is built on a foundation of trust, social networks and knowledge exchange.

Literature on the estimation of the COC is scanty. The major challenge in these estimations is the multitude of technical requirements with different procedures of conformity assessment. The World Bank surveyed the COC of high-value food products to EurepGAP standards for animal products in Ethiopia, fish and spices in India, non-traditional agricultural exports in Jamaica, fish and horticulture in Kenya, animal products in Latin American Southern Cone, fruits and vegetables in Morocco, shrimp in Nicaragua, fish and groundnuts in Senegal, and shrimp and horticulture in Thailand, quantifying the costs incurred by both the public and private sectors (Aloui and Kenny, 2004). According to Tatter et al. (2001), EurepGAP standards are high and its protocol can restrict trade of agricultural and food products and their enforcement can escalate trade barriers, undermining the benefits from bilateral and unilateral trade agreements.

Compliance to SPS measures and implementing a certification standard can be taken at different levels – at the individual farm, farmers' group or cooperatives, packing house and export. The individual farm can improve the production situations for the compliance. Likewise, farmers' groups or cooperatives can do collective actions for making their products biosecure. Packing houses that prepare for export need to comply with the SPS and standards chosen by the importing country. Packing house is a convenient point to monitor and inspect for certification bodies and SPS auditors. Once the packing of the products is done with full compliance, there is little risk of contaminations to occur after this. Similarly, exporters can play a major role in matching the quality of the product to the requirements of the destination market. They can even change the final destination of the products. The exporters can set certain standards for private packing houses and cooperatives. Understanding the COC to biosecurity can help to identify the role of intervention from the public sector delineating a scope for public policy. The quantification of compliance costs gives the baseline picture and helps in obtaining external supports for public and private sector compliance with international standards (UNCTAD, 2005). Channelling the limited resources from the public and private sectors to the most critical points in the agro-food supply chain can increase resource use efficiency along with the compliance to biosecurity.

Table **8.**7 presents relationships between the levels of biosecurity standards on the one hand and various costs and COC on the other. It shows that as the level of standards is raised, food cost increases, food safety related health cost decreases and export increases but at a cost of compliance.

It is clear by now that adoption of biosecurity increases the costs of production. If the increased cost is recouped from the increased market price of the safe products, awareness building and technological intervention would be enough. While some recovery could also come from increased volume of exports as the product becomes safer and better in quality, what is crucial is consumers' willingness to pay (WTP) and an efficient market to pass the premium price paid by the consumer to the farmers. Under a competitive market, the extent to which the compliance cost is partially or fully transferred to consumers depends on nature of the market and price elasticity of the demand. It is easier to pass the costs to consumers under inelastic demand situations than when demand is price elastic. As most of the food products are essential commodities and thus largely inelastic, most of the incremental COC tend to pass to consumers.

Biosecure agriculture also generates positive externalities throughout the economy. Thus, non-compliance to biosecure practices by a segment of producers also reduces those good externalities. For this reason, non-compliance due to higher costs is not just a private issue for a segment of farmers (i.e. smaller farmers) but also a matter of wider concern

Table 8.7: Cost implications of different levels of standards

	Level of adoption of Biosecurity	Food cost	Health costs	Export	Cost of compliance
1	Base level (business as usual)	Low	High	Low	No
2	Low level of standard	Medium	Medium	Low	Low
3	High level of standard	High	Low	Medium	Medium
4	International standard	High	Low	High	High

Source: Author.

for society as a whole and thus a matter of public policy. For this reason, there is a strong rationale for public policy to find innovative ways of reducing the COC in general and for the small holders in particular. Towards that goal, one could start with more obvious responses such as empowerment of the farmers with awareness, access to information and availability of the government services at the farm gate level. Many farmers are not aware why their produce is not fetching good price in the market and what are the measures required to increase the acceptability of their produce in the local and international markets. The level of awareness and understanding of the compliance measures can help the farmers plan better for the compliance. All background studies under this biosecurity project make this point – there is simply a serious lack of awareness among farmers about these issues, i.e. desirable good practices and standards, COC, availability of technology and options, and so on. For example, some farmers may have awareness that pesticide is damaging to the health, but they have little idea of the safer substitutes. Simply providing this information could reduce COC.

The coverage of the public technical staffs in the field is low, and so alternative ways of reaching them have to be found. An example is the development of group certifications for producers or cooperative-based certification which increases the volume of transactions of the certified products as well as reducing per unit costs. Group certifications also have other benefits in terms of the group managing own internal controls, better marketing channels and the advantage of volumes for procurement of raw materials and inputs as well as for group activities towards transportation, storage, processing and sale of final produce. Developing regional linkages on good practices and sharing experiences on compliance matters are other useful measures. Experiences of countries such as India, Bangladesh, and those from the ASEAN area could be valuable for assisting farmers in Nepal. Trade encourages farmers to upgrade standards and also recoup the costs, and thus re-orienting farm production systems to trade and facilitating trade are important responses to reduce the COC.

8.5 Conclusions

The study developed a framework for estimating the costs of compliance (COC) to biosecurity measures. The empirical application of the framework at the farm level demonstrated a significantly high COC for the smallholder farmers. One conclusion from this analysis is that if left unsupported, the smallholder farmers with small scale of production and high per unit costs cannot bear the full COC unless they receive premium price for their products. To receive a premium prices at least two conditions should be met. First, consumers at domestic and export market should be willing to pay a premium price for safer products. Second, premium price paid by the consumers should get transmitted to the farm gate price.

Willingness of consumers to pay for a premium price depends on quality of the product and quality assurance which needs certification and labelling. Quality assurance is still more difficult for export market which requires three sets of conditions: SPS measures of the importing country, quality requirements of supermarket chain and preference and tastes of consumers.

Adoption of good practices by the farmers is necessary for supply of safe farm products. For ensuring the adoption of good practices by farmers, there is a need for legislations, management protocols, institutional capacity and infrastructures to support producers and exporters. Farmers and agro-entrepreneurs need access to biosecurity-related scientific and technical expert services and financial resources to reduce economic losses and meet market and export requirements. It is clear that smallholder farmers cannot themselves afford individually for registration and compliance to international standards. The small scale of the production makes it very difficult for individual farmers to get their products tested and certified from international certifying agencies. Empowerment and organization of the farmers for group-based implementation and certification can also reduce the COC to farmers per unit of produce. Packaging houses, and domestic and external traders can take over responsibilities for internal control system and third party certification helping the farmers reduce per unit cost of compliance. It is essential that these actors of the supply chain should have the supply of biosecure farm products from farmers for which they need to pay more.

There is a clear need for technical assistance for developing a market assurance system including certification and traceability that can reduce the

COC and benefit agro-food supply chain actors by expanding the volume of business and linking them to high income market segments.

The study developed a framework for estimating the COC to biosecurity measures that can be replicated to other stages of the supply chain, other agricultural products, and in other places. The analysis presented is, of course, based on limited case studies and so there will be a wide variation of the COCs across the product, region, country, as well as depending on the standards used.

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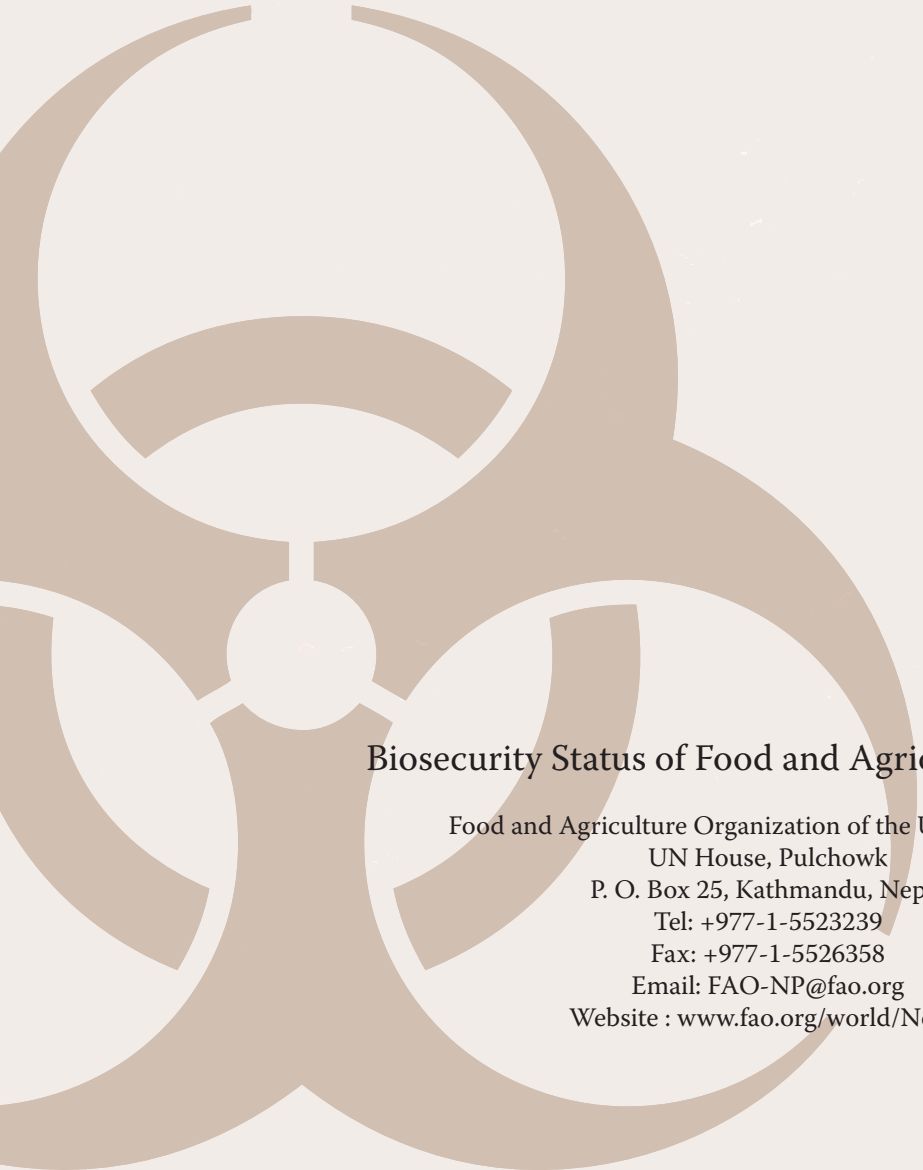

Biosecurity Status of Food and Agriculture in Nepal

Food and Agriculture Organization of the United Nations
UN House, Pulchowk
P. O. Box 25, Kathmandu, Nepal
Tel: +977-1-5523239
Fax: +977-1-5526358
Email: FAO-NP@fao.org
Website : www.fao.org/world/Nepal