FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Loading goats at Khasibazar, Kalanki; Photo credit, R. Lamichhane.

FEED THE FUTURE
BUSINESS DRIVERS FOR FOOD SAFETY

Cooperative Agreement No. 720BFS19CA00001

NEPAL FOOD SAFETY SITUATIONAL ANALYSIS

(Nepal FSSA)

December 2021

USAID
FROM THE AMERICAN PEOPLE

www.feedthefuture.gov

Food Enterprise Solutions

Food Enterprise Solutions. (2021). *Nepal Food Safety Situational Analysis*. Food Enterprise Solutions: Arlington, Virginia, United States.

Acknowledgements
This work was produced by Feed the Future Business Drivers for Food Safety (BD4FS), funded by USAID and implemented by Food Enterprise Solutions (FES). FES created the "Food Safety Situational Analysis" as a conceptual framework that reviews and analyzes the food safety conditions (hazards, risks, drivers, impacts) of a country. FES wishes to thank all the FES staff, consultants, businesses, government agencies and other individuals that participated in this effort.

EXECUTIVE SUMMARY

Food Enterprise Solutions (FES) implements a private sector-driven food safety strategy in Nepal through Feed the Future Business Drivers for Food Safety (BD4FS), an economic development activity co-created with, and funded by, the United States Agency for International Development (USAID). This food safety strategy is executed through a five-step D-5 approach[1], and the current report, the Nepal Food Safety Situational Analysis (FSSA), is part of the first Discovery step that will inform a subsequent Design step.

The Nepal FSSA was done through desk reviews and targeted interviews of food business owners in two distinct "production to consumption" corridors of Nepal. Due to COVID-19 lockdowns imposed by the Government of Nepal and associated risks of infection to study members and respondents, broader stakeholder engagement and full interviews were postponed until regular activities were safe to resume. This phase was subsequently launched in December 2021 as "Nepal FSSA Phase 2." However, because of the clear impact of the global pandemic on Nepal's food systems, the team conducting this first phase of the FSSA prepared a parallel report on the impacts of COVID-19 on food businesses, and the mitigating measures taken by the business owners.

A review of existing literature shows a large amount of information available on the food safety situation in Nepal. However, current and in-depth information is not readily available in the context of nutrient-dense, perishable foods in Baghmati Province, specifically the Kathmandu and Chitwan food corridors. This FSSA attempts to fill this gap by exploring various aspects of food safety, including risks and hazards, the regulatory framework and enforcement of laws and standards, the government institutions engaged in food safety, the state of supporting infrastructure, and prevalent market systems and consumer attitudes. Although the overall aim of Feed the Future in Nepal is to improve the food safety of a wide variety of nutrient-dense foods, in consultation with USAID Nepal, BD4FS selected three commodities as proxies for the study - fresh fruits and vegetables, eggs, and goat meat. These commodities represent priority value chains identified by the USAID Mission in Nepal. The FSSA was undertaken in the Kathmandu and Chitwan food corridors in Baghmati Province, the initial geographic focus areas of BD4FS to understand better the food safety situation in the country.

Nepal's regulatory framework is a few decades old, but the recent release of the National Food Safety Policy of 2019 and the Food Hygiene and Quality Bill of 2020 indicates signs of improvement. The enforcement of standards, laws, and policies remains very weak, however. The FSSA interviews revealed growing commitment towards food safety by large, medium, and formal small-sized food businesses, resulting in part from increasing pressure to address food safety issues by discerning consumers. While large-sized businesses have in-house food safety systems, formal small- and medium-sized food businesses lack resources and knowledge to tackle these issues. A commitment to food safety is less clear among informal micro-businesses, food kiosks, and food hawkers that mostly cater to consumers who prioritize food price over quality in their buying decisions. Further, as the demand for temperature-controlled food is increasing at a slow pace, the growth of cold chain capacity is likewise gradual.

Through this FSSA, BD4FS observed three different retail practices with different levels of interest in food safety: (1) conventional retail stores, kiosks, and informal businesses that are less interested in food safety; (2) large retail supermarkets; and (3) on-line trading food businesses that are very interested in food safety with customers who are willing to pay extra for quality. The latter two segments of the market are still very small, but they are rapidly growing due to increasing awareness of the importance of food safety. While large- and medium-sized food businesses borrow from banks, most of the small firms borrow from relatives, informal sources such as savings and credit groups, and use personal savings to finance working capital.

---

[1] Created by BD4FS Technical Team in partnership with local stakeholders, "D-5" is a 5-step approach: discover, design, deploy, document, and disseminate. Further information can be found on: https://agrilinks.org/activities/business-drivers-food-safety

This study presents some key recommendations for consideration at the food enterprise and food systems levels to further the agenda on improving the food safety of nutrient-dense, perishable foods in Nepal.

CONTENTS

FIGURES AND TABLES

LIST OF ACRONYMS

ADB	Asian Development Bank
AI	Avian Influenza
APLAC	Asia Pacific Laboratory Accreditation Cooperation
BD4FS	Business Drivers for Food Safety
CBS	Central Bureau of Statistics
CRD	Chronic Respiratory Disease
DCA	Direct Credit Assistance
DFID	UK's Department for International Development
DFTQC	Department of Food Technology and Quality Control
DLS	Department of Livestock Services
DOA	Department of Agriculture
DoAD	Directorate of Agriculture Development
DoLFD	Directorate of Livestock and Fisheries Development
EDCD	Epidemiology and Disease Control Division
ENPHO	Environment and Public Health Organization
FAO	Food and Agriculture Organization
FES	Food Enterprise Solutions
FFV	Fresh Fruits and Vegetables
FSSA	Food Safety Situation Analysis
GAP	Good Agriculture Practice
GFB	Growing Food Business
GoN	Government of Nepal
GVP	Good Veterinary Practices
HACCP	Hazard Analysis and Critical Control Point
I/NGOs	International/Non-Government Organizations
IBD	Infectious Bursal Disease

LIST OF ACRONYMS

ILAC	International Laboratory Accreditation Cooperation
INFOSAN	International Food Safety Authorities Network
IPM	Integrated Pest Management
KFVM	Kalimati Fruits and Vegetables Market
MOALD	Ministry of Agriculture and Livestock Development
MoFAGA	Ministry of Federal Affairs and General Administration
MoHP	Ministry of Health and Population
MoICS	Ministry of Industry Commerce and Supplies
MOLMAC	Ministry of Land Management, Agriculture, and Cooperative
NABL	National Accreditation Board for Testing and Calibration Laboratories
NARC	Nepal Agriculture Research Council
NARI	National Crop Research Institute
NAST	Nepal Academy of Science and Technology
NBSM	Nepal Bureau of Standards & Metrology
ND	Newcastle Disease
NRB	Nepal Rastra Bank
NS	Nepal Standard
NTMs	Non-Tariff Measures
RIBB	Research Institute for Bioscience and Biotechnology
SOW	Scope of Work
SPS	Sanitary and Phytosanitary Measures
UK	United Kingdom
UQSR	Universal Quality Standard Registrar
URS	United Registrar of Systems
US	United States
USAID	United States Agency for International Development
USD	United States Dollar
USDA	United States Department of Agriculture
WTO	World Trade Organization

OVERVIEW

1.1. Background

Food safety is a significant issue in Nepal. Various assessments have reported that Nepal's food safety regulations are outdated, testing laboratories are not adequately equipped, food safety communication to producers is poor, setting of standards is inconsistent, and compliance is modest (USDA, 2018; Bajagai, 2012). In fact, food safety concerns exist from use of farm inputs, growing and harvesting practices, to moisture and temperature control during storage, distribution, and transportation, as well as contamination all along the supply chain (Varyvdoa et al, 2021). A recent FAO 2018 report indicates that the main food safety challenges in Nepal include (a) lack of compliance in terms of Good Agricultural Practices (GAP), Good Hygiene Practices (GHP), and Good Manufacturing Practices (GMP); (b) non-existent or weak control overuse of pesticides and veterinary drugs resulting in residues in agricultural produce and animal products, minimal regulation of food additives, and failure to control mycotoxins in certain human foods and animal feeds; and (c) poor hygiene and sanitation infrastructure and practices in food markets, retail, restaurant, and catering sectors (FAO, 2018). The recent devolution of state authorities to state and local governments in Nepal has further complicated the situation.

At the request of the USAID Nepal Mission, USDA conducted research in Nepal in 2017/18 to assess the existing food security issues and provide a roadmap towards the development of a sound, modern sanitary and phytosanitary (SPS) system that would help promote agricultural exports and open investment opportunities (USDA, 2018). While the main purpose of this USDA study was to better enable the country in regional and international trade, the efforts would also contribute to improving domestic consumption of safer foods. The USDA report suggested that the government focus on four measures, including standards setting, proper sampling and testing that reflects actual food safety risks, strengthening food testing and analysis capacity, and proper communication to producers on food safety. Additionally, various international agencies have helped the government of Nepal to conduct studies and produce reports and guidelines (SSG and Chemonics, 2015; IFC, 2014; ADB, 2019; FAO, 2018; USDA, 2018, DFID, 2020). However, the implementation and follow-up from these reports have been mostly delayed or not prioritized.

Improving Nepal's food safety situation is a daunting task, and government efforts alone will not be enough to facilitate the uptake of food safety practices at the private sector level and build a "food safety culture". Both government and the private sector need to work hand in hand along with the development sector, civil society, and the public. To fulfill this gap, Food Enterprise Solutions (FES) co-created with USAID the Feed the Future Business Drivers for Food Safety (BD4FS) project, which aims to improve food safety in the domestic market by leveraging the initiatives of the private sector.

As food moves from producers to consumers through aggregation, packaging, storage, transportation, wholesaling, and retailing, it is susceptible to contamination and spoilage that contribute to the incidence of foodborne diseases. In food supply chains, various micro-, small-, and medium-sized food enterprises function and possess the capacity to reduce food contamination. BD4FS aims to strengthen the ability of Growing Food Businesses (GFBs)[2] and help them become agents of positive change. By investing in GFBs, BD4FS will better understand the mechanisms of "pulling" food safety standards in the food systems more broadly. The expected results will be enhanced food safety, reduced food waste and loss, improved business investments and profitability, and overall improvements in providing safer food and nutrition security especially for the more vulnerable populations such as women, children, and the elderly.

[2] *For the purpose of this assessment, a Growing Food Business is defined as a micro-, small- or medium-sized firm engaged in the Nepalese food sector, with good potential for growth in terms of volumes and innovation, among others.*

FES created and deployed a BD4FS five-step approach called the **D-5 Approach**: (1) **Discover** - holding cocreation meetings with USAID Mission to prepare and undertake a Food Safety Situational Analysis (FSSA) to identify food corridors, business constraints and opportunities, and potential GFBs to partner with; (2) **Design** - reviewing FSSA findings with USAID and other key actors in the system, and partnering with lead GFBs to cocreate food safety interventions that are specific for each context; (3) **Deploy** - implementing with partner GFBs the codesigned solutions for improved food safety and regularly reviewing and adapting with the partner GFBs; (4) **Document** - monitoring, evaluating, and documenting outcomes in terms of increased use of food safety practices; and (5) **Disseminate** - producing technical reports, highlighting successes and lessons learned, to share findings with local partners, USAID, and other food system actors.

As the first step of the D-5 Approach, FES conducted the Nepal FSSA, which was designed with the following three components: (1) a desk review including a literature review and secondary data collection; (2) field observations by collecting primary data through observations, key informant interviews and focus groups; and (3) stakeholder engagement by working with local GFBs and other stakeholders to validate the findings of previous two steps and to codesign interventions. However, due to various constraints posed by the spread of COVID-19 in Nepal, this assessment focuses primarily on the desk review and some primary data collection through in-depth key informant interviews. Special safety measures were taken to conduct in–person interviews. In addition, realizing the severe impacts of COVID-19 on food businesses, the study team explored the dimensions and extent of the impacts and the adaptive measures undertaken by food businesses. Those findings are presented in a separate report, *A survey on COVID-19 challenges and responses among Nepalese food businesses*.

While a large amount of published literature on food safety issues in Nepal by aid agencies, Nepal government, and private sector exists, there is a need for in-depth information on the food safety landscape in the context of nutrient-dense, perishable foods. This information is critical to the design and implementation of BD4FS interventions. This study aims to fulfill this gap by exploring the risks and hazards related to nutrient-dense perishable foods, regulatory framework in the country, government institutions engaged in food safety, state of food safety infrastructure, and market systems.

1.1.1. Rationale for selecting fresh fruits and vegetables, eggs, and goat meat for the FSSA

BD4FS aims to improve the food safety situation of perishable, nutrient-dense foods. To focus efforts, the FSSA team selected three commodities that are important to Nepal and priority value chains of USAID Nepal: fresh fruits and vegetables (FFV), poultry eggs, and goat meat. The study employed a food systems approach for each of these commodities to generate the depth of insight needed for the success of BD4FS. A food systems approach investigates place-specific clusters of all food actors and institutions engaged in producing, processing, distributing, and selling foods, and in the case of BD4FS, this entails all actors and institutions from post-farm-gate to pre-consumer segments of the chain.

Although the overall aim of Feed the Future in Nepal is to improve the food safety of a wide variety of nutrient-dense foods, together with USAID Nepal, BD4FS selected these three commodities to serve as proxies for understanding the food safety landscape. These commodities represent priority value chains identified by the USAID Mission in Nepal (USAID, 2018).

Goat meat: The most preferred meat in Nepal

Goat meat is the preferred meat of many Nepalese consumers and is one of the main dishes served in households, restaurants, banquets, and hotels. On average, a traditional butcher sells about 15 to 100 kilograms of fresh goat meat in a day, and there are such butcheries on nearly every corner of the city. Freshly cut goat meat is the consumers' first choice, but frozen and processed goat meat in the form of sausages, *momos* (dumplings), and pickled meat are also becoming popular, especially with younger generations. Middle-class households and migrant returnees are also major consumers of frozen goat meat. Gourmet-Vienna, a frozen food supply chain with its own cold storage, sensors, and refrigerated trucks, sells more than 34 tons of frozen goat meat every year. According to supply chain actors interviewed for the FSSA, the demand for frozen and chilled meat is increasing. Usually, street butchers sell fresh goat meat, and supermarkets like Bhatbhateni, Bigmart, and Valley Cold Store sell frozen and chilled meat.

1.1.2. Rationale of selecting Baghmati Province for the FSSA

For field observations and primary data collection, BD4FS selected two food corridors[3] from Baghmati Province - Kathmandu and Chitwan, including their sub-corridors and food-sheds[4] as the initial geographic focus area. Baghmati Province was selected because of co-creation meetings with USAID Nepal to better understand the food safety situation in the country with Kathmandu and Chitwan food corridors being among the busiest in Nepal. Kathmandu, the capital city of Nepal, is increasingly consuming some of the highest levels of FFV, eggs, and goat meat in the country. A significant amount of these commodities are supplied to Kathmandu from surrounding districts, which comprise the Kathmandu food corridor. In addition, FFV, eggs, and goat meat are imported to Kathmandu from India and other countries. Chitwan is another significant consumption and production center and located in the Terai, along the Nepal-India Border. Chitwan alone produces over 50% of eggs consumed in the country. In addition, key players of nutrient-dense, perishable foods, whether producers and traders or processors and importers/exporters, are concentrated in these two corridors. Despite the significant trade activity in these food corridors, food safety issues abound as evidenced in the USDA SPS study (2018). By focusing on these two corridors, BD4FS explored the food safety challenges of GFBs as part of a complex and robust food system and document the many lessons from the GFBs in these corridors so they may be applied in other parts of Nepal and in other BD4FS countries where applicable. Geographic proximity and accessibility are also important for a sustained engagement with participant GFBs when BD4FS moves to the "Deployment" phase, given the modest resources of BD4FS in Nepal. For more information on the selected food corridors, see section 3.2.

OBJECTIVES AND APPROACH

2.1. Objectives of the FSSA

The overall aim of the FSSA is to support the BD4FS project to help improve the food safety situation in Nepal by working with the private sector. BD4FS intends to mobilize the private sector by identifying and suggesting commercially feasible food safety interventions that GFBs could incorporate in their operations and improve their profitability while providing safer foods. This study hopes to generate relevant and updated information for BD4FS to develop such interventions.

The primary objective of the FSSA was to map the food safety landscape for nutrient-dense, perishable foods, particularly in the context of Kathmandu and Chitwan food corridors, as determined in the co-creation meetings with USAID Nepal. BD4FS accomplished this by:

- Outlining the regulatory framework that guides Nepal's food safety practices.
- Elaborating the roles of key government institutions that operate in the area of food safety.
- Assessing the status of infrastructure for food safety, particularly in Kathmandu and Chitwan corridors.
- Exploring market systems and consumer attitudes towards food safety, particularly in the context of FFV, eggs, and goat meat.

[3] A food corridor is a network of actors created to support territorial food systems. It links food production areas with food consuming cities. These networks are created to generate knowledge and experience, and solutions to the current challenges facing food systems as well as opportunities and learning. Territorial integration is a focus of food corridors, reconnecting proximity of production and consumption through rural and urban food policies. The concept of "corridor" fosters inter-connected solutions for rural and urban areas.

[4] A food-shed is the geographic location that produces the food for a particular population. The term describes a region where food flows from the area that it is produced to the place where it is consumed, including the land it grows on, the route it travels, the markets it passes through, and the tables it ends up on. A food-shed is analogous to a watershed in that foods-sheds outline the flow of food feeding a particular population, whereas watersheds outline the flow of water draining to a particular location.

2.2. Outline of the Study Approach

The FSSA is an exploratory study in which BD4FS used qualitative research approaches to gather and analyze information from secondary and primary sources. BD4FS deployed a five-member technical team with expertise in the following areas: food safety; value chain and enterprise development; financial services; and monitoring, evaluation, and research.

Preceding the field survey, between August 2020 and May 2021, BD4FS conducted an extensive desk review of the literature on Nepalese food safety efforts and initiatives. To complement the literature review, BD4FS collected primary data by interviewing different types of GFBs such as processors, traders including wholesalers and retailers, and transporters. Sixty-one companies were interviewed, 18 percent were female, and 82 percent were male. About 10 percent of them belonged to the age group of 15 to 30 years. Most of the businesses interviewed (45%) were FFV businesses, followed by goat meat (19%) and eggs (10%). In terms of types of businesses interviewed, retailers and wholesalers combined amounted to about half of respondents. Aggregators, transporters, processors, importers, and exporters each comprised between 3 to 5 percent of respondents.

The FSSA team created in-depth interview guides that were used to assess current food safety risks and challenges in the regulatory framework, institutional framework, infrastructure, market systems and consumer attitudes, and in the overall food safety landscape. The team identified relevant and appropriate respondents from the literature and via referral to identify critical issues; the purpose was to collect qualitative information, not to quantify responses. The team tabulated relevant interview data in a master Excel sheet and transferred the data to SPSS software for analysis.

MAPPING THE FOOD SAFETY LANDSCAPE IN BAGMATI PROVINCE

3.1. Introduction

Literature shows that the food safety situation in Nepal experiences several issues (USDA, 2018). Contaminated foods, particularly fresh fruits and vegetables (FFV), eggs, and meat are openly sold through food kiosks and other retail stores throughout Kathmandu and Chitwan. Exported perishable products are often rejected due to poor SPS compliance (Varyvoda et al., 2021; Bhandari, 2020; Kumar et al., 2016). The products that face the highest rejections are processed food, medicinal herbs, and supplements. Import rejections are due to several reasons, possibly related to poor handling of products before shipping, or lack of compliance to regulatory standards in the country of destination. These patterns suggest that the compliance problems faced by Nepal are not commodity-specific but are pervasive across several food sectors. However, food safety is not a new concept in Nepal. As early as 1967, the Government of Nepal passed Food Safety Law. Subsequently, several by-laws, directives, and standards were issued. A USDA report suggests that Nepal's SPS system has several key components in place, however, it also has significant gaps (USDA, 2018). Various international agencies are currently working in Nepal to improve food safety for both local and export markets. This survey revealed that while supermarkets and larger food businesses are supplying much safer foods, the traditional local markets are still dominated by contaminated (biological/chemical) fresh produce such as FFV, eggs, and meats. In terms of laws, rules, and standards, Nepal is making progress but the implementation and enforcement of these laws and standards appear to be the weakest link in improving the food safety situation in Nepal.

By obtaining a current and clear picture of the food safety situation in Nepal, BD4FS will design and implement its interventions, and this landscape mapping aims to fill that gap.

BD4FS explored various elements of food safety in Nepal (Figure 1) focusing on the following: a brief description of the selected food corridors to supply context, the food safety risks and hazards, the regulatory environment, infrastructure for food safety, and market systems and consumer attitudes towards food safety.

Figure 1: Elements of food safety in Nepal. Schematic prepared by the research team.

While mapping this food safety landscape, BD4FS reviewed relevant literature and interviewed food businesses from the Kathmandu and Chitwan food corridors, located in Baghmati Pradesh Province. Mapping of the corridors and identification of key actors in these corridors is foundational information that is specifically relevant to BD4FS. It is noteworthy that several topics covered under the food safety landscape discussion are as applicable to Baghmati province as they are too many areas in Nepal. Nonetheless, the study makes special efforts to explore location-specific issues particularly relevant to Kathmandu and Chitwan corridors.

3.2. Brief Description of Selected Food Corridors

3.2.1. Background of the selected corridors

Kathmandu (total population 2,517,023) and Chitwan (total population 579,984) are major consumption centers of FFV, eggs, and goat meat in Nepal (CBS, 2011). The total consumption of these two cities surpasses the consumption of other major cities such as Biratnagar, Pokhara, Butwal, and Nepalgunj combined.

The Kathmandu and Chitwan corridors are also major food production centers. Chitwan is one of the consistent vegetable suppliers for the major vegetable markets of the country including the capital city, Kathmandu. Chitwan is ranked third among major vegetable producing districts in Nepal, with an annual production of 87,560 metric tons from a 6,369-ha area. Baghmati Province alone produces almost 20 percent of fruits, 17 percent of fresh vegetables, and more than 50 percent of eggs in the country (Table 1).

Table 1. Total Production of Fresh Fruits/Vegetables, Eggs, and Goat Meat.

	Citrus Fruit (MT)	Winter Fruits (MT)	Summer Fruits (MT)	Goat Meat (MT)	Eggs ('000)	Fresh vegetables (MT)
Bagmati Province	59,317	26,195	67,699	11,996	802,562	735,541
Nepal	271,808	115,443	790,289	73,914	1,534,680	4,271,270
Bagmati share	22%	23%	9%	16%	52%	17%

Source: Statistical information on Nepalese agriculture, 2018/19, MOALD, 2020.

The cities of Kathmandu and Chitwan consume more goat meat and FFV than what is produced in the Bagmati province. Hence, FFV and goats (live and processed) are imported into Bagmati from several other provinces.

3.2.2. Production and consumption of Fresh Fruits and Vegetables (FFVs) in the corridors

The main production areas for FFV in the Kathmandu corridor include Kabhrepalanchouk and Dhading districts. Other surrounding areas such as Sindhupalanchouk, Nuwakot, and Makawanpur also produce a significant amount of FFV that is imported to Kathmandu. Kathmandu valley itself (Kathmandu, Lalitpur, and Bhaktapur districts) produces a significant amount of FFV. Kathmandu alone has about 50 percent of the market centers in the province (over 15 centers), and these are major market centers where more than 70 percent of the FFV is sold (Figure 2 and Figure 3).

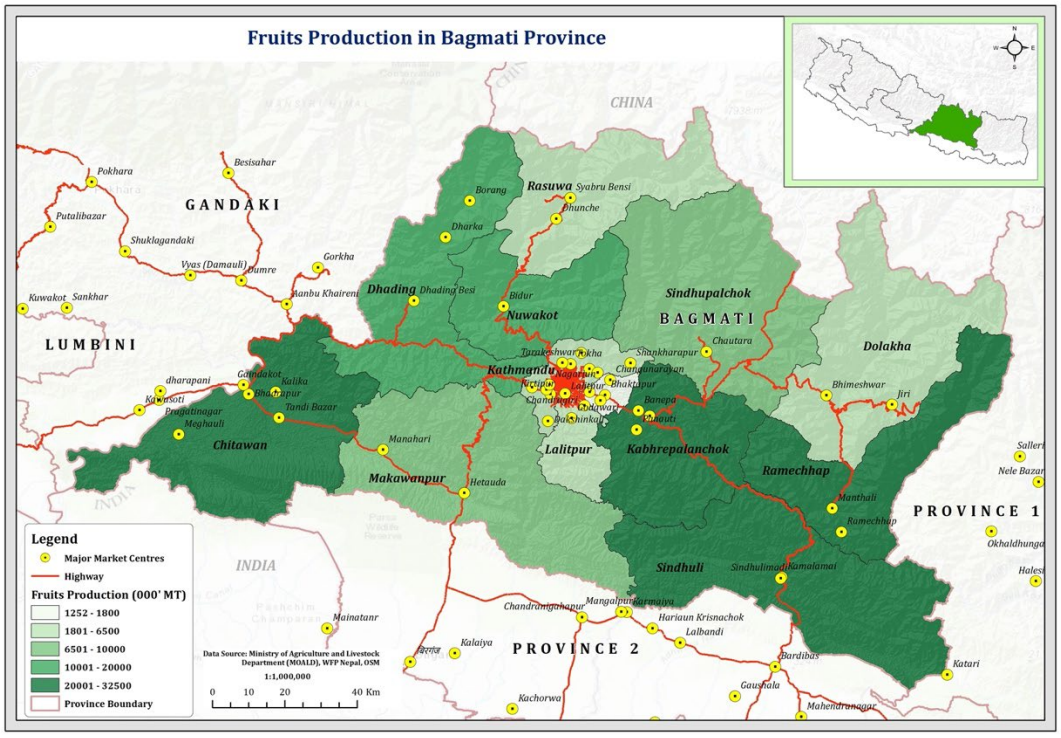

Figure 2. Production of fresh fruits, major market centers, and road network in Baghmati Province.
Source: Map prepared by the research team.

The Chitwan corridor produces a large amount of the FFV needed for the district. It is also supplied some seasonal fruits and vegetables from hilly regions to its north. Chitwan has five (5) major market centers as highlighted in yellow in Figures 3 and 4. Mostly all-weather roads connect these production pockets and market centers. In some cases, they are connected by fair weather

roads, which are operable for about nine (9) months of the year. The flow of FFV from production areas to market centers is generally smooth, except during the rainy season (July-September) when roads can be blocked due to landslides and floods. General strikes and lockdowns (such as lockdowns during COVID-19) are other factors that can interrupt the flow of produce from production to consumption centers.

Nepal exports fruits and vegetables (tomatoes, chilies, cabbage, cauliflowers, garlic, ginger, potatoes, bananas, mangoes, orange, lemons, watermelons) to India and other markets. It also imports fruits and vegetables from India and other countries. As informed by one of the leading fruits importers of Nepal, almost 90 percent of fruits consumed in Nepal are imported from India and China. Nepal also imports almost 30 percent of the fresh vegetables that it consumes. Vegetables like tomatoes, chilies, onion, cabbage, cauliflower, carrots, potatoes, beans, mushrooms, and pumpkins among others are imported in large volumes. Interviews with DFTQC and Kalimati Market officials revealed that the imported fresh vegetables are tested for pesticide contamination in customs entry points by DFTQC and in Kalimati market. As per the managers of Kalimati market, however, these tests do not cover all banned pesticides. In addition, they are not tested for microbial contamination. In cases of processed food items, the DFTQC officials conduct chemical analyses.

3.2.3. Production and consumption eggs in the corridors

In the case of eggs, the Baghmati province is considered self-sufficient as Chitwan district alone produces over 50 percent of the eggs consumed in the country. Despite being the main producer of eggs in Nepal, Baghmati province and the Kathmandu and Chitwan corridors still receive eggs from other districts and other countries. The production centers of eggs are connected to market centers by good roads, and hence the supply is not interrupted except occasionally in the rainy season (Figure 3).

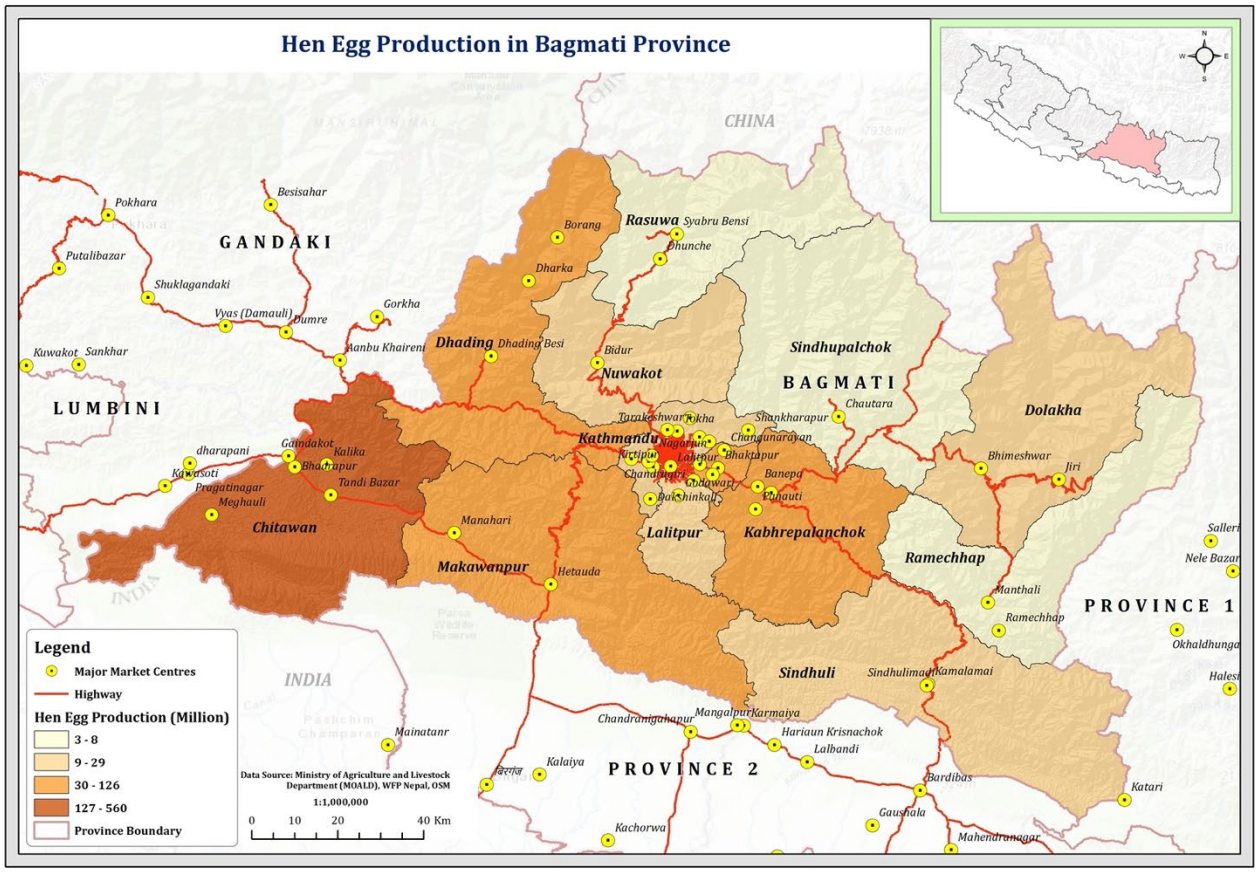

Figure 1: Production of eggs, major markets, and road network in Baghmati Province. Source: Map prepared by the research team.

3.2.4. Production and consumption of goat meat in the corridors

The major producers and suppliers of goat meat to Kathmandu corridor include Sindhuli, Makwampur, Kavrepalanchouk, and Nuwakot districts (Figure 4). There are several major market centers in Kathmandu valley where live goats are supplied. These centers include: the Khashi Baazar- Kalanki, Koteshwor goat market, and the Bhaktapur goat market. Farmers also sell live goats directly to the local butchers or the traders. Retailers like butchers and fresh meat vendors then buy live goats from traders, process them, and sell meat to the customers, hotels, and restaurants. Except for poultry, there are no centralized abattoirs in these markets. "Valley Poultry" has centralized slaughterhouses that sell products mostly through supermarkets. Traders usually bring live goats to these markets by using dedicated commercial vans and trucks. Transporters of food items are required to register, but such registration does not exist specifically for the transportation of goats. Occasionally, goats are transported on rooftops of passenger buses. Goat meat is one of the least processed items, and it is considered fresh when butchers sell it directly to the consumer. Live goats are brought to Kathmandu from as far as Nepalgunj in the west and Dharan in the east (up to 24 hours' drive). Roads connect the production pockets and market centers for goat transport and trade; however, the supply is occasionally interrupted during the rainy season due to landslides and floods. In the Chitwan corridor, the district produces some of its goat supply, but most come from neighboring districts as well as from far-flung areas of the country, as far as 15 to 20 hours' drive. Some of the goats coming to Kathmandu and Chitwan from Nepalgunj come from India.

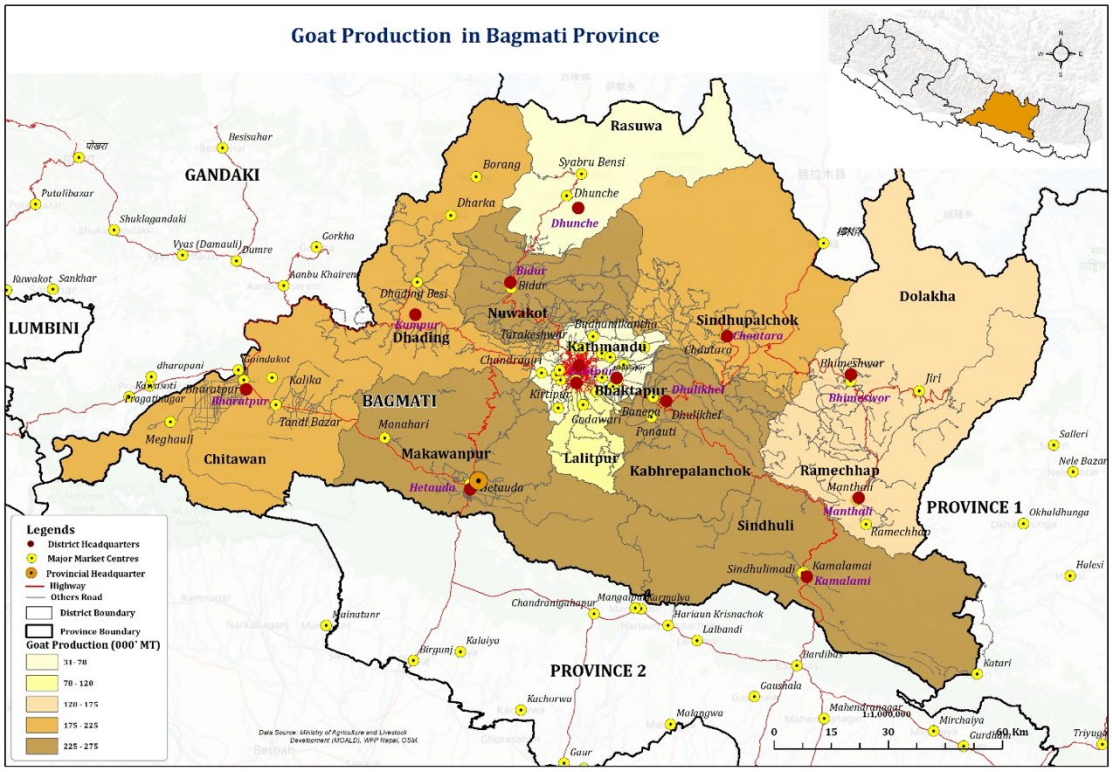

Figure 2: Production of goat meat, major market centers, and road network in Baghmati Province. Source: Map prepared by the research team.

3.2.5. Other key features of FFV, eggs and goat markets in the corridors

Aggregation: Middlemen, local traders, cooperatives, and large farmers collect and aggregate FFVs in collection centers. These centers are situated either at roadsides or at the end of link roads. In the Chitwan corridor, 12 collection centers are operational (AKC Chitwan, 2020). At these collection centers, the fresh produce is traded either under the open sky or under rudimentary sheds without any facilities such as water, electricity, or cold rooms. In the Kathmandu and Chitwan corridors, there are much fewer collection centers for goat meat as compared to those for FFV. Meat goats are generally assembled in local *haat bazaars* (weekly markets), vegetable collection centers, and nearby roads. A Heifer International study showed that goat farmers, schoolteachers, and local goat traders collect goats at the village level and bring them to collection centers (Heifer, 2012).

In poultry farms, eggs are collected, graded, sorted, packed, and supplied to markets on the same day. The Egg Producers' Association plays a key role in collection, price fixing, and distribution of eggs. The association has insured any losses of eggs that may occur during transportation. Farmers that are not associated with the egg producers' association rely on middlemen to collect and sell eggs. The eggs supplied from these farmers are stored at room temperature and take longer to sell, often after a few days compared with those from larger producers.

Nepal has its egg transportation and storage standard promulgated in 2014. The eggs are categorized as feeding eggs, hatching eggs, and specific pathogen free eggs. The eggs should be of three grades: grade A, B, and C. Grading is based on eggshell, egg size, egg weight, and the number of yolks present in the egg. The eggs handlers should wear separate uniforms and boots while handling eggs in the egg farms, egg collection centers, grading and packing centers, and during transportation of eggs. The storing temperature should not exceed 180 C with relative humidity 70%-85%. There is a prohibition on the re-use of egg trays and crates. Each batch of eggs should be well labeled with the name of the poultry farm, type of egg, numbers of eggs in each consignment, dates of egg production from and to, egg packing date, time, and place. Each consignment should be with a certificate from a certified veterinarian ensuring no infectious diseases in the consignment.

Imports and exports: Almost 75 percent of goat meat consumed in the capital is imported from India. Imports have slowed after the Nepalese government made it mandatory for traders to produce a quarantine certificate while importing live goats from India. In urban markets, butchers and cold chain suppliers source both local varieties as well as imported goats from India which are regularly supplied by traders. The imported fresh vegetables are either tested in customs entry points by DFTQC labs or in Kalimati market for pesticide residue.

Key actors in the corridors: Many actors play active roles in bringing FFV, eggs, and goats from production pockets to several market centers and consumers. Aggregators gather these products from villages and bring them to the nearest collection points. Transporters pick up the products from collection centers and bring them to warehouses, wholesalers, or retailers in different market centers; then the products are sold to consumers. In some cases, products are stored in cold storage facilities, especially if there is an over-supply of FFVs and eggs that need to be maintained at a cold temperature to be sold at a later date. Interviews revealed that in a limited amount, FFVs and eggs are exported to India, Middle East, and other export markets. The data on the volume of such exports is not available.

3.3. Current Status of Food Safety

3.3.1. General status of food safety in the country

Foodborne diseases, chemical contamination, epidemics and public health emergencies, and different kinds of hazards and risks compromise the current food safety situation of Nepal. Food safety hazard refers to contamination of food items by agents with the potential to cause adverse health consequences for consumers. Such contamination occurs when food is exposed to hazardous materials. Food hazards may be biological, chemical, or physical, and may be introduced into the food supply any time during production, harvesting, processing, packaging, labeling, transportation, storage, preparation, and serving. While hazards can cause undesirable effects, the risks associated with the hazards indicate the probability of the occurrence of the undesirable effect. Understanding the risks associated with each hazard can dramatically reduce the potential of a foodborne illness. Therefore, identification of food hazards and estimation of associated risks are critical components of food regulatory control systems that aim to ensure food safety and safeguard public health.

Although comprehensive data on etiological agents responsible for foodborne diseases is still lacking in Nepal, various fragmented academic research and reports show that there is enough evidence of prevalence of microbial contamination, mostly attributable to consumption of contaminated unsafe food. In a 2020 study conducted on two very popular meat dishes of Nepal, *Chhoyla* and *Kachela* from Kathmandu valley, high microbial loads of *Coliform, Salmonella, Staphylococcus,* and *Shigella* were isolated (Khanal et al., 2020). Another study conducted on 200 samples of fresh chicken meat from Chitwan showed that 30.5 percent of samples harbored *Salmonella* species, out of which 7.5 percent of the samples showed the presence of *Salmonella typhi*. In the same report, it was reported that 98.4 percent of the isolated *Salmonella* were identified as multidrug-resistant (against cotrimoxazole, ciprofloxacin, tetracycline, gentamicin, and azithromycin) (Adhikari et.al., 2020). Similarly, during the monitoring process of the government's Department of Food Technology and Quality Control (DFTQC) for the year 2018/2019, they

found 3.8 percent of fruit and vegetable products to be substandard according to the national standards prescribed by DFTQC. Out of 1054 samples, 137 samples were collected during one market inspection, and 20.4 percent of meat and meat products were found to be substandard (DFTQC, 2018/19). It has been noted that organisms associated with improper food handling in Nepal include *Salmonella spp.*, *Shigella spp.*, *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, and fecal streptococci (Lawrie, 1998).

While the above-mentioned data shed some light on food safety risks in Nepal, a more accurate estimation of the incidences of foodborne diseases and risk attribution usually come from modeling approaches, which are not available in Nepal. Moreover, there are no systems in place for regular surveillance, diagnostics, and foodborne epidemiological monitoring in Nepal. Recurring outbreaks of diarrhea, 5th highest cause of death, and an abundance of food poisoning cases in the country indicate that the actual number of foodborne disease outbreaks and individual cases are likely several times higher than what is reported by these occasional studies.

The majority of the FSSA respondents suggested that there is no proper centralized system to record and analyze the impact of foodborne illness in the country. The few incidences of foodborne illness presented by the media include wild mushroom poisoning, methanol poisoning, and food poisoning, especially in cultural feasts in rural areas. As data on the impact of foodborne illness are not gathered, analyzed, and disseminated, the general public and the government most likely underestimate the seriousness of food safety issues.

The most common biological and chemical risks and hazards associated with FFV, eggs, and goat meat are listed in Annex 5. The annex also lists the existence or lack of national standards for these foods. For example, the national standard for FFV includes specifications for only 17 FFVs, while there are no national standards for eggs or goat meat.

3.3.2. Hazards and risks associated with FFV

The Nepalese fresh fruits and vegetables are exposed to a number of hazards that exist all along the different nodes of these value chains. Improper use of pesticides in production systems is, most likely, the number one hazard associated with FFVs. In Nepal, pesticide residue hazards caused by pesticide application are due to overuse (unnecessary or ineffective) and more commonly due to misuse (mistakes and inappropriate use). Most of the pesticides used in Nepal are of broad spectrum in nature, some of which are banned in other countries. Farmers usually do not follow the recommended protocols that prohibit spraying for at least a week before harvesting vegetables. According to government laboratory officials, particularly those of DFTQC, most of the pesticides under the organophosphate group have been banned in Nepal but the pesticide is easily available at any agro-vet market across the country because of informal pesticide trade with India as a result of an open border between the two countries. It was reported in interviews that Nepalese farmers are also using other types of pesticides mostly coming from India, which are yet to be detected in laboratories. In samples collected from Kalimati Fruits and Vegetable Market in mid-December 2020, the Central Agricultural Laboratory found a high level of organophosphate compounds in samples of cauliflower and bottle gourd produced in Dhading. Farmers are still known to spray methyl parathion, a banned organophosphate insecticide, on cauliflower to give it an extra white appearance. Similarly, to make them look greener, vegetables, like lady's finger, are dipped in copper sulphate, a harmful substance although not yet banned. In addition, high levels of pesticides are found in vegetables imported from India, which according to anecdotal reports, are not all detected in testing laboratories at customs points.

Nepal does not have a widely adopted residue monitoring and traceability system and lacks comprehensive data on the number of pesticides imported and the amount used in agriculture. The associated potential risk of increased pesticide use on human health and the environment is not well documented and a concern. Repeated use of single or limited pesticide active ingredients, use of higher rates of pesticide than needed or allowed, and lack of user knowledge on pesticide type and toxicity are some of the current major issues associated with the pesticide use in Nepal.

In the long run, pesticide exposure can cause persistent health issues such as dermatosis, cancer, genotoxic, neurotoxic, and respiratory effects. In emerging economies, the use of outdated, non-patented, more toxic, and environmentally persistent pesticides are the leading causes of higher toxicity of these chemicals. In addition, farmers in developing countries are exposed to toxic chemicals due to a lack of technical knowledge on toxicity levels of pesticides, safe use and measures to protect

themselves from chronic exposure. The improper handling of pesticides occurs mainly at the time of mixing and application, during storage, and during pesticide disposal. In Nepal, very few studies have been conducted on pesticide use, knowledge, and practices.

Proper pesticide waste disposal is also an important part of responsible pesticide use. Accidental release or uncontrolled discharge of pesticide waste into the environment can harm people and contaminate the environment. While most of the farmers know the health hazards of pesticides if sprayed during fruiting or harvesting stage, they spray chemical pesticides due to absence of alternative control measures, such as integrated pest management. There is no market control for these chemicals, pesticide residues are not checked in markets and there *is no price differentiation for vegetables produced using pesticides versus those produced with alternate pest management measures* in the market.

Despite adverse effects on human health, vegetables laced with high amounts of pesticide residues continue to be supplied to Kathmandu Valley and Chitwan markets.

3.3.3. Hazards and risks associated with poultry

Over the last decade, the poultry sector has boomed and makes an important contribution in Nepal's economy and livelihoods of many poor people while providing nutrient-dense food for children, women, and nursing and pregnant women. However, there are periodic outbreaks of common poultry diseases such as colibacillosis, Newcastle disease (ND), infectious bursal disease (IBD), avian influenza (AI), chronic respiratory disease (CRD), infectious bronchitis (IB) in different parts of Nepal resulting into a significant loss to the poultry industry (DLS, 2018).

In Nepal, increasing commercialization of the poultry sector has led to increased use of antimicrobials, resulting in more than half of the chicken meat and eggs with antibiotic residues. All treatments with drugs and feed additives must be regulated according to the toxicity of the drug and its potency based on maximum residue limits, treatment, and withdrawal periods. Using these drugs, particularly antibiotics in a random manner for growth promotion or prophylactic purposes, may end up in the human food chain, and likely develop antibiotic resistance, hypersensitivity, and other reactions in humans. Microbial contaminants of eggs are usually enteric bacteria, *Salmonella enteritidis*, being the greatest threat. A study conducted by Nelson and colleagues in 2020 identified *Salmonella enterica* in most of the eggs of poultry farms, and the cause was identified to be their water sources (Nelson et al., 2020). Other causes of egg contamination are use of the same trucks that also carry poultry feed and eggs along with poor packaging. Further, the veterinary doctors providing services to multiple farms without proper protective gear/clothing are suspected to transfer diseases from one farm to others (Osti et al., 2017). Eggs are usually found contaminated due to improper washing, and poor storing and packaging.

Measures must be taken to avoid contamination of the hens and eggs and these include: (a) selection of breeding stocks for pathogen resistance, (b) maintaining a pathogen-free status in parental flocks, (c) using systems and procedures that prevent cracked eggs, (d) decontaminating facilities between flocks, (e) vaccinating hens against pathogens, (f) using pathogen-free feeds and feedstuffs and maintaining pest-free facilities, and (g) maintaining clean egg production and cool storage conditions. Consumers must also be educated to buy eggs that have been refrigerated, cleaned, and not cracked before processing or cooking.

The use of antibiotics in the poultry industry should be regularly monitored by authorities to prevent the misuse of antibiotics. Government of Nepal should strictly implement plans for surveillance and monitoring antibiotic residues and its resistance. Public awareness programs should be conducted to educate consumers on the impacts of residues on human health. Currently, information dissemination among consumers and poultry farms, on safe and nutritious egg production and consumption, is not adequate. In its report of July 30, *Nepal Today* claimed that eggs transported from Chitwan to Kathmandu may have failed to meet basic standards and were not healthy to eat due to their exposure to heat during transportation. In the absence of a temperature control system during transport, eggs lose weight and quality.

3.3.4. Hazards and risks associated with goat meat

The most important foodborne bacterial pathogens associated with goat meat are *Salmonella spp., Staphylococcus aureus, Escherichia coli, Campylobacter jejuni, Listeria monocytogenes, Clostridium perfringes, Yersinia enterocolitica and Aeromonas hydrophila. Salmonella species, Campylobacter jejuni, Listeria monocytogenes* and *verocytotoxin* producing *E. coli O157* are considered a major public health problem. While intrinsic bacteria are found in low levels in goat meat, the greatest contributors to carcass and meat contamination in Nepal are from extrinsic factors such as poor slaughtering facilities and meat handling practices. Meat carcasses may become contaminated from fecal material, paunch content, and the hide. Additional sources of cross-contamination exist in the slaughtering process, such as tools, equipment, human contact, and carcass-to-carcass contact.

The subtropical climate, poor sanitary conditions, improper storage facilities, poor food hygiene practices, limited knowledge of food safety among butchers and meat handlers, and lack of prevention against diseases in Nepal have contributed to a number of disease outbreaks. Contributing to these outbreaks are a lack of sufficiently well-organized slaughterhouses, poor hygiene in butcheries (fresh houses) and the meat shops, and quality issues (lack of cold storage, clean water, weighing machines, etc.) making meat in Kathmandu subject to contamination. There is also a limited number of cold chains supplying fresh meat to businesses (hotel, catering, etc.). Although the 'Slaughterhouse and Meat Inspection Act 1999' aimed to make meat inspection scientific and ensure the production of safe and hygienic meat, butchers slaughter goats (and poultry) in poor hygienic conditions with complete disregard to the provisions of the law. The supervisory agencies are ineffective in supervising individual butchers who are spread all around the city. Due to the lack of implementation of the Meat Inspection Act and absence of meat inspection, meat from sick or parasite-infected animals can become a source of infection to humans as well as to other animals. Meat quality can also be adversely affected by poor handling conditions in the slaughterhouses as well as in the meat markets or retail shops.

Lack of expertise and knowledge in safe meat processing activities, along with very limited slaughterhouses, meat processing factories, deep freezers, and cooling chambers all contribute to foodborne illness. Also, the conditions of most of the available slaughterhouses do not meet the standards set under the 'Animal Slaughterhouse and Meat Inspection Act.' The unsanitary conditions of slaughterhouses and their surrounding environment are major factors contributing to microbial contamination of meat. Parasitic and zoonotic foodborne diseases are particularly prevalent in warmer locations such as Chitwan corridor.

While sanitation and clean water use during the slaughtering and processing of meat can protect the meat from contamination, a study of meat shops in Kathmandu revealed that most of the shops were using contaminated water and covering hanging carcasses was rarely practiced. In addition, the same chopping blocks without any cleaning and disinfecting in between were used for different types and batches of meat leading to cross-contamination. It has been documented that *Listeria spp*., *Staphylococcus aureus*, *Yersinea enterocolitica*, *Salmonella*, and *Aeromonas spp* have been detected in floors and walls, hand basins, knives, and chopping blocks at several slaughterhouses.

Contamination of meat by food handlers is another common hazard in both Kathmandu and Chitwan corridors. Such contamination takes place due to poor personal hygiene of the food handlers such as not washing hands after visiting the bathroom, not wearing overalls and gloves, and lack of hot water and soap in the facility for proper handwashing, which is common in most slaughterhouses in these markets. A common practice seen in both Kathmandu and Chitwan markets was the handling of money and meat at the same time with bare hands, another source of microbial pathogens.

As indicated by interviews, another major hazard observed in Kathmandu and Chitwan corridors is the indiscriminate use of antibiotics and chemical fattening agents on goats, thus creating the risk of residues more than the permitted level. Interviews also indicated that inspecting and certifying livestock for slaughter to avoid the consumption of meat from sick animals is hardly practiced.

3.3.5. Cultural factors and practices amplifying the hazards and risks

There are several cultural factors and practices that amplify these hazards. For example, poorer segments of the population were found to prioritize price over safety, which creates a large market for cheap and unsafe meat, FFV, and eggs. Similarly, many informal actors in the fresh food value chain lacked awareness and knowledge on safe practices. Growing food businesses were found using unsafe practices due to lack of resources to invest in food safety infrastructure. Lack of knowledge on Good Agricultural Practices (GAP) and Good Veterinary Practices (GVP) was also found to be a major source of food safety hazards.

Growing food businesses also had limited knowledge regarding the risks of unsafe foods on human health. When asked what kinds of risks unsafe foods pose to human health, they responded in vague terms such as bad effect on health, food poisoning, foodborne illnesses, and poor nutrition. The FSSA respondents, particularly the GFB owners, were asked whether and what measures do they use to minimize risks and hazards of food contamination. Their responses are ranked in Table 2 below.

Table 2. Preventive measures adopted by food business owner respondents.

PREVENTIVE MEASURES	**Rank**
Cleaning schedule	1
Proper waste management	2.5
Product segregation	2.5
Pest control	4
Staff training and awareness	5
Standard operating procedures (SOPs) for handling, storage, and distribution of incoming, in-process, and outgoing products	6
Internal Control System- monitoring and supervision	7
Certification (GAP, GVP, GMP, GHP, HACCP, organic etc.)	8

As the table above (Table 2) shows the top three measures were: maintaining cleaning schedules, proper waste management, and product segregation. Other less common measures were pest control, staff training, adoption of standard operating procedures, supervision and monitoring, and certification.

The physical observations of their business locations and operations, however, suggested that the preventive measures claimed by them were minimally practiced by most of them, except the larger processing businesses. This suggests that these larger businesses are at least aware of the value of these measures. To understand why the GFBs would not implement modern food safety practices, a list of probable causes was identified through a qualitative interview and the list thus developed was ranked in terms of their importance (Table 3).

Table 3. Perceptions of food businesses regarding the reasons for poor food safety practices in Nepal.

REASONS- POOR FOOD SAFETY PRACTICES	Rank
Consumers are not prepared to pay extra price	1
Food businesses need educating in food safety issues	2
Government enforcement is weak	3
Others	4

The results showed that the GFBs do not use many modern food safety measures primarily because they do not see any financial benefits or business opportunities from implementing expensive food safety practices. About 90 percent of the respondents thought that the consumers would not pay extra price for safe foods. They also thought that lack of knowledge about food safety among food businesses (85%) and weak enforcement by the government (80%) contributed to poor implementation of food safety practices (Table 3).

3.4. Regulatory Environment for Food Safety in Nepal

3.4.1. Legal framework

It is important to note that Nepal is a member of Codex Alimentarius Commission (CAC), Word Trade Organization (WTO), Food and Agriculture Organization (FAO), South Asian Association for Regional Cooperation (SAARC), and World Organization for Animal Health (OIE). The food safety system in Nepal for several decades was by the Food Act of 1967 and Food Regulation of 1970. The Food Act was the basis for control of inspection of food premises, destruction of nonconforming products, and ensuring safety and quality of imported foods. This was then followed by the Plant Protection Act of 1972 and Animal Health and Livestock Services Act of 1998. However, recent release of the National Food Safety Policy 2019, developed with assistance from the FAO and ADB, introduced new approaches, opportunities, and provisions in the area of food safety. These provisions are more scientific and based on risk-analysis.

In addition, the Government of Nepal has issued laws, some of them in response to the Food Safety Policy 2019, to regulate the use of pesticides in agricultural crops, ensure animal health, ensure food safety practices in slaughterhouses and issuance of certification marks to products meeting the specified product quality.

Laws Relevant to Food Safety in Nepal

1. Food Act, 1967
2. Food Regulation, 1970
3. National food safety policy, 2019
4. Pesticide Act (1991),
5. Pesticide management Act 2019
6. Animal Health and Livestock Services Act, 1999
7. Slaughterhouse and Meat Inspection Act, 1999
8. Nepal Standards (Certification Marks) Act 1980.
9. Unified market monitoring guidelines-2012
10. Food Hygiene and Quality Bill 2020
11. Pesticide Rule 1994
12. Consumer Protection Act 1998

As a standard practice, related ministries and departments have issued numerous sub-decrees such as directives, procedures, work instructions, which provide guidance in the implementation of different FS laws, regulations, and standards throughout various food supply chains. Weaknesses observed in effective execution impact the effectiveness of these sub-decrees as well.

3.4.2. Institutional framework

Various organizations are tasked to ensure food safety in Nepal. The highest-level authority in charge of managing the overall national food safety and quality is the Ministry of Agriculture and Livestock Development. Under this ministry, two departments, the Departments of Livestock Services and the Department of Agriculture are charged with handling food safety at primary production points. The Department of Food Technology and Quality, also under this ministry, is responsible for food safety and quality in the market. The Nepal Council for Standards and the Nepal Bureau of Standards and Metrology are charged with standards development and implementation. They are the standards governing body and custodians. Nepal Council for Standards (NCS) is mandated to approve all Nepalese standards while the Nepal Bureau of Standards and Metrology (NBSM) functions as the secretariat that prepares the standards. NBSM has developed and adopted more than 100 standards related to food. Through the South Asian Regional Standards Organization (SARSO), the country is also actively involved in development of regional standards. The Food Standards Board (FSB) advises government on standards and ensures that they are aligned to international standards.

As a federal state, Nepal has established three levels of government: federal, provincial, and local. Along with the federal government (FG) based in Kathmandu, there are seven provincial governments (PG) and 753 local governments (LG). The food safety and agriculture sectors are under concurrent responsibility of all three levels of government, except that agricultural extension is now the sole jurisdiction of LGs. Agricultural research and education are placed under both federal and provincial governments, but agricultural quarantine and food safety are the responsibility of the federal government. This division of responsibility between the three levels of government has been taking into account the recommendations made by FAO's

technical report (FAO, 2018). The detailed description of the division of roles among the three levels of government regarding food safety issues is presented in Table 4 below.

Table 4. Division of roles regarding food safety among three governance levels.

Level	Activities	Federal	Provincial	Local
	Policy Formulation			
	Policy Analysis			
	Acts and Regulations			
	Standards/Guidelines			
Policy Level	Establishment and Operation of Food Council			
	Monitoring of Food Safety Functions at Provincial and Local Levels			
	Registration, Monitoring, and Surveillance of Food Business Operators			
	Operational Dispute Settlement			
	Coordination with Development Partners			
	Coordination with Other Government Organizations			
	Coordination with Non-governmental Organizations			
Implementation	Coordination with International Agencies such as Codex, INFOSAN, etc.			
	National Food Reference Laboratory			
	Service-Providing Laboratory			
	Food Inspection, Certification, and Quarantine for Import and Export			
	Licensing of Food Business Operators			
	SPS Enquiry Point and Codex Contact Point			
	Monitoring and Inspection of Food Business Operators			
	Education and Awareness			
	Research and Development			
Service Delivery	Emergency Preparedness and Alerts			
	Appointment and Management of Food Safety Officers, Public Analysts, etc.			
	Capacity Enhancement Activities (Academic/Trainings etc.)			
	Skill Development			
	Risk Analysis			
	Analytical Skills			
HR and Capacity Building	Inspection			
	Food Epidemiology Surveillance			
Database	Generating Food Epidemiology Data and Others			

Level	Activities	Federal	Provincial	Local
Food and Nutrition	Research and Development			
	Dissemination/Extension			
Other Activities	Registration and Monitoring of Food Inspection Bodies and Food Testing Laboratories in the Private Sector			
	Formation of Scientific Coordination Body			

Although several of the food safety activities are placed under concurrent responsibility among the three tiers of government, the federal government is in charge of regulating food safety throughout Nepal. This is so because the provincial and local governments are still too young to undertake these responsibilities. As evolving institutions, they are still defining collaboration and coordination protocols among the three tiers of government. Before the federal structure was implemented, there were eight regional laboratories to test the presence of pesticides and chemicals in vegetables. Now, these laboratories have been placed under the jurisdiction of Provincial Governments.

The Ministry of Agriculture and Livestock Development (MoALD) is the main body, at the federal level, charged to enforce food safety policies and strategies. However, there are four other ministries and their departments involved, in varying degrees, in food safety activities: Ministry of Health and Population (MoHP), Ministry of Industry, Commerce and Supplies (MoICS); Ministry of Federal Affairs and General Administration (MoFAGA), and, to a lesser extent, Ministry of Culture, Tourism and Civil Aviation. The ministries as well as the provincial and local governments have different food safety responsibilities and jurisdictions as shown in Table 5 below. The detailed roles of each of these units are explained in Annex 3.

Table 5. Ministries and Departments Directly involved in Food Safety Activities.

Federal	**Ministry of Agriculture and Livestock Development** • Department of Agriculture • National Horticulture Development Centers • Central Agriculture Laboratory • Agriculture infrastructure Development and Mechanization Promotion Centre • Department of Livestock Services • Department of Food Technology and Quality Control • Regional Food Technology and Quality Control Offices • Divisional Offices • Food import/export quality certification offices • National Food and Feed Reference Laboratory • Department of Livestock services
	Ministry of Industry, Commerce and Supplies • Department of Industry • Department of Commerce, Supply and Consumer Protection Department • Nepal Bureau of Standards & Metrology • Department of Micro, Cottage and Small Industry Promotion Center
	Ministry of Health and Population • Department of Health Services • Epidemiology and Disease Control Division (EDCD)

Provincial	**Ministry of Land Management, Agriculture and Cooperatives** • Agricultural Development Directorate • Agriculture Knowledge centers • Agri-business Promotion, support and Training Center • Cooperatives Academy • Laboratories (Not in all Provinces)
Local	**Municipalities (Agriculture/Livestock Sections)** • Agriculture Knowledge Centers • Livestock Service Centers; including sub-centers

3.5. Status of Infrastructure for Food Safety

There was a strong perception that critical infrastructure that is necessary for safe handling of fresh food from farm-gate to consumers is inadequate. These include inadequate supply of clean water, unprotected storage facilities, substandard or non-existent cold chain, irregular supply of electricity, and an inadequate transport network.

3.5.1. Water

It is claimed that nearly 91 percent of households have access to improved potable drinking water supply (MOWS, 2076/77), however, whether it is completely safe for consumption is yet to be determined. The government of Nepal has clearly defined water quality standards and directives for water suppliers to ensure water quality. They have provided the lists of parameters and frequency of testing for various urban, rural, commercial, and non-commercial water providers. However, observations of various nodes of fresh food value chains show that slaughterhouses are dirty, unsanitary, and lack proper washing facilities; and most eggs that come to market without proper washing and storage areas are hardly washed for months. However, this does not appear related to lack of water, considering 83 percent of the respondents said that they had an adequate supply of water. This is more likely attributed to lack of knowledge and motivation.

While the availability of water may not be a serious problem, the quality of water is. Various studies have shown evidence of presence of contaminants (physical, chemical, and microbial) in various water samples from different sources (Yadav et al., 2011; Bhandari et al., 2021). Due to poor execution of laws and low surveillance, private and public water providers are not motivated to put control measures in place to ensure a safe water supply.

While several fresh foods processing plants in Nepal have their own water treatment facilities to adhere to safety requirements, most small and medium fruits and vegetable collectors, processors, butcheries, and egg producers rely on public or private (water tankers) water supply systems. Some such small firms rely on their own borehole wells and tube wells, which do not have adequate water filtering systems. As such, the supply of clean water to food businesses, particularly small and medium firms, is inadequate leading to several food safety issues. While 42 percent of the respondents mentioned that they had an adequate water supply, 19 percent of respondents, which were mostly smaller and informal food businesses, said they did not have an adequate supply of water and were receiving water mostly from municipal supply systems and some from their own boreholes.

3.5.2. Electricity

Although the Government of Nepal claims that electricity has reached 95.5 percent of Nepal's population, its supply is interrupted during busy hours. The situation, however, is gradually improving with additional electricity supply augmenting the national grid almost every month. About 90 percent of the respondents said that they had access to electricity, although irregular. Several informal food kiosks were not using electricity either because they could not afford it or the electric lines were not connected to their business locations. The federal Minister of Water Sources, Energy and Irrigation recently announced that those using less than 20 KW per month would receive free electricity; this measure will enable even poorer food businesses to afford and use electricity.

3.5.3. Transportation and road connectivity

Poor road connectivity is a major constraint for Nepal. Its road density is low, about 14 kilometers (km) per 100 square km (km2) or 0.9 km per 1,000 people. However, all 13 districts in the Kathmandu and Chitwan food corridors are well connected by blacktopped highways including the Tribhuvan Highway, Araniko Highway, and Prithivi Highway. Additionally, BP Koirala Highway that passes through mid-hills connects the Kathmandu corridor with the eastern part of Nepal. The Mahendra highway links Chitwan with mountain and hilly regions. Chitwan corridor is a major trading post and terminal market in the country for domestic or imported products. These highways are connected with link roads (the majority not blacktopped), which operate for about nine months in a year. During monsoon season, when most of the FFV are produced in mountainous regions of Nepal, the link roads get obstructed due to weather which creates interruptions in the supply of produce from production to market.

Loading goats at Khasibazar, Kalanki; Photo credit - R. Lamichhane.

The transportation of vegetables from farms and between markets is usually not done in temperature-controlled vehicles. FFVs are often loaded in trucks and on rooftops of public buses. Larger cooperatives, traders, and specialized retailers use their own trucks, also without temperature control measures. They also use smaller trucks that can travel on the small link roads to collect vegetables from farms and collection centers. Similarly, no specialized trucks are used to transport live goats. Some traders from Kathmandu were found making simple modifications in their trucks used to carry goats. Eggs are usually transported in small size trucks (Bolero). These trucks, mostly owned by poultry farms, are modified to transport eggs. From interviewees, it was learned that at times eggs are transported in trucks that are used also for poultry feed and other supplies without proper cleaning, which increases the chances of cross-contamination. However, it was also learned that potential contamination might not penetrate beyond eggshells, as they are not tested for contamination before and after transportation. A few larger traders/processors of FFV have started to use refrigerated trucks and vans, they include: Sarwagi Group, Golyan Group, BBSM and Valley cold store. Several Indian transporters are also found using temperature-controlled vehicles to transport eggs as well as FFV and frozen meat products.

Proper packaging was also found as a significant problem in maintaining the quality and safety of FFV, eggs, and meat. FFV was packaged mostly in jute and plastic sacks, and to a limited extent in cartons and crates. These packaging practices exposed FFV to dust and other contaminations. Eggs were packaged in paper crates, which also exposed eggs to dust and other contaminations. Frozen meat was transported in refrigerated vans and live goats were transported in very poor sanitary conditions. A majority of the respondents said that they had taken measures to control postharvest and transit losses but were not able to elaborate on the measures taken.

3.5.4. Cold chain

Currently, there are only 49 cold storage facilities in Nepal, with an average unit storage capacity of 3,000 metric tons. Demand exists for at least 25 similar additional facilities, or for an additional 75,000 metric tons (ADB, 2016). It was reported in Kathmandu Post that the provincial government of Bagmati Province is building 10 large cold chains in the Kathmandu and Chitwan corridors (Bista, 2019). The Agriculture Knowledge Centers of Lalitpur reported that there are at least 18 "Coolbots"(small grid or solar-powered storage units) in the Kathmandu corridor. The private cold storages are used to store their own vegetables and fruits, and some provide "third-party logistics" or "3PL" services by renting space to farmers and other food businesses. In addition, FFV are stored in zero-energy storage structures, constructed using local materials such as brick and sand (Battarai et al., 2018); hence they are cheaper and can operate without electricity. With the increase in the consumption of frozen foods in Nepal, supermarkets like Bhat Bhateni, and Big Mart are using refrigeration technology to store their perishable products. Most local meat shops and butchers in the Kathmandu and Chitwan corridors use refrigerators. Bhat Bhateni supermarket has started its own slaughterhouse, which uses refrigeration along with other food safety measures. Gourmet Vienna, a frozen food supply chain, sources its goat meat from Nepal Meat Company Pvt. Ltd. from Chitwan/Nawalpur and supplies frozen goat meat to its clients including Bhat Bhateni supermarket. Because no cold chain is maintained in the supply of eggs from producers to customers, the poultry farms and members of Nepal Egg Producers Associations make their best efforts to distribute eggs within 72 hours of egg production. This is mainly because there is a general perception among consumers that eggs can be stored for weeks without refrigeration. As such, even after eggs reach consumers, they are stored without refrigeration.

When asked whether the food businesses were using temperature-control mechanisms currently, almost 60 percent said they were not using such mechanisms. In another question regarding whether they thought there was demand for temperature-controlled products, almost 70 percent said there was sufficient demand. When asked why they were not using temperature control technologies despite having sufficient demand, they suggested several reasons for not using the temperature control technologies: while customers would prefer temperature-controlled products, they would not pay a higher price; lack of financing; and unavailability of appropriate technology to scale their business. Some GFBs thought it would increase their costs and reduce the size of market. They also thought that for products other than meat, there was no need for cold chain if the products are to be sold within a few days of harvest.

Cold storage of frozen meat products; Photo credit - M. Chhetri.

3.6. Market Systems and Consumer Attitudes Towards Food Safety

The agricultural market system as shown in Figure 5, is made up of core actors, supporting functions, and rules that govern the exchange and service provision. The typical core market actors include the input suppliers, producers, processors, traders, exporters, wholesalers, and retailers. The supporting functions help the core actors to physically transact, and through this transaction the commodity ultimately reaches consumers. Some of the typical support service providers include the transport service providers, financial service providers, packaging materials, other input providers, extension service providers, and others. Regarding the rules governing transaction and service provision, there are the general, sectorial, and sub-sectorial policies, strategies, laws, by-laws, regulations, and standards set out and enforced by the federal, provincial, and local governments. These include the regional and international regulations and rules as well as voluntary and informal rules, norms, and standards set by community and industry actors.

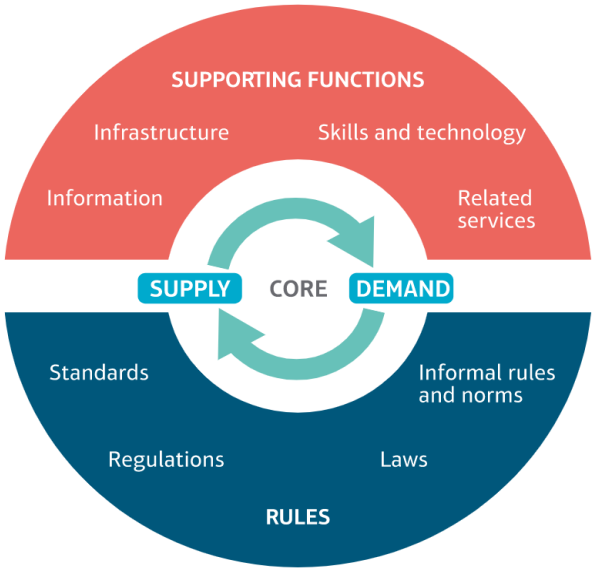

Figure 5. The market system "doughnut"; Source: M4P, 2021.

In general, Nepal's agricultural market is impaired by seasonality, poor organization, inadequate market infrastructure, small size and geography. It is fragmented, has a 'thin' private sector, operates in a donor-rich environment, and the state has weak regulatory frameworks and enforcement (Samarth, 2019). Added to these, the influence of Indian agriculture policy (e.g., subsidies, export restriction, informal cross-border trade) and over - and under - supply of commodities largely affect Nepal's agriculture market. Although China is a significant neighbor in the north and a major trade partner, their agricultural policies do not have significant impact on Nepalese agricultural market. This is mainly because Nepalese agricultural products, particularly FFV and goats, do not compete with Chinese products. Nepal imports some fruits and goats (during Dasain) from China.

3.6.1. Core market actors

The core market functions in the FFV, egg, and goat meat value chains typically include production, aggregation, trading, exporting, importing, processing, retailing, and consumption. Depending upon the end markets and specialization, the value chain might include other functions and actors. The state of these market systems of the selected commodities, presents significant food safety issues, as discussed below, by commodity.

Fresh Fruits & Vegetables (FFV)

The consumption of fruits and vegetables is increasing, and the domestic supply is not able to meet the growing demand. Marketed volumes of fruit and vegetables are low in Nepal, as farmers have limited access to agriculture technology. Postharvest losses are also high, with estimates suggesting losses between 10 and 14 percent for fruit and vegetables. Careless handling of crops during loading and unloading and a lack of storage facilities at collection centers are contributing factors. This domestic demand-supply gap is fulfilled by imports from India; hence there is ample opportunity for import substitution in the horticulture sector. Seasonality, poor organization, inadequate market infrastructure, and small size/scale are some of the distinguishing characteristics of Nepal's horticulture market. Added to these, the influence of Indian agriculture policy (e.g., subsidies, export restriction) and over and undersupply of commodities (e.g., export restriction on onions) largely affect Nepal's horticulture market.

A typical FFV value chain engages various actors including input suppliers, producers, collectors/traders, wholesalers, retailers, and consumers.

Key input suppliers include private agro-vets, government service providers (*Krishi Gyan Kendras)*, municipalities, and resource centers), NGOs/projects, and cooperatives. These input suppliers provide seeds, fertilizer, pesticides, insecticides, tools, extension services, and technical know-how to farmers. Key issues affecting safety and quality of FFV at this node are as follows:

- Inputs (such as certified seeds, fertilizer, pesticides) are unavailable and of poor quality, and agro-vets have limited knowledge resulting in poor inputs and inadequate provision of extension and advisory services.
- Seeds are sold loose and poorly labeled, resulting in issues of germination, production, and poor quality.

Producers are the primary actors, and they are either: (i) subsistence farmers lacking access to information, inputs, markets, and incentives for commercialization; or (ii) commercial farmers who are willing to invest for growth if provided with an assured market. With increasing road connectivity, urbanization, and consumer demand, the vegetable sub-sector is gradually commercializing, particularly in terms of application of new technologies and pooling of land through cooperatives. Such developments are taking place, especially in the areas with proximity to roads. While corporate farms and vertical integration would speed up the commercialization of the vegetable sub-sector, it is not yet happening in any significant measure.

As shown in the maps (Figures 2 and 3) above, Kavrepalanchowk, Chitwan, Dhading, and Makwanpur are the largest vegetable producing districts in the Baghmati province. Key challenges that vegetable producers face include poor revenues/incomes, poor market access, and high postharvest loss (Rai et al., 2019). Key issues vis-a-vis food safety and hygiene at this node are:

- Overdose, haphazard, and frequent application of pesticides along with cocktail spray (mixture of two or more pesticides). For example, in one study pesticide residues were found in 93 percent of eggplant samples, and all the chili and tomato samples. Pesticide residues (triazophos, omethoate, chlorpyrifos and carbendazim) in 4 percent of the eggplant, 44 percent of the tomato, and 19 percent of the chili samples exceeded the EU maximum residue limits (Bhandari et al., 2019).
- Dipping green vegetables in chemicals/pesticides (e.g., malathion, mancozeb solution) just before taking to market to make them glossy and attractive (Sharma, 2015). The report on Pesticide Evaluation and Safer Use Action Plan, commissioned by the KISAN project even recommended that the 'Traders who dip vegetables in pesticide to make them shiny and thus more attractive to consumers need to be arrested as this practice is criminally dangerous' (USAID, 2019).
- Farmers lack information and incentives for Good Agriculture Practices (GAP), including cleaning, grading, and sorting. Markets fail to provide incentives for appropriate post-harvest GAP. GAP are voluntary standards for food safety, quality control, environment-friendly and worker welfare-friendly practices which contribute to safe and sustainable agriculture. GAP is a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social, and environmental sustainability.
- For packaging, traditional practice such as the use of *Doko* (corn husk and paper) is common. However, farmers are slowly adopting improved packaging materials such as plastic crates. While using *Doko*, farmers incur about 10 percent of the product loss during transportation. The total postharvest loss in offseason vegetables from producer to retailer is estimated to be 25-50 percent. The postharvest losses are mainly due to improper harvesting, handling, packaging, and poor facilities at collection centers (ANSAB and NEAT, 2011).
- The majority of the agricultural strategies and policies of Nepal are more directed towards improving agricultural productivity. Risk-based food safety approaches such as GAP for on-farm production are critically important to elevate protect safety and quality of FFV.

Collectors/traders are the key actors linking farmers to the market. These actors operate at various levels and are responsible for the trading of more than 70 percent of vegetables from production pockets to wholesale markets. Their trading activities include buying and assembling, repacking, sorting, selling to middlemen, transporting, and selling to wholesale markets (USAID/NEAT, 2011). Actors at this node are (a) *local collectors*- who collect FFV from farmers or collection centers, (b) *road head traders/district headquarter traders*- who collect fresh F&V from local collectors or collection centers and aggregate the products, (c) *regional traders*- who collect FFV from collection centers or road head traders and supply to (d) *wholesalers* in the same or other districts. The wholesalers are in the market hubs (for e.g., the *Kalimati*, *Balkhu, Tukucha, Lagankhel, Bhaktapur* wholesale markets in Kathmandu) with some infrastructure such as open stores, transaction sheds, shop sheds, and storage facilities. Key issues vis-a-vis food safety and hygiene at this node are:

- Quality deterioration and high postharvest loss during transportation and handling; improper handling during loading and unloading; rough roads leading to damage during transportation; lack of dry and cold storage facilities leading to deterioration of quality; over stacking of cartons in the transport vehicles; lack of air circulation leading to heat build-up inside vehicles, in collection centers, and satellite markets; displaying of fruit and vegetables on the open ground without any protective barriers at wholesale and retail markets. All these factors contribute to postharvest losses. However, the FSSA did not make attempts to estimate these losses and recommends doing so in the second phase of the FSSA.
- Poor and unhygienic market infrastructure- for example, congested and unhygienic marketplace, lack of basic amenities including sanitation and handwashing areas, poorly designed loading and unloading docks, and the absence of or ineffective waste management system outside the market (ADB, 2019).
- Poor warehousing and lack of controlled temperature storage: Lack of proper warehousing facilities, especially with controlled temperatures, is one of the major problems/constraints in the F&V sector. Cold storage is an indispensable part of the perishable farm-to-market chain to retain and add value to commodities. In the widespread absence of appropriate storage facilities, farmers are compelled to sell their produce at low prices at harvest (DFID/UKAid, 2020). No specific data were available to estimate income losses of farmers and other actors. We suggest the FSSA phase two to explore this further.

Ujjwal Karki: A prominent wholesaler at Kalimati shares his observations

Every day before dawn, Ujjwal Karki joins hundreds of wholesalers at Kalimati Fruits and Vegetable Market (KFVM), a sprawling and chaotic but lively market, where trucks/vehicles blare popular music; porters haul huge crates, *dokos* (bamboo basket) and sacks of produce; customers walk over discarded remains of fruits and vegetables; and hawkers supply tea and cigarettes. He wholesales vegetables and has been able to employ a number of staff. He also runs a very successful finance cooperative within the premises of Kalimati market. With over 30 years of experience in vegetable trading he has witnessed all the phases of Kalimati market and various ups and downs of Nepalese fruits and vegetable trade.

According to him, the Kalimati Market is now saturated. He thinks that it needs an effective facelift, which requires various new changes including better infrastructure, new technologies, and most importantly, measures to improve quality and safety.

He also thinks that some of the traders may not like these changes. He however believes that it will take some time for them to adapt to new changes. He himself had gone through similar change a while ago when Rapid Bioassay for Pesticide Residue (RBPR) tests were initiated. Out of fear of being scrutinized and fined as a result of RBPR tests, some 20% of the traders had shifted their business from Kalimati Market. But the traders will "eventually adapt once they are made aware, trained and helped to implement the new provisions," he said.

His cooperative serves almost 90% of Kalimati traders by providing loans up to NRs. 500000/- (Approx. $5000) to trading license holders without any collateral. "During Covid-19, most of the retailers withdrew their savings, but only a few wholesalers did so, suggesting that retailors were impacted more by Covid-19 than the wholesalers," he said. He strongly emphasizes the need for effective enforcement of food safety in the agribusiness sector. He stated that the market monitoring /surveillance should lead the food businesses towards safety and quality and should not force them towards their closure or relocation of the business in less scrutinized market centers.

Retailers buy FFV from the wholesale markets and supply to the consumers. Institutional consumers (e.g., hotels and restaurants) make up the bulk purchases, however, they purchase directly from the wholesalers. Retailing is done through vegetable and/or grocery shops, supermarkets, street vendors, and doorstep suppliers. Key issues at this node vis-à-vis safety and quality of FFV are as follows:

- High postharvest loss- Retailers buy from wholesalers and are not allowed to sort, leading to disposing of at least 20 percent (volume) of the produce. In the traditional produce markets, sellers see value in mixing bad products with the good. By the time the retailers sell to consumers, almost 20 % (volume) of the products, mostly the bad ones, are lost to drying, rotting. This practice is, however, not common in modern channels such as grocery supermarkets and online selling. (DFID/UKAid, 2020).
- Products have a short shelf life and degrade in quality in absence of proper time and temperature control during storage.

The current FFV value chain is highly inefficient with too many nodes extracting profit/markups without capturing value. It is understood that at least 10 percent or 20 percent mark-ups are added in each step, without any real value addition. The consumers thus pay more while farmers receive low prices (DFID/UKAid, 2020). There have been some efforts by the entrepreneurs, especially in urban centers like Kathmandu, to shorten or truncate this chain by directly sourcing from producer groups/cooperatives and local collectors. In addition, there are farmers' markets run in selected places in Kathmandu and other urban centers.

Furthermore, there is interest from various agribusiness in having a more direct relationship with the farmers- through structured and intermediary relationships, contract farming, or backward integration within the supply chain and having joint ventures with farmers and cooperatives to co-invest in joint storage, aggregation, and processing facilities (SSG Advisors, 2015). However, interviews indicated that no significant progress has been made in these areas.

The approval/ratification of the draft Agribusiness Promotion Bill is important at this juncture to foster a transparent and formal relationship between actors and help better integration through contract farming provisions. This will also ensure market access for farmers and attract private players in commercial agriculture (Kathmandu Post, 2017). Contract farming provisions will not only help build strong relationships but will also open doors for quality improvement, enforcement of standards, and production and marketing of safe and hygienic products.

Governance: FFV is a loosely organized and poorly integrated chain that does not include formal mechanisms for trade contracts such as supply agreements and buy back mechanisms, probably because Nepal has not yet promulgated contract-farming regulations. However, farmers and traders have been found engaged, occasionally, in contract farming relationships in an informal basis. Since actors do not have a long-lasting relationship and adequate trust built among each other, it limits the flow of credit, inputs, and information among the players (ADB, 2019). Furthermore, it makes enforcement of the quality and safety standards difficult. The value chain is buyer driven with minimum trust between the actors. A USAID/NEAT study found that while the traders complain about the poor quality of products, farmers perceive that they are being exploited by the traders and other market intermediaries (ANSAB and NEAT, 2011). Interviews confirmed that there has not been much improvement in this situation; there is still minimum trust among value chain actors.

The level of integration is weak and so are the horizontal and vertical linkages. However, as mentioned above, there is an interest for a strengthened and transparent relationship between the actors, especially between the agribusinesses and farmers.

Horizontal linkages

- Farmer to Farmers: There is a large number of producer groups and cooperatives. In many commercial pockets, farmers practice group or cooperative marketing of inputs and outputs.
- Traders to Traders-: They are members of the commodity associations, chamber of commerce, and industries and have shared interest in pricing of the purchase.
- Retailers to Retailers-: They operate on their own and are indifferent to many of the value chain issues. Limited interaction and sharing of information.

Vertical linkages

- Inputs suppliers to Producers: These include business relationships between agro-vets and farmers. As far as government services are concerned, it is almost free or at nominal charges. In commercial pockets, groups/cooperatives also provide inputs and technical 'know-how' to producers.
- Farmers to Traders: In most instances, traders determine the price and farmers have to comply. There is lack of trust, transparency, and inadequate flow of information among these actors. Traders should provide farmers with the market information related to demand, quality, variety, volume etc., so that farmers can adjust based on these market forecasts. This will generate win-win returns, easing periods of low production and reducing waste and losses (DFID/UKAid, 2020).
- Traders to Retailers: The survey indicated that traders, particularly the intermediaries who aggregate produce and sell to retailers determine the price. Retailers, including local vendors, not only do not have much say on pricing, but they also have to buy in bulk without any quality assessments such as sorting and grading of produce based on the color, quality, size, firmness and so as valued by customers. However, sorting and grading were found quite common in the case of modern channels such as online traders and supermarkets.

Eggs

In Nepal, chickens are produced commercially in 64 of the country's 77 districts. As estimated by the National Commercial Poultry Survey (CBS, 2016), there were 21,965 commercial poultry farms/farmers in Nepal, of which 20,483 were broiler farms (93%), 1337 layers farms (6%), 128 hatcheries (0.6%), and 8 Giriraj farm (0.04%). Bagmati Province is the poultry hub of Nepal, contributing to more than half of Nepal's total layer population (54%) and egg production (52%). Chitwan is the largest egg producer in Nepal, contributing to ~70 percent of the total egg production in the province and 36 percent of the country's total egg production. In 2018/19, Nepal produced 1.5-billion hen eggs (MoALD, 2020) and now the country is reported as self-sufficient in eggs and meat.

The poultry sector in Nepal is estimated at $240 million and employs over 70,000 people (IFC, 2014). Poultry is perhaps one of the leading agro-based subsectors with a rapid pace to commercialization. Agribusinesses have a big stake in the success through integrating small farmers/firms and enterprises in the poultry value chain. Small farms/farmers and backyard poultry farming are still dominant in rural areas. Backyard poultry is prevalent in almost all parts of the country whereas commercial poultry is mostly concentrated in the urban and semi-urban areas that are equipped with electricity and road facilities. Rural households typically rear backyard poultry for a source of animal protein, additional family income and cultural purposes. Chitwan, Kathmandu Valley, Kaski, and Morang dominate Nepal's poultry production.

AI/bird flu and farm management are the biggest issues in Nepal's poultry industry. Nepal experienced its first outbreak of bird flu in 2009. There have been multiple outbreaks of bird flu thereafter every year, but the year 2013 saw the worst flare-up – a total of 201 outbreaks – in different districts of Nepal in both backyard poultry and commercial farms (The Himalayan Times, 2011). The major foodborne diseases related to poultry meat are Salmonellosis and Campylobacteriosis. There is a compelling need for a 'one-health approach' to protect public health and prevent disease from the poultry sector, including AI, Non-Typhoid Salmonella (NTS), and others.

Contrary to the goat meat and FFV sectors, the poultry chain is better integrated, with subsidiary functions like feed and eggs being interlinked with hatcheries. The supplies of chickens and eggs are provided through the same channels to consumers. Most of the poultry value chain actors have two-way relationships with their immediate buyers and suppliers. Suppliers selling to a particular business also assist in selling products to their consumer market (Sharma, 2008). The current survey also confirmed that the poultry value chain is better integrated than that of goat and FFV.

Hatchery: There are more than 200 hatcheries in Nepal, out of which around 120 are located in the Chitwan district alone (The On-line Khabar, 2019). These hatcheries import parent stock from foreign countries including Australia, the Netherlands, Germany, the United Kingdom, the Philippines, Malaysia, Sri Lanka, and Belgium. In the first five months of FY 2020/21 parent stocks worth Rs 540 million were imported, with additional Rs 100 million spent on airfare. Since the outbreak of AI, imports

from India have been banned (Sharma, 2008), and this ban still continues. A parent stock variety 'Cobb500' is produced in Nepal under direct supervision of Cobb-Vantress Inc., an American company. Cobb Nepal Private Limited has established farms in Panchkhal and Dhulikhel and Kavre for production of parent stock (My Republic, 2020). Most of the hatcheries supply their products to chicken dealers.

The survey revealed the following safety and hygiene issues at this node:

- Hatcheries are aware of AI but do not believe that they are personally at risk of AI.
- Incubators are cleaned using disinfectants, but farm premises are not regularly and routinely cleaned.
- Improper disposal of un-hatched eggs, dead chicks, and chicken raising sanitary concerns. Industry standard.
- Antibody tests against diseases are non-existent in all the hatcheries.
- A few hatcheries have rodent proof construction while others do not have any rodent control.
- Overall, hatcheries have low sanitary and bio-security conditions.

Producers: Commercial chicken and egg producers are the most crucial actors in the poultry industry as they are closely linked with their suppliers as well as other market chain actors like wholesalers, retailers, and often directly with consumers. Key safety and hygiene issues at this node are:

- Producers are aware of AI but lack complete information.
- Risk management and bio-security measures are poor.
- High prevalence of *Non- Typhoid Salmonella* (NTS[5])- 55.5 percent of farms were found to have at least one environmental sample positive to NTS (Sharma et al., 2021).
- *Salmonella enteritis* is also commonly found in whole poultry production chains from production to retail level. At farm level it is transmitted by pests and contaminated feed and vertical transmission from egg to chicks in hatcheries.
- Proper fencing around farms, provision of footbaths, and regulation of vehicles. Producers need training on bird flu and adoption of appropriate bio-security standards. Foot dipping in disinfectant solution, spraying disinfectant, hand washing, changing boots, clothes are some examples of biosecurity measures applied in poultry farms. Small-scale commercial farms rarely implement these biosecurity measures, increasing chances of disease outbreaks.
- Though they have regular vaccination schedules, most of the poultry farmers do not follow the regimentation, including vaccination of all chicks known as 'all-in-all-out' system (all chicks that get into the pipeline get vaccinated before getting out of the pipeline) (Sharma, 2008). Data were not available to ascertain whether this practice continues. This is another area to explore in the second phase of the FSSA.
- Informality- Only 23 percent of the poultry farms are formally registered, making them impermeable to government regulation and monitoring (CBS, 2016).
- The industry as a whole loses up to $32 million in profits, and most of this loss occurs at the producers' level. This loss is primarily because local SMEs lack formal training on farm management and struggle to stay profitable (IFC, 2014).

Feed Companies: Feed is the most important input in the poultry value chain; almost 67 percent of the total farm cost is attributed to feed (CBS, 2016). Feed companies play a vital role in the poultry industry; not just in supplying feed to the farms and producers, but also in supplying chicks to the farmers/farms and meat to the market. They sell about 30 percent of eggs and more than 50 percent of broiler chicken. Most feed companies are owned by hatcheries as subsidiary companies. Most of the ingredients are purchased locally, and minerals and other additives are imported. Although the poultry industry has grown significantly in the country over the last few years, the organic phosphate waste from poultry farms has not been a concern yet, mainly because poultry waste is widely used as manure across Nepal.

Most of the feed industries check ingredients for quality at a laboratory. Handling of feed preparation and distribution is done with a satisfactory level of health and hygiene practices. Bio-security measures in the feed industry are considerably better than in other sectors, but many feed companies do not use disinfectants while cleaning mills. Animal feed is also a source of contamination (microbiological and chemical) for the poultry flock. Intensive use of pesticides used to control insects, fungus, etc., in crop production can result in elevated levels of pesticide residues in animal feed which in turn can cause food safety risks in foods of animal origins.

Wholesalers and Retailers: Egg wholesalers function as egg collection centers and acquire their supply from hatcheries through egg dealers. They use small trucks and vans to deliver eggs. Egg retailing is done at the groceries, supermarkets, and fresh houses. These outlets acquire their supply from egg collection centers and egg wholesalers. At both levels, packaging is done using paper crates. The following are safety and hygiene issues:

- Lack of awareness on AI. Most of the wholesalers and retailers have heard of it but are not aware of symptoms and mitigation measures.
- Wholesalers and retailers maintain low hygienic measures while handling eggs and reported that there is no veterinary inspection on eggs in the market.

Goat meat

Goat rearing is common amongst smallholders across Nepal. It provides manure for agricultural crops and a source of meat that is greatly in demand. The goat value chain engages various actors that include goat producers, traders, meat processors, retailers, and consumers.

Input suppliers include the private agro-vets, government managed livestock services, para-vets, and NGO/project funded technical service providers. These input suppliers provide extension services/technical 'know-how', breeding stocks, concentrated feed and other feeds, veterinary medicines, salt, mineral concentrates, forage seeds, etc. to the producers. Key issues relating to food safety and hygiene at this node are:

- Veterinary health service providers are not able to reach and cater to the needs of farmers/producers in a timely manner.
- The supply of drugs and vaccines is not adequate. There is little to no guidance on use of drugs and other chemical treatments.
- Agro-vets lack knowledge on disease and treatment methods.
- Feeds are of poor quality and composition.

These issues lead to poor health of goats, eventually leading to poor growth and poor quality of meat.

Producers are the first link in the goat value chain and include: (i) smallholder farmers who rear goats in their backyard as a subsidiary enterprise for attaining additional income, (ii) semi-commercial farmers who keep 5-10 goats and largely aim for local and road head markets, (iii) commercial farmers who are largely young entrepreneurs with technical 'know-how' on modern production and marketing and with exclusive market orientations, and (iv) government resourced farms. These producers largely operate on their own but in many instances are members of local groups or cooperatives. The total number of goat producers/farmers in Baghmati province is not known, but Ministry of Agriculture and Livestock Development (MoALD) statistics place Baghmati province as the third largest population of goats (MoALD, 2020). Nuwakot hosts the largest goat population (270,061 heads), followed by Makwanpur (263,196), Kavre (255,213), and Sindhuli (229,123) in Baghmati province.

- Production and productivity optimization is the key issue at this node, largely because of unscientific management, improper breeding, and poor nutrition and health of the herd (NARC, 2013).
- The majority of the producers were found unaware of their responsibilities in safe and hygienic meat production. For example, sick animals would be sold rather than spending on veterinary services. A Heifer study found in 2012 that even when veterinary drugs were administered no farmers followed a drug withdrawal period before selling (Heifer, 2012). Since 2012, awareness campaigns have been implemented to address this problem, although they

have not been effective. No information was available on whether educational and other direct interventions were implemented since 2012. The second phase of FSSA may explore this issue.
- Factors relate to lack of knowledge and access to veterinary health service providers. Disease management is a big challenge with rising temperatures and prevalence of pests. Farmers need knowledge and training for managing diseases for a whole range of livestock including goats.

Goat marketing/trading is a complex phenomenon that is comprised of the primary, secondary, and tertiary markets and involves more than one trading agent. Local traders and collectors are most active at primary markets in which they buy live goats from producers, hold them for a while, and sell either to local butchers, haat bazaars, road-head traders, or in few cases supply directly to the terminal markets. The secondary market, or the catchment market, sources live animals directly from farm-gate or from the primary markets. These markets are dominated by small-scale traders and middlemen (NARC, 2013), and are largely found in the district market centers and road-heads along the major highways. The terminal markets serve the needs of urban consumers. Major terminal markets for domestic and imported goat meat are located in the Kathmandu valley, followed by Pokhara, Biratnagar, Bharatpur, Janakpur, and Butwal. These bigger end markets also supply live goats to smaller local markets, including district headquarters to meet demand not fulfilled by the supply from local goat production clusters (Heifer, 2012).

There is no organized live goat marketing system in the country, except weekly markets in some areas. The infrastructure status of some market centers, as assessed by Heifer International, was found to be extremely poor. A study conducted in 2018 identified that FFV and goat value chains do not incentivize the adaption of a safe food production system, which leads to unorganized markets and poor production and market infrastructure (USDA, 2018). The general mode of goat transportation is walking them to the collection points from where goats are transported either in buses or pickup trucks to near and distant end markets. In urban areas goats are transported in a small van from wholesale to retail markets or meat retailer shops. Key issues regarding safety, quality, and hygiene of goat meat at this node are:

- Crowded holding yard (only 3sq.ft. per goat) and congested transportation system (36 goats in a small cabin of a bus).
- Weight loss during transportation and unhealthy feeding practices for the weight loss recovery (whole grain with salt and water).
- Overfeeding whole grain with salt was also observed as a malpractice to reduce transportation related weight losses, thereby trading off meat quality.
- Acidosis from excessive grain feeding is known to increase lactic acid content in meat.
- Stress-induced hormonal imbalances leading to poor meat quality.

Goat processing and retailing involve slaughtering, fresh meat production, and selling to individuals, hotels, restaurants, *sekuwa* corners, party palaces, food caterers, and others. Butchers and fresh meat shopkeepers are the only actors involved in processing and retailing goat meat, and they are mostly undifferentiated with a few exceptions that have safer food handling practices. The survey found that this node is very vulnerable in terms of food safety and hygiene because of the following factors:

Individual Behaviors (observation)

- Staff handle meat and money simultaneously.
- Staff wear jewelry, which is a physical hazard and do not use proper protective gear, aprons, and masks.
- Staff smoke while handling meat.
- Staff do not maintain personal health and hygiene.

Compliance (survey)

- Conditions of most of the available slaughterhouses do not meet the standards set by the government under Animal Slaughterhouse and Meat Inspection Act.
- A large number of meat producers and butchers operate informally, which limits their monitoring by the Government and compliance with national standards.

- A national livestock wellness survey undertaken in 2018 revealed that more than half of the butchers/meat producers were not registered and are operating informally.

Facilities and tools (survey)

- Wet market conditions- segregation, most of the slaughter slabs are unacceptable that are not properly cleaned and disinfected between uses.
- Facilities have congested space in the slaughter area, pollute nearby water wells, and block drainage because of poor offal management.
- Facilities have dirty water for cleaning and evisceration.
- Disposal of ingest is a consistent problem.
- A national livestock wellness survey reported that out of 102 meat producers, only half used a refrigerator/freezer to store the meat. None of the sellers have equipment to vacuum pack the meat. Among those without a refrigerator or freezer, 28 percent try to sell the meat on the day of slaughter and 24 percent simply keep meat out in the open (Animal Nepal, 2018).
- In a 2006 study, 14 percent of the meat samples collected from Kathmandu were found to be positive for *Salmonella*. Several meat-borne parasitic zoonoses and multi-drug resistance isolates were also found (Maharjan et al., 2006).

Governance: The interviews revealed that goat meat is a loosely organized, poorly integrated, and buyer-driven chain. The level of trust among actors is low, and the relationships and cooperation are informal and weak. A large majority of the micro-, small- and medium-enterprises operate informally, thereby remaining outside of the government radar, which is a key challenge in providing extension services and trainings, enforcing standards, and monitoring quality. The level of integration, both horizontal and vertical, is quite weak. However, the linkages and relationships are stronger higher up in the chain.

Horizontal linkages

- Farmer to Farmer: Horizontal linkage is fairly strong (groups, cooperatives, associations, etc.) but collective action is lacking. The strength of their linkage/network for input supply, production, scale up, marketing, and other collective actions largely remain unexploited. Collective marketing is emerging in some goat production pockets. A study undertaken by Heifer found collective goat marketing by cooperatives in Dhakeri and Banke (Heifer, 2012).
- Primary market traders: Horizontal linkage is weak and lacks organization/association. Information flow is sporadic/selective but when it comes to bargaining with farmers, there is reciprocity in information sharing.
- Secondary and Tertiary Market Traders: Horizontal linkages are quite strong but informal, and rely on personal network/connection, and family relations.
- Processors and Retailers: Horizontal linkages are quite strong - most of them are part of their association. Collective advocacy is there but collective and consensual action for quality improvement, reducing adulteration, and minimizing malpractices are weak.

Vertical linkages

- Inputs suppliers to Producers: This includes business relationships between suppliers and producers, such as agro-vets and farmers for vet medicines. Government services are free or provided at nominal costs. Producers have established trust with the input suppliers.
- Farmers and Primary Market Traders: Lack of trust, information sharing, and bargaining. Lack of appetite for long-term business relationships.
- Primary Traders to Secondary and Terminal Market Traders: Relationships are preferential/selective but strong and informal. Secondary and terminal market traders do provide cash advances to the primary traders (in some cases).
- Traders to Processors and/or Retailers: Relationships are preferential/selective but strong and informal.

3.6.2. Support services

Financial Services

Actors along the value chain/food corridor require capital to carry out existing activities and/or to upgrade the process, product, function, and channel to improve food quality, food safety, and hygiene. MSMEs face a dearth of capital, as, unlike 'big' agri-business, they are not able to dispose or mobilize cash or capital investment upfront. Hence, the role of financial service providers is quite crucial. There are different means through which the actors along the food corridor can access finance. In integrated chains like egg and vegetable seeds, farmers have been receiving inputs and financial support from the buyers or anchor companies. However, in the cases of goat meat and FFV chains, this is not the case as the chains are very loosely organized and poorly integrated. Hence, the actors need to rely on other means such as informal borrowing from relatives, moneylenders, and local merchants (which entails higher interest rates); and borrowing from formal institutions and systems such as cooperatives, finance companies, development banks, and commercial banks.

Nepal Rastra Bank (NRB), through the monetary policy (2020/21), has directed commercial banks to invest at least 15 percent of their total credit in the agriculture sector by mid-July 2023 (NRB, 2021). The third trimester review of the Monetary Policy (2020/21) revealed that the commercial banks, by the end of the third trimester, had invested 12.6 percent of their credit to agriculture (NRB, 2020). Most bank loans to the agriculture sector have been for processing firms such as mills, poultry, feed, dairy products, cold storage, and compost fertilizer. Lending into production systems is low, as most agriculture production is subsistence farming, incurs high transaction costs, and is deemed risky (DFID/UKAid, 2020).

The overall policy and operational environment for financial access is promising. Commercial and development banks have partnered with the development actors, I/NGOs, and projects to develop and implement customized financial products to meet specific needs of the value chain actors. For example, the USAID-funded KISAN Project has established Direct Credit Assistance (DCA) with Laxmi Bank to increase access to credit for actors within agricultural supply chains (USAID, 2015). Similarly, DFID's Sakchyam Access to Finance Program introduced the Warehouse Receipt model, Invoice Discounting model in sugarcane, and loans against receivables (ADB/White Lotus, 2016).

Furthermore, many agribusinesses and buyers are already pursuing joint ventures and partnerships with farmers and cooperatives to co-invest in joint storage, aggregation, and processing facilities. There is strong interest from the agribusiness to invest in supply chain infrastructure and supplier networks. To address the requirement of the long-term financial instrument for investment in supply chain infrastructure, the NRB has approved issuance of an agricultural bond worth 18 billion rupees (~155 million USD) as a long-term financial instrument (NRB, 2020). Private equity funds are also emerging in agriculture and food industries. Business Oxygen Private Limited (https://bo2.com.np/), which is Nepal's first private-equity fund, is one of those with prioritized investments in primary agriculture, horticulture, dairy, and livestock.

Several food businesses interviewed were found borrowing from commercial banks, cooperatives, and relatives to finance their working and investment capital. Of the 61 respondents, 29 had outstanding loans at the time of interview. They also mentioned that their main problem in borrowing was providing collateral that financial institutions would accept.

Extension and training

The Nepal government provides some agricultural research and extension services. Under the federal system of governance, agricultural (including livestock) extension has been devolved to the local Government services. Accordingly, municipalities have agricultural units and there are *Krishi Gyan Kendra* (Agriculture Knowledge Centre), Veterinary Hospital/ Livestock Service Centre, and Integrated Livestock and Agriculture Development Offices connecting agricultural and livestock research with farmers and serving as knowledge resource bases for local farmers. In addition to extension and advisory services, they provide subsidized input support (seeds, pesticides, fertilizers, mechanization, other inputs- like plastic tunnels, drip irrigation etc.), organize technical trainings, and provide matching grants for agricultural and livestock processing and value addition. To a large extent, their support is oriented towards improving production and productivity and less on food safety and hygiene. However, this last mile communication leg offers enormous opportunity in addressing the issues of quality, post-harvest loss, food safety, and hygiene at the production node (including preliminary processing).

The Directorate of Agriculture Development (DoAD) and Directorate of Livestock and Fisheries Development (DoLFD) at the provincial level and Department of Agriculture (DoA) and Department of Livestock Services (DoLS) at the federal level are involved in facilitating extension services and promoting commercialization, mechanization, and modernization of agriculture (including livestock). The Ministry of Agriculture and Livestock Development is the apex body for the growth and development of agriculture and livestock sectors in Nepal.

Engagement of cooperatives and private sector in agriculture extension and trainings is a recent development for Nepal. They are emerging as sustainable and differentiated extension service providers, which also focus on product quality and market demand (e.g., organic and IPM). While the role of cooperatives in agri-extension is already conspicuous in horticulture (especially in vegetables and vegetable seeds), private sector agri-extension is largely found in poultry and plantation crops, like tea, as an embedded service.

Several of the food businesses interviewed suggested that they had received training from government programs, commodity associations, private training providers, in-house training programs, and Kalimati market in diverse topics such as supply chain management, food safety, post-harvest handling, business management and accounting, and business plan preparation.

Research and development

Nepal Agriculture Research Council (NARC) is an autonomous organization established to conduct agricultural research in the country. NARC includes the National Crop Research Institute (NARI), National Animal Science Research Institute (NASRI), and other institutes under which there are research centers/programs on horticulture crops (including FFV), livestock (breeding, nutrition, health, pasture, and forage), and food science and technology. NARC has a dedicated research station for goats in Bandipur. Based on their research, NARC provides location-specific technological recommendations for production and productivity improvement. However, food quality and safety has remained, so far, a less researched area at NARC.

3.6.3. Consumer attitudes towards safe food

With the increase in education, health awareness, and purchasing power, consumer preference is shifting towards nutritious, safe, and hygienic food. Nevertheless, price remains 'the dominating factor' leading to tradeoff between food safety and price. Leaving the price tag aside, consumers find local vegetables tastier and superior in quality than Indian imports, but because of the price factor, they opt to buy the Indian produce, even while aware that these imports enter Nepal without quarantine and pesticide checks (DFID/UKAid, 2020).

Safe, hygienic, natural, and organic foods (especially vegetables) are becoming popular among the urbanites. A study (Aryal et al., 2009) on willingness to pay (n=180) for organic products in Kathmandu conducted by the Nepal Permaculture Group in 2009 revealed that the respondents were willing to pay a price premium, but the level of acceptability varied considerably. A total of 58 percent of the consumers were willing to pay a 6- 20 percent price premium, whereas 13 percent were willing to pay up to a 50 percent premium. The average premium was estimated at about 30 percent. About 39 percent of the respondents felt the extra cost for organic products was reasonable, while 27 percent considered it too high. The survey pointed to the necessity of product development and innovations in certification, processing, labeling, and packaging (Aryal et al., 2009).

Goat meat is considered a delicacy and its consumption/demand is income elastic. In general, there is preference of local goats over imported ones and Nepalis prefer mountain goats. Despite better carcass yield of Indian goats (65%) over Nepalese goats (62%) with skin intact, this preference is apparent (Heifer, 2012). Meat lovers prefer freshly slaughtered and skin intact meat (80%) over frozen and skinless meat (20%). A study undertaken by Heifer International (Heifer, 2012) found that urban consumers were more concerned with improvements in hygiene and sanitation of meat retailer's shop, preferring slaughtering at time of purchase to avoid risk of adulteration. However, their willingness to pay for improved hygiene and sanitation conditions was not apparent, as only 11 percent of the respondents were willing to pay more. Only 25 percent of consumers expressed their willingness to pay more for choice cuts of meat.

Although more consumers are buying vegetables from supermarkets, the majority still prefer local retailers, as they feel supermarkets are expensive (DFID/UKAid, 2020). Similar preference is seen with goat meat, and consumers prefer fresh meat slaughtered in front of them to buying frozen meat.

CONCLUSIONS AND RECOMMENDATIONS

4.1. Key Findings and Conclusions

4.1.1. **Commitment to food safety (FS):** There is significant interest and inclination towards improving food safety by GFBs. However, this buy-in varies by the size of the business. Almost all businesses expressed their belief that improving FS would benefit their businesses in terms of increased sales, better prices, and profitability. However, only large and medium-sized firms are prepared to invest in FS provisions, including acquiring technical expertise, FS technologies, training, cost-effective logistics, and laboratory services. Several larger businesses were already implementing various FS measures, including obtaining necessary certificates from various government departments including DFTQC and third-party certification bodies. They also had plans to make investments in organic/IPM practices, cooling technologies, packaging, and grading as well as QR codes and blockchain. Some said they were looking for cost-effective, appropriate technologies.

While informal businesses, particularly the small retailers, were mostly unsure of the benefits, they were interested to know how FS would be beneficial to them. Smaller businesses neither have capacity to make investments in FS nor see significant benefits of doing so.

This is explained by the fact that many smaller, informal food businesses cater to the low-end market segments that put price over quality in buying decisions. Larger businesses see the benefits and are willing to make investments because they cater to upper- and middle-class customers who value food safety and quality, and this segment of the market is rapidly increasing.

An example of food safety challenges in small butcheries

The FSSA team observed the food safety situation in retail butcheries in Kathmandu to be the worst among the businesses we visited. Operating stations were unhygienic with knives and chopping boards that had gone for days without cleaning. Often the establishments did not have supply of clean or warm water. Improper handling of waste appeared to be spreading contamination. The staff hardly received any formal training on food safety. They were, however, eager to try food safety technologies that would be profitable in a small butchery. Efforts to introduce such food safety technologies in butcheries may contribute significantly to improving food safety as there are hundreds of such establishments in the Kathmandu food corridor, and they are popular among customers as they sell freshly cut meat.

4.1.2. **Common health risks:** Respondents attribute health risks like increased disease incidence, malnutrition, and food poisoning to 'unsafe' and contaminated foods, which occur quite frequently in Nepal. However, outbreaks of food related diseases, such as salmonellosis, are hardly reported by the government or the press, which has resulted in a low level of awareness of the fatal risks of these diseases among the general public. Neither government nor the general public appear to be adequately serious about these public health issues resulting from unsafe foods. A well-planned public awareness campaign is a need at the moment.

4.1.3. **Medium and smaller food businesses and market centers have most food safety problems:** While large food businesses appear to adequately manage their FS issues, the informal retailers have significant FS and quality problems. Medium-sized food processing industries such as FFV canning also had a lot of quality and safety issues. These processors, however, were seeking cost-effective solutions to address their FS problems. The FS issues in large market centers such as Kalimati, Balkhu, and Khasibazar were quite severe. These market centers were poorly managed, unhygienic, and lacked basic FS infrastructure. They did not have an adequate supply of clean water nor provisions for proper waste management. As such, they appeared to be the locations where most contamination would take place. Addressing the sanitary issues in these major market centers where over 70 percent of Kathmandu's FFV are sold would go a long way in addressing FS issues in the Kathmandu corridor.

4.1.4. Some hazards got more attention than others: While government agencies, businesses and the general public appeared to be quite concerned with the hazards posed by excessive use of pesticides in FFV, they were least concerned with the hazards of microbial contamination. Although largely ineffective, the regulatory bodies have some programs to address pesticide hazards. However, no such program was noted to address microbial hazards.

4.1.5. The regulatory framework for food safety is improving: In Nepal there are a number of FS related laws that are supposed to effectively regulate food standards, hazards, and risks and ensure the supply of safe food to consumers. However, experts argue that most of these laws are outdated and ineffective to address FS issues in the country. Recent release of National Food Safety Policy-2019, developed with assistance from the FAO and ADB, has introduced new approaches, opportunities, and provisions around food safety. These provisions are more scientific and based on risk analysis. UN agencies are assisting the government of Nepal to develop other laws and policies, which are expected to improve the regulatory framework for food safety in Nepal.

4.1.6. Poor enforcement of existing policies and standards is the weakest link: Although Nepal's food safety situation at present is constrained by a number of issues including, inadequate standards adaption, lack of supervision and testing of products based on inherent risks, inadequate testing capability, poor communication and training to various actors of the supply chain, old and outdated legal framework, and inadequate food safety infrastructure, the weakest link appears to be poor execution of standards and enforcement of laws and policies. Enforcement is weak because related government agencies are poorly funded and understaffed as well as incentives are not there to support food safety. Respondents reported that the minimum monitoring and surveillance that takes place also prioritizes price surveillance over food safety surveillance. In addition, inspections are challenging due to many retailers scattered over a wide geographic territory. Although BD4FS supports regulatory and enforcement, these agencies have been found to be a source of harassment by governments by SMEs. This results in "hiding" income and evading taxes etc.

4.1.7. Road connectivity is good but other elements of food safety infrastructure are poor, particularly for smaller firms: The production and consumption centers in both Kathmandu and Chitwan corridors are well connected by road networks. Roads connecting primary collection centers with production farms are fair weather roads. As such, supplies are temporarily interrupted only when landslides and floods block roads during monsoon season. Over the last year, supplies were interrupted due to government lockdowns owing to COVID-19. However, other elements of food safety infrastructure are weak. For example, supply of electricity is frequently interrupted. Supply of adequate and clean water for most smaller food businesses is a huge concern. Medium-scale food businesses were found using municipality water systems. Since the water supplied by the public water systems is not adequately treated, the medium-scale firms were using their own filtration systems. They also regularly tested the water. Large food businesses had their own water supply and treatment facilities.

4.1.8 Slow growth of cold chain: With increasing demand in Nepal for temperature-controlled, nutrition-dense, perishable foods, the traders have also started to seek cold storage services. As of now, there are 49 cold storages in Nepal with an average unit capacity of 3,000 metric tons (ADB, 2016). This is less than half of the total demand for cold storage space for FFV. Eggs are never stored in cold storage and fresh meat is stored in domestic and industrial refrigerators. The federal and provincial governments have developed plans to build 10 large cold storages in Baghmati Province alone (Kathmandu Post, 2019). Large establishments use their own temperature-controlled vans and trucks. This shows that Nepal's perishable food industry is moving towards increasing use of temperature-controlled supply chains, including cold storage and temperature-controlled transport services. However, the largest segment of Nepalese FFV, eggs, and fresh meat markets belong to lower and lower middle class that is not ready yet to pay the extra price incurred for temperature-controlled foods. It is estimated that countries with a per capita income of $4,000 can generally afford temperature-controlled fresh food. Nepal's per capita income is below that level suggesting that only higher- and middle-class households will afford price points of temperature-controlled fresh produce. As such, the growth of cold chain services in Nepal will be a gradual one reflecting the growth in demand for temperature-controlled fresh produce. In the meantime, as intermediate strategies, traders are looking for alternative cold chain technologies such as cooling racks, small-scale cooling and multi-chamber cooling technologies.

4.1.9 **Different retail practices and food safety:** The interviews suggested that at least three types of retail practices are emerging in Kathmandu and Chitwan corridors: (1) traditional retail through conventional neighborhood stores that cater to the lower-income markets and does not pay much attention to food safety issues including cold chain, sanitation, and testing; (2) retailing through modern supermarkets that pay full attention to food safety issues including cold chain, sanitation, proper packaging, etc. and caters to the higher end of the market; and (3) retailing that emerged partly due to the COVID-19 pandemic is e-commerce of food and specialized high-end retail start-ups that target upper and higher middle-class households. These retailers are found directly sourcing produce from farmers to avoid in-transit contamination.

4.1.10. **Demand for temperature controlled, safe food is increasing:** Almost all respondents agreed that the demand for safe food is increasing in Nepal due to increased awareness as well as affordability. Younger population, expatriates, and migrant returnees (from overseas employment) are more inclined towards safe and quality foods. They are among the main customers of frozen and temperature-controlled products sold through supermarkets. The majority of the respondents believed that the increase in demand for temperature control and quality products is because of this segment of the market.

4.1.11. **Access to finance:** While large- and medium-sized food businesses borrowed from banks, the majority of the small firms borrowed from relatives, informal sources such as savings and credit groups, and used personal savings to finance working capital. Some firms were found borrowing to finance trucks and pick-up vans. None were found to have borrowed, specifically to improve their food safety initiatives.

4.1.12 **Need for agricultural logistics company:** The fresh produce supply chain in Nepal is chaotic, controlled by a few actors, and is inefficient. Very few food safety-related activities are performed in agricultural products logistics. Conventional traders are not even aware of food safety risks, hazards, food safety standards, emerging technologies, and potential benefits from them. In consideration of this, respondents suggested that there is a need for an agricultural logistics company.

4.2. Recommendations

4.2.1 The survey showed three distinct retail channels emerging in Nepal: traditional channels, supermarket outlets and online trading. Customers who buy from the second and third retail channels (supermarkets and online home delivery) were found to value and afford temperature-controlled, safer foods. In addition, the traders operating through supermarkets and online channels had financial incentives to adopt safer food practices, including investments on cooling technologies. As such, the BD4FS project should consider partnering with the GFBs operating these modern channels and develop them as role models.

4.2.2 Trying to improve government systems for food safety is a long-term proposition with many uncertainties. In addition, various other international development agencies such as the World Bank, and FAO are working with the government to improve the enabling environment. As such, BD4FS should focus on working with the private sector, particularly with the GFBs as defined in this FSSA Report to improve food safety in Nepal. An effective approach to work with the GFBs will require understanding the target market dynamics and deploying tailored strategies, such as co-creation of potential interventions with target GFBs in meeting their financial needs, accessing appropriate technologies, incentivizing the supply chain for safer food practices as well as training and awareness generation among consumers and supply chain actors.

4.2.3 Various government agencies as well as development partners and private sector have been able to raise the awareness among the Nepalese public of the dangers of unchecked use of pesticides. It is equally necessary to raise public awareness on the dangers of microbial and other hazards, which should be addressed by BD4S within its training and awareness generation strategies.

4.2.4 BD4FS should target medium-sized food businesses because large businesses have their own systems for water and electricity supply and refrigerated vans. They would not need project interventions to improve food safety provisions in their businesses. Informal food businesses such as kiosks and hawkers neither have resources nor the knowledge or

motivation to adopt food safety provisions. The formal, small and medium food businesses, therefore, seem to be the ideal target group, which can become the agents of change for food safety in Nepal. The large food businesses can be mobilized to assist medium and small GFBs by sharing their food safety knowledge and experiences. Larger food businesses can also be partnered with to influence the enabling environment for food safety. Such knowledge and data sharing (e.g., food production, processing and storage best practices, consumer trends) will be an important area where BD4FS can partner with relevant stakeholders to improve efficiency for GFBs along the value chain. In addition, this sort of greater vertical integration within the value chain (e.g., creation of retailer private label programs that represent safe practices) can mobilize accountability and ownership of food safety.

4.2.5 Guidance, training, and awareness programs targeted at all relevant food business operators are necessary for building a foundation for recognized food safety certifications. BD4FS can coordinate targeted capacity development for GFBs to implement Good Manufacturing Practices (GMPs) and Good Hygienic Practices (GHPs) and gradually implement full-fledged Food Safety Management Systems. BD4FS can advocate for mandatory risk-based systems (e.g., HACCP) for industries producing high-risk food products.

4.2.6 A large segment of the market, particularly the one being served by informal kiosks and hawkers, is not ready yet to pay an extra price for temperature maintained, safe food. This is not only because of affordability; it is also because of lack of knowledge about food safety among many consumers as well as consumer tastes, behavior, and perceptions. It is common for consumers from upper-middle and middle-class families to buy fresh fruits and vegetables and freshly cut goat meat from roadsides. Empowering consumers through effective risk communication and education to make safe and healthy food choices will further stimulate the industry to produce safe, nutritious, and appropriately labeled foods. Educated and informed consumers can play an important role in driving good hygienic practices and environmental sanitation in food processing and retail, as well as in traditional food market settings. BD4FS's partnerships can facilitate simple but effective tools for improving food safety outcomes by providing accurate health messages on hazards and risks associated with production, processing, and sale of perishable foods.

4.2.7 The FSSA showed that BD4FS could contribute by emphasizing positive experiences. Infrastructure limitations are a common denominator across Nepal, especially poor road networks, unreliable power supplies, lack of sanitary facilities, and underdeveloped cold chains all have a disproportionate impact on a business's ability to maintain food safety protocols, especially with highly perishable foods such as FFV, eggs, and meat. Larger food businesses have been able to implement various food safety provisions on their own, despite this poor public infrastructure and regulatory environment. BD4FS can encourage its business partners to learn from these successes.

4.2.8 Currently, there is a void in documenting and reporting outbreaks of foodborne epidemics. There is no formal system to recall contaminated foods. There is an urgent need to establish a food safety incident and emergency response system, and this should link to the International Food Safety Authorities Network (INFOSAN) and the International Health Regulations (IHR), as appropriate. As part of such plans, national guidance or codes of practice should be developed for traceability of implicated food and feed for timely identification and effective recall of affected products. BD4FS may work with other development partners and the government to introduce such systems within the national regulatory framework.

4.2.9 The survey discovered that GFBs were not using temperature control technologies even when there was sufficient demand. And they cited these as the reasons for not using temperature control technologies: (a) while customers would prefer temperature-controlled products, they would not pay a higher price; (b) GFBs lacked financing to invest in these technologies; (c) they could not find temperature control technologies appropriate to their scale of business; (d) some GFBs thought such technologies would increase their costs and reduce the market size, and as such would make the strategy unviable; (e) they also thought that for products other than meat, there was no need for cold chain if the products are to be sold within a few days of harvest. BD4FS is recommended to explore these factors further and partner with GFBs to address the resulting issues.

4.3. Areas for further investigation

4.3.1 Interviews revealed that several companies had fully understood food safety, but they were hesitating to invest in food safety measures. Further investigation on what is demotivation them and how the BD4FS project can work with them to undo this obstacle.

4.3.2 The survey indicated that agricultural logistics companies have not taken roots in Nepal. Establishment of such companies would avoid several postharvest food safety hazards. The project can explore what are the obstacles in operating such a company in Nepal

4.3.3 While there are some third-party certification agencies in the country, a lot of room exists to promote more of such agencies that would address areas such as good agricultural practices, good livestock practices, etc. BD4FS could explore why more such agencies are not coming up and how to facilitate the growth of such agencies.

4.3.4 The pesticide tests conducted by current labs are very basic. The survey uncovered that new and more dangerous pesticides are being used in the country and there are no facilities to test them. BD4FS could explore what new pesticides are being used, and how lab capacities should be improved to cover the risks and hazards posed by these new pesticides.

4.3.5 FFV and meat (and to a lesser extent eggs) value chains in Nepal are found to be middlemen (aggregators, transporters) driven in that producers have very little say in pricing. This results in minimum trust between the actors and enforcement of the quality and safety standards become difficult. For example, while traders complain about the poor quality of products, farmers complain that they are being exploited by the middlemen (traders and other market intermediaries). BD4FS could explore how more trust and fairness could be promoted in these value chains.

4.3.6 A USAID/Winrock study found in 2008 that most of the poultry farmers did not follow the vaccine regimen. Data was not available to ascertain whether this practice continues. This is another area the second phase of the FSSA could explore.

4.3.7 The respondents of the survey argued that most of the producers were unaware or did not care about their responsibilities in safe and hygienic meat production. The respondents suggested that the farmers would sell sick animals rather than spending on veterinary services. A Heifer study in 2012 confirmed this perception, but no information was available on whether this perception and practice continues. The second phase of the FSSA may explore this issue.

REFERENCES

Accreditation, Education, Research and Scientific Service Center (AERSSC). 2019. *Quality Manual: Based on ISO/IEC 17011:2017 'Conformity Assessment – General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies*. Kathmandu: AERSSC. Available online at: http://aerssc.com.np/wp-content/uploads/2019/05/Quality-Manual-1.pdf

Adhikari S., Khadka S., Sapkota S., Sharma BR, Ghimire A., and Chalise M. 2020. Multi-drug Resistant and Extended Spectrum β-lactamase Producing Salmonella Species Isolated from Fresh Chicken Liver Samples. *Kathmandu University Medical Journal*. 2020; 69(1): 23-7.

Animal Nepal. 2018. *National Livestock Wellness Survey: A situation Analysis of Livestock Sector in Nepal*. Kathmandu: Animal Nepal.

ANSAB and NEAT. 2011. *Value Chain Analysis of the Off-Season Vegetable Sector in Nepal*. Kathmandu: USAID Nepal.

Aryal K.P., Chaudhary P., Pandit S., and Sharma G. 2009. Consumers' Willingness to Pay for Organic Products: A Case from Kathmandu Valley. *Journal of Agriculture and Environment*. vol. 10, no. 6.

Asian Development Bank (ADB)/White Lotus. 2016. *Scaling-up Investments in Agriculture in Nepal: Opportunities, Challenges and Way Forward*. Kathmandu: ADB/White Lotus. Available online at: http://white-lotus-centre.com/scaling-up-investments-in-agriculture-in-nepal-challenges-opportunities-way-forward-final-report-24august2016.pdf

Asian Development Bank (ADB). 2019. *Dysfunctional Horticulture Value Chains and the Need for Modern Marketing Infrastructure: The Case of Nepal*. Kathmandu: Asian Development Bank.

Bajagai, YS. 2012. *Food Safety Regulation in Nepal and Issues in the Regulation of Meat Safety: Proceedings of National Conference on Food Science and Technology*. Kathmandu: Ministry of Agriculture Development

Bhandari, L. R. 2020. *Impacts of food adulteration in Nepal. International Journal of Applied Research*. 6 (9): 333–339. Available online at: https://www.allresearchjournal.com/archives/2020/vol6issue9/PartE/6-6-60-703.pdf

Bhandari G., Zomer P., Atreya K., Mol GJ., Yang X., and Geissen V. 2019. *Pesticide residues in Nepalese vegetables and potential health risks*. Available on-line: https://pubmed.ncbi.nlm.nih.gov/30852454/

Bhandari **P**., Banjara M., Singh A., Kandel S., Rawar D., Pant B., 2021. Water Quality Status of Groundwater and Municipal Water Supply (Tap Water) From Bagmati River Basin in Kathmandu Valley, Nepal. *Journal Of Water, Sanitation and Hygiene for Development*. Vol.11, Issue 1.

Bhattarai D., 2018. Post-harvest Horticulture in Nepal. *Horticulture International Journal*. Available online at: https://www.researchgate.net/publication/336159585_Postharvest_horticulture_in_Nepal

Bista P., 2019. Province 3 Invests Rs. 450 million to Build Cold Storages. *The Kathmandu Post*, September 28, 2019. Available online at: https://kathmandupost.com/money/2019/09/28/province-3-invests-rs-450-million-to-build-cold-storages

Central Bureau of Statistics (CBS). 2011. *National Population and Housing Census 2011*. Available online at: https://unstats.un.org/unsd/demographic-social/census/documents/Nepal/Nepal-Census-2011-Vol1.pdf

Central Bureau of Statistics (CBS). 2016. *Nepal Commercial Poultry Survey 2014/15*. Kathmandu: CBS, Government of Nepal.

Department of Food Technology and Quality Control. 2018. *Annual Bulletin*. Kathmandu: Ministry of Agriculture and Livestock.

Department of Food Technology and Quality Control. 2018/019. *Annual Bulletin.* Kathmandu: Ministry of Agriculture and Livestock.

Department of Food Technology and Quality Control. 2020. *Annual Bulletin.* Kathmandu: Ministry of Agriculture and Livestock.

DFID/UKAid. 2020. *Vegetable Sector Strategy- Nepal, Commercial Agriculture for Smallholders and Agribusiness.* Kathmandu: DFID/UKAid, Nepal.

FAO, 2018 *Technical Summary Report on Food safety policy and legislation in the newly decentralized Federal Democratic Republic of Nepal.* Rome Italy: FAO, 2018

Gurung, T., Joshi, B., Singh, U. and Paudel. 2012. The Proceedings of the National Workshop on Research and Development Strategies for Goat Enterprises in Nepal. *National Workshop on Research and Development Strategies for Goat Enterprises in Nepal.* Kathmandu*:* Nepal Agriculture Research Council (NARC).

Hedley, E., Freer, G., and Lopez-Gomez, F. 2019. *Samarth - Nepal Market Development Program: Final Evaluation Report*. United Kingdom: ePACT Consortium.

Heifer International. 2012. *A Study on Goat Value Chain in Nepal.* Kathmandu: Heifer International, Nepal. Available online at: https://dokumen.tips/download/link/a-study-on-goat-value-chain-in-nepal-heifer-international-goatvalue2016-03-08this

International Finance Corporation (IFC). 2014. *Stories of Impact in Agribusiness: Strengthening Poultry Supply Chains in Nepal.* Available on-line: https://www.ifc.org/wps/wcm/connect/fa38a89d-1c3b-4025-bf40-5df80cdb80c4/StoriesOfImpact2014_PoultryNepal.pdf?MOD=AJPERES&CVID=kE5ZcQy.

Khanal, S., Kumal, A., Shrestha, R., Sapkota, S., Baral, S., KC, S., and Joshi, D. 2020. Microbial Quality of Chhoyla and Kachela: Traditional Newari Meat Products. *Journal of Food Science and Technology Nepal*, 12(12), 9 - 13. Available on-line: https://doi.org/10.3126/jfstn.v12i12.18134

Kumar, A., Thapa, G., Joshi, P. K., and Roy, D. 2016. *Adoption of food safety measures among Nepalese Milk Producers: do smallholders' benefit?* International Food Policy Research Institute. Available online at: https://www.ifpri.org/publication/adoption-food-safety-measures-among-nepalese-milk-producers-do-smallholders-benefit
Ledgerwood J.2021. *Making Market Systems Work for the Poor (M4P).* United Kingdom: Practical Action Publishing ltd.

Maharjan M., Joshi V., Joshi D., and Manandhar P. 2006. Prevalence of Salmonella Species in Various Raw Meat Samples of a Local Market in Kathmandu. *Annals of New York Academy of Sciences*, vol. 1081, no. 1.

Ministry of Agriculture and Livestock Development (MoALD). 2020. *Statistical Information on Nepalese Agriculture 2018/19*. Kathmandu: MoALD, Government of Nepal.

Ministry of Industry, Commerce and Supplies (MOICS). 2012. *Unified market monitoring guidelines - 2012*. Kathmandu: MOICS, Government of Nepal.

My Republica. 2020. *Broiler parent stock worth Rs. 540 million Imported in five Months.* Available online at: https://myrepublica.nagariknetwork.com/news/broiler-parent-stocks-worth-rs-540-million-imported-in-five-months/

National Food and Feed Reference Library. 2019. *NFFRL Accreditation certificate and Scope.* Kathmandu: SPS National Enquiry Point, Ministry of Agriculture and Livestock Development, Government of Nepal.

Nelson A., Manandhar S., Ruzante J., Gywali A., Dhakal B., 2020. Antimicrobial Drug Resistance Non-Typhoidal Salmonella Enterica in Commercial Poultry Value Chain in Chitwan, Nepal. *One Health Outlook*. Available online at: https://onehealthoutlook.biomedcentral.com/track/pdf/10.1186/s42522-020-00025-4.pdf

Nepal Agribusiness Innovation Center (NABIC). 2019. Survey on Needs for Quality Infrastructure Services Among Food Processing Industries in Western Nepal. Kathmandu: NABIC. Available online at: http://nabic.com.np/application/themes/pagoda_c/img/brochure/PTB_GDC%20Quality%20infrastructure%20survey%20report.pdf

Nepal Rastra Bank (NRB). 2020. *Monetary Policy of Fiscal Year 2020/21*. Kathmandu: Nepal Rastra Bank, Government of Nepal.

Nepal Rastra Bank (NRB). 2021. *Third Trimester Review of the Monetary Policy 2020/21*. Kathmandu: Nepal Rastra Bank, Government of Nepal.

Online Khabar. 2019. Hatcheries Across Nepal to Close for Next Ten Days. Online Khabar, December 15, 2019. Available online at: https://english.onlinekhabar.com/hatcheries-across-nepal-to-close-for-next-10-days.html

Osti R., Bhattarai D., Choudhary H., Singh V. 2017. Poultry Production in Nepal: Characteristics, Productivity and Constraints. International Journal of Applied Sciences and Biotechnology. 5(2):222. Available online at: https://www.researchgate.net/publication/318024611_Poultry_Production_in_Nepal_Characteristics_Productivity_and_Constraints

Rai M., Nepal P., Rai D., Poudel B. 2019. Commercial Vegetable Farming: Constraints and Opportunities of Farmers in Kirtipur, Nepal. *The Geography Journal of Nepal*. Vol. 12: 101-118, 2019

Sharma D.R., 2015. *Status of Chemical pesticides use and their regulation in Nepal.* Available on-line: http://npponepal.gov.np/uploads/files/Status%20of%20Chemical%20Pesticides%20and%20their%20use-%20Dr%20Dilli%20Ram%20Sharma.pdf

Sharma S., Fowler P.D., Pant D.K., Singh, S., and Wilkins, M.J. 2021, Prevalence of non-typhoidal Salmonella and risk factors on poultry farms in Chitwan, Nepal. *Veterinary World*, vol. 14, no. 2. Available on-line: http://www.veterinaryworld.org/Vol.14/February-2021/14.html

Sharma, N., Karki, N., Gurung, B., and Nepali, N. 2008. *The Nepal Poultry Value Chain and Avian Influenza. Lalitpur*: Stop AI-DAI, Winrock and IDE

SSG Advisors, LLC and Chemonics International, Inc. 2015. *USAID/Nepal Private Sector Engagement Assessment - Agricultural Sector*. Kathmandu: USAID Nepal.

The Himalayan Times. 2021. The Bird Flu Scare. The Himalayan Times, February 2021. Available online at: https://thehimalayantimes.com/opinion/editorial-bird-flu-scare.

The Kathmandu Post, 2017. Draft Farm Bill Envisages Starting Contract Farming. The Kathmandu Post, October 2017. Available online at: https://kathmandupost.com/money/2017/10/17/draft-farm-bill-envisages-starting-contract-farming

USAID. 2019. *Pesticide Evaluation Report and Safer Use Action Plan*. Available online: https://www.usaid.gov/documents/1865/pesticide-evaluation-report-and-safer-use-action-plan-persuap

USAID. 2018. The Global Food Security Strategy Nepal Country Plan. Kathmandu: USAID Nepal. Available on-line at: https://www.usaid.gov/sites/default/files/documents/1867/GFSS-Nepal-Country-Plan.pdf

USDA. 2018. *Nepal SPS Assessment: Roadmap to adapting a Modern SPS System*. Kathmandu: Feed the Future, USAID/Nepal.

Varyvoda Y., Cederstrom T., Borberg J, and Taren D. 2021. Enabling Food Safety Entrepreneurship: Exploratory Case Studies from Nepal, Senegal, and Ethiopia. *Frontiers in Sustainability,* 27 September. Available on-line: https://doi.org/10.3389/fsufs.2021.742908

Yadav I, Dhuldhai U, Mohan D, Singh S. 2011. Current Status of Groundwater Arsenic and its Impacts on Health and Mitigation Measures in the Terai Basin of Nepal: An Overview. *Environmental Reviews*. Available online at: https://cdnsciencepub.com/doi/10.1139/a11-002

ANNEXES

Annex 1. GFB Interview Guide

Namaste.

I am …….(INTERVIEWEER'S NAME) and my colleague here is ……. ….. (NOTE TAKERT'S NAME). We are working as short-term consultants on this assignment for Food Enterprise Solutions, a US based development organization. We are conducting this research to understand how Nepalese food businesses, that collect, transport, store, process and sell poultry, meat, vegetable and fruits, both fresh and processed, are addressing food safety concerns in Nepalese markets. We are also interested in new technologies and practices that these food industries are using or would like to use.

We are grateful for your agreeing to participate in this research by providing us relevant information. This in-depth interview will require about an hour of your time. Your personal identity will not be revealed, and your responses will be kept confidential. The information provided will be used solely for the purpose of this research.

We would prefer to record our conversation for our future reference. Do you have any objection to our recording of this interview?

We have thought of a few topics for our interview/discussion. So, let me start. But you are welcome to raise other topics at any time or ask any questions. My colleague will be taking notes.

II. BUSINESS/INTERVIEWEE PROFILE:

a. Name of the enterprise:

b. Age of the enterprise: How long is this business in operation?

c. Name/ contacts of interviewee:

d. Interviewee's position: (owner, partner, senior officer, others)

e. Type of business:
What is/are the major activities of your food business? (Collector/aggregator, transporter, storage/warehouse, processing, cold chain, wholesaler, retailer, importer, exporter, others). Tick all that apply.

f. What types of foods does your business handle?

g. Number of employees: just the owner; family members; up to 5: 6 to 10; 11 to 25; over 25 (temporary- hour basis 25, 10 regular employee)

h. Interviewer: based on number of employees, make judgment as to Micro (family), Small (up to 5), medium (6-25), or large Over 25

i. Gender of business owner: Male/Female.

j. Age group of owners: 15 to 29 years, 30 years and over

k. Education of owner: University, High school, Primary school, can read and write, cannot read and write

l. Number of partners…

m. Number of clients ……

III. LANDSCAPE QUESTIONS

A. Questions to all VC actors (Collectors, wholesalers, retailers, etc.)

Risks and hazards

1. Based on your experience and knowledge, what are the common risks to human health from consumption of contaminated foods? Yes

2. Based on your experience, is the demand for safe food increasing? Yes

If yes, are you implementing any preventive measures to prevent food contamination? Please tick all that apply.

Measures	Yes
a. Pest control measures	
b. cleaning schedules	
c. Waste management system	
d. Product segregation	
e. Staff training and awareness	
f. Standard Operating Procedures (SOPs) for handling, storage, and distribution of incoming, in-process, and outgoing products	
g. Internal Control System- monitoring and supervision	
Certification (GAP, GVP, GMP, GHP, HACCP, organic etc.)	
Others (Please specify……..)	

3. What are the key reasons for poor food safety practices in Nepal? a) Consumer are not prepared to pay extra price, b) government enforcement is weak, c) companies need educating on food safety issues, e) others - specify?

Infrastructure: Transport

4. Please tell us the mode of transportation and packaging materials used during transportation of agri-food products.

	Fruits and vegetables	Eggs	Goat
Type of vehicle			
Packaging material			

5. Are you taking any actions or using any technology to reduce post-harvest/in-transit loss and increase shelf life of perishables?

If yes, please specify.

If not, why: (i) not aware of, (ii) no incentives, (iii) lack investment capital, (iv) others……

Infrastructure- Cold chain:

6. Do you use temperature-controlled mechanism?

If yes,

	Type of cooling technology used		
F&V			
Eggs			
Fresh meat			

If not, why?

If yes, is optimal storage temperature maintained in the cold chain?

7. Is there local demand of temperature-controlled products sufficiently large enough to make cold chains commercially viable? Yes.

Infrastructure – water, electricity:

8. What is the source of your water and is there adequate supply to wash products, equipment and machines, storage facilities, slaughter slabs, processing facilities? Yes/No

9. Is regular electricity available at different stages of the value chain?

Regulatory framework

10. Are you aware of any food safety monitoring/surveillance system in Nepal? Yes.

If yes, what is your experience with the current monitoring and surveillance system and is this system effective in improving

food safety?

If not, do you think there should be a mechanism to monitor food safety across the chain? Who should monitor and how?

11. Do you undertake lab test of your products?

If yes, when (at arrival, during storage, or during dispatch) and where (private or public lab)? If not, why?

Market systems

12. Do you know whether the commodities you trade (F&V, meat, egg) are domestically produced, imported, or both?

If both, what is the rough share of: (i) domestically produced (…… %) and (ii) imported (…%)

13. How are the prices determined at different nodes of value chain? Which actors are most influential in determining prices?

Support Services

14. Who do you normally access to for following services?

Services	Service Providers
Finance	Working capital: Fixed capital: Others:
Technical skills	
Technology	

15. Have you borrowed/taken any loan currently? Are there any constraints you faced in borrowing?

16. Have you received any training on following subjects?

Subject	Training providers	Paid or free
a. Agri-food supply chain management		
b. Food safety		
c. Post-harvest handling		
d. Business management		
e. Accounting		
f. Business plan		

g. Others (specify……)		

Consumer attitude towards food safety:

17. Based on your observation and experience, what dominates consumer decision to buy food products? Price (…) OR Quality (….)- pls select one.

18. Based on your knowledge and experience, what proportion of consumers is willing to pay premium price for safe and hygienic products? (…….%)

_____

III. COVID RELATED QUESTIONS

1. What changes you have experienced in your food business during the COVID pandemic?
a. Consumer demands: Increased _____ Decreased _____
b. Sales: Decreased _____ Airlines stopped
c. Prices of your products/services: Stable
d. Your overhead cost: Increased _____ Decreased _____
e. Prices of your raw materials and supplies: Stable

2. Did government-imposed lockdowns and restrictions result in the closure of your business? Yes Since COVID started, how many days approximately was your business closed? 230 days, home delivery

3. **Sales:** within the following time periods whether your total sales increased or decreased?

	(1) March-Aug 2020, or first six months	(3) Jan2021-present or last six months
Decreased by … %		
Increased by …%		
Stayed about the same		

4. What measures were taken to address declining sales? Tick all that are applicable.
a. Scaled back production/operation, Family start doing works /All staffs were asked to leave the jobs
b. Sought new markets,
c. Formed new partnerships,
d. Designed new products,
e. Used new distribution channels (home delivery),
f. Used new ways of advertisement (social media)
g. Others

5. **Supply chain**: What supply chain challenges were faced during following time frames? Tick all that are applicable

	(1) March-Aug 2020, or first six months	(3) Jan2021-present, or last six months
a. Shortage of raw materials and other inputs		
b. Supplier' production and delivery reduced		
c. Delays in receiving raw materials, supplies		
d. Transportation problems due to closures		
e. Increase in transportation costs		
f. Others		

6. What measures were taken to address supply chain issues? Tick all that are applicable
a. Sought new suppliers
b. Went in favor of more local supplier
c. Introduced digital measures
d. Others

7. What **workforce** related challenges were faced during the following time frames? Tick all that are applicable

	(1) March-Aug 2020, or first six months	(3) Jan2021-present, or last six months
a. Difficult to get skilled workers /employees at site due to closure		
b. Demotivation due to having to accept temporary pay cut		
c. Resignation by employees		
d. Absenteeism due to sickness and other reasons		
e. Lack of motivation due to extra hours of work		
f. Having to make new arrangements to come to work		
g. Took longer hours to come to work		
h. Others		

8. What measures were taken to address workforce issues? Tick all that are applicable

i. To assure staff – daily health screening, training on COVID protocols, work areas equipped with more hygienic procedures/tools/ sanitizers. Transportation provided to employees
ii. Working from remote locations allowed
iii. Scale of operations reduced- 3 outlets were closed
iv. Introduced machinery (automation) to replace some workforce
v. Contracted out some part of operations
vi. Others I am relocating my industry to rural areas to reduce operation cost

9. What **finance related** challenges were faced during the following time frames? Tick all that are applicable

	(1) March-Aug 2020, or first six months	(3) Jan2021-present or last six months
a. Faced working capital shortages		
b. Could not automate operations because I could not get investment capital		
c. Banks reduced credit due to increased unproductive loans.		
d. Physical accessibility of banks reduced as they closed		
e. Borrowing took much longer than earlier		
f. Not able to pay the loan, interest, or EMI		
g. Others		

No major threat in all areas.

10. What measures were taken to address finance related issues? Tick all that are applicable

i. Borrowed from non-bank sources
ii. Purchased raw materials and supplies on credit but this is a regular practice
iii. Received grants and support from the government and/or donors
iv. Settled on reduced operation due to working capital shortages
v. Postponed automation or introduction of machinery until later
vi. Others

11. Compared to the pre-lockdown period (e.g., April 2019), how much of your business/operation has resumed now?

a. Less than 25%; b. 26% to 50%; C. 51 to 75%; D. over 75%

12. Do you think improving food safety would be beneficial to your business? Yes, no, not sure; If not why not. If yes, in what ways?

i. Better market access,

ii. greater customer satisfaction and repeat customers,
iii. reduced food loss,
iv. better working conditions for employees,
v. increased sales and profit,
vi. others.
vii. Farmers get premium

13. Would you be willing to invest on food safety provisions in your businesses? Yes. If yes, what would you invest in and what would be necessary for you to do so? If no, why not? I do not have capacity to invest on it.

14. It is believed (though not definitively proven) that COVID started from wet meat markets in China, which means lack of adequate food safety provisions by businesses. In this context, do you think food safety should be given higher priority by businesses, government and general public in these changed environments? If yes, what would be the priority food safety actions in light of COVID by businesses, government and general public? If no, what should be the priority actions by businesses, government and general public in light of COVID?

15. Would you do anything different in your business as a result of COVID? If yes, what would you do differently?
16. To recover from the impacts of Covid on food businesses, what do you think food businesses should do?
17. What governments and other supporters can do to help food businesses to recover from the impacts of COVID?

V. CLOSING:

We greatly value your co-operation. Thank you for your time and consideration. If you have any questions regarding this project, please feel free to contact us on: TEL. ……; EMAIL ……

Additional questions to Key exporters:

1. Please mention the export markets and the main products that you export to.

2. Are the existing cooling technologies/cold chains facilities effective in meeting export market requirements? Yes/NO; If yes, can they also be used to cater products for the local markets? Yes/No

3. What are the key export market requirements for perishables (fruits and vegetables) such as certification requirements? - Plant Quarantine, Pan Number, Registration, Cargo provide lists of vegetables that should be expected.

Documents, lab test, Real 100 per sample test

4. What are the key problems/challenges in meeting SPS standards of the importing countries? Cartoon damage, airport transfer, etc.

5. Have you faced or are you aware of food safety issues during export of perishables (F&V) and meat? Please specify. Yes. 1 Packaging, 2. Type of vegetables, 3. Timespan of types of vegetables,4. Washing and Dried vegetables (the pesticides are less detected) 5. Wrapping

Consumers- Asian

Kalimati case study:

Questions – What are the key activities of Kalimati management? Its organizational structure? Governance? What is the size of

transaction/turn over? What is their value add in marketing/distribution, food safety and reduction of food losses? Their lab services – scope, strengths weaknesses? What facilities could be added (e.g., cold storage) to improve their services and operations. What are their overall concerns and suggestions? Explore also the status and issues of wet markets of Kalimati, including goat meat, fish, and eggs.

Annex 2. Types of Companies Interviewed for COVID Brief

Categories	Counts
Vegetable and fruits	6
Fruits only	7
Eggs	2
Organic food	3
Vegetables only	11
Meat	8
Other	24
Total	61

Annex 3. Roles and responsibilities of Government of Nepal departments and institutions in food safety

The Department of Food Technology and Quality Control (DFTQC) under the Ministry of Agriculture and Livestock Development (MoALD) of Government of Nepal (GoN) is the apex organization responsible for monitoring food safety/food quality and enforcement of food safety related legislations. DFTQC's role also includes setting permissible limits of chemical contaminants, microbial contaminants, heavy metals, mycotoxins, MRLs of pesticides, veterinary drugs, antibiotics, etc. and processing aids and food additives as well as labeling specification of food commodities. Further, the department has an important role in augmenting appropriate food processing and post-harvest techniques and research to promote agribusinesses. However, food safety at the farm production level is controlled by the Department of Agriculture (DOA), and Department of Livestock Services (DLS). After the farm products are transformed to food products, they are classified and monitored by the DFTQC to control unsafe, adulterated foods and food additives.

Key Government Agencies Involved in Food Safety in Nepal

1. Ministry of Agriculture and Livestock Development (Department of Agriculture, Department of Food Technology and Quality Control, Department of Livestock services)
2. Ministry of Industry, Commerce and Supplies
3. Ministry of Health and Population
4. Provincial Ministry of Land Management, Agriculture and Cooperatives
5. Municipalities (Agriculture/Livestock Sections)
6. Various laboratories
7. National CODEX committee
8. SPS Enquiry Point
9. International food Safety Authorities Network/ Nepal
10. Nepal Agriculture Research Council (NARC)
11. Nepal Bureau of Standards & Metrology (NBSM)

Since 1974, Nepal has been a member of CAC and established National CODEX committee in 2004, and the National Codex secretariat is situated at DFTQC. The Director General of DFTQC is the CODEX contact point of Nepal. DFTQC has also been given the role of National SPS Enquiry Point since 2004. In addition, DFTQC is also the focal point as well as emergency contact point for International Food Safety Authorities Network (INFOSAN).

DFTQC regulates the food safety of exported and imported food products as per various regulations including food labeling regulations and additives and contaminants regulations. For this purpose, DFTQC has established 12 Food Import Export Quality Certification offices in all designated entry/exit point including one in Tribhuvan International Airport. DFTQC is also responsible for the establishment and management of the National Food Standard.

Department of Agriculture (DOA) and Department of Livestock Services (DLS) are tasked to regulate primary production starting at the farm level, The DOA regulates the registration and inspection of pesticides and fertilizers through the Pesticide Act, 1991 (revised as Pesticide Management Act in 2019). DLS regulates the production and productivity of livestock and related products through Animal Health and Livestock Services Act, 2055 (1999), Animal Slaughterhouse and Meat Inspection Act, 2055 (1999) and Animal Health and Livestock Services Rules, 2056 (2000). DOA as well as NARC conduct research and provide skills development training on topics such as good agricultural practices (GAP) to all producers, including small farm holders. However, DFTQC has been assigned with the role of providing Nepal GAP certification to registered farms in compliance to its requirements.

Nepal Bureau of Standards & Metrology (NBSM) is the National Standards body of Nepal under Ministry of Industry, Commerce and Supplies. It is also the national enquiry point/nodal point for WTO (TBTs and NTMs). The main activities of NBSM are to: formulate national standards; operate the product certification mark; provide testing facilities and technical services; work as the third-party guaranteeing agency; provide service for lot certification and pre-shipment inspection, as well as laboratory recognition and launching of consumer awareness programs on quality; Provide laboratory services for testing of various commodities and involved in environment protection. Additional activities include legal metrology and calibration services for monitoring and measuring devices. Scientific Metrology Section of NBSM is responsible for establishing the national standards, providing traceability to the working standards of satellite offices of NBSM which are responsible for legal metrology

in Nepal, providing calibration services of instruments used in research & testing laboratories as well as laboratories in the manufacturing industries such as pharmaceuticals and food.

As the national standard and certification body of Nepal, NBSM provides various types of certification services. It is the sole agent for product certification against Nepal Standards (NS Mark) under the provisions of the Nepal Standards (Certification Marks) Act 1980. NBSM has established an Inspection and Certification Section to award licenses to industry to apply NS Mark on those products, which conform to national standards and carry out inspection and certification work for product/process/services with the introduction of the certification schemes. However, Nepal standard for foods products by NBSM and National Food Standard by DFTQC are not completely aligned to each other creating FS-gaps. In the case of food safety management system certification, as there is no authoritative agency to maintain data on the number of FSMS certifications or similar certified companies and to keep record of the number of certifying bodies and their operations in Nepal, it is very difficult to ascertain the exact number of food businesses receiving and renewing different management system certifications. Most of the food industries in Nepal have received the management system certificates from foreign certification bodies, directly or through local affiliated private organizations. Some of these third-party certification providers are BSI Certificate Ltd, UK; ACM EMB Pvt. Ltd; Intertek Labtest Ltd, US; TNV System Certification, India; Quality Austria; SAI Global Certification Services, Australia; TUV Sud America Inc., US; TUV SUD South Asia; United Registrar of Systems (URS) Ltd, UK; Universal Quality Standard Registrar (UQSR)-Multinational; and SIS Certification, India.

NBSM has recently initiated introduction of ISO 9001, 14001, 50001, and 22000 certifications. This is expected to positively impact the food sector in the coming years. As for agriculture sector, DFTQC has been assigned for the certification in conformance to Nepal Good Agriculture Practice (Nepal GAP certification) for fruits and vegetable production. DFTQC have certified 3 fruits and vegetable farms so far with Nepal GAP certifications (DFTQC, 2020).

Department of Industry: While DFTQC provides licensing service to run food businesses, department of industry (DoI) under MOICS, approves food industry registration for medium and large firms, provides permission for foreign investment and technology transfer, and issues/recommends certificate of origin for the products that are to be exported. However, small food processing firms are registered and assisted by the micro, cottage and small industry promotion center under MOICS.

The Nepal Agriculture Research Council (NARC) is the autonomous agency under the government of Nepal mandated to develop technologies in production, postharvest management, and marketing. The Nepal Agriculture Research Council includes, in its structure, a Horticulture Research Division, several commodity-specific Agricultural Research Stations and a National Food Research Center. NARC is particularly responsible for research on postharvest loss, and postharvest technologies for extension services.

Agencies involved in Food Inspection: At present DFTQC is the sole regulatory body to enforce legislations on food safety. However unified market monitoring guidelines-2012 released by the MOICS have clearly stated the at least 5 representatives out of stated 14 from various department of government of Nepal to be present during market inspection and monitoring. DFTQC manages monitoring activities such as: monitoring of any food processing areas, food producing, sales, distribution and storage industries, food adulteration, safety and quality of raw materials of food processing industries, food additives, all types of sweets, milk and milk products, packaging and selling, and advertisement and labeling requirements of foods. Whereas DCSCCP monitor the supply, manufacturing and expiry dates, monopoly of trade, trade barriers to market, consumer protection and party palaces/catering. In case of fruits and vegetables, their production area, chemicals used for their processing, storage as well as for ripening and maturing, quality of fertilizers is monitored in coordination of DOA. DLS coordinates with the unified market monitoring for poultry and livestock, their meat and meat products, hormones, antibiotics used for meat production, sanitation of slaughterhouses, quality/pricing and packaging practices of meats in retail sites and wholesale livestock market. Whereas monitoring of butcheries, meat production, processing, selling has to be done under coordination of local government (MOICS, 2012). The mechanism of food market inspection and monitoring is there in place with developed guidelines support. However, the monitoring of various departments under the ministries of Agriculture and Livestock Development and Industry, Commerce and Supplies show that there are a lot of overlaps in the monitoring responsibilities and coordination, and the mandatory presence of stated 5 representatives of unified market monitoring team are usually overlooked.

The poor implementation of monitoring and surveillance provisions is further demonstrated by the fact that 90% of the respondents were aware of the existence of the provisions, but only 17 percent had experiences of being supervised by regulatory authorities; Over 80 percent of the food businesses were never visited by authorities to monitor their food safety provisions.

Laboratories/testing and calibration facilities: Food testing and analytical services are provided by both public and some private institutions, as well as by research laboratories (refer table of laboratory below). Due to weak infrastructure and capacity shortage, Nepalese laboratories provide testing services to very limited food products on very limited parameters. Many important and critical tests are being done abroad primarily in India but also in Europe and US or country with approved accreditation status where export is of concern. Meeting the food quality standards of destination markets is the fundamental requirement for increased export of agricultural produce. Despite its membership in the WTO, Nepal has not been able to adopt all international standards on sanitary and phytosanitary measures because of inadequate resources. The National Food and Feed Reference Laboratory at Kathmandu is the only laboratory in Nepal with international accreditation for food testing but, as mentioned earlier, limited test parameters (81 in total including chemical and microbiological parameters) are included in the scope of accreditation (NFFRL, 2019). These limitations hamper smooth movement of agricultural commodities between Nepal and India, which is a major trading partner. Exporters face significant delays and higher transaction costs because they are subject to multiple tests on both sides of the border and overhead costs shoot up if they have to send their samples abroad for testing for different technical parameters. As a result, despite agriculture sector growth, imports among the top traded agricultural products are growing strongly.

At present, the scientific metrology division of National Bureau of Standards and Metrology (NBSM) has six calibration laboratories in operation out of which three; (a) Mass, (b) Volume and Density and (c) Temperature and humidity laboratories of NBSM are accredited according to ISO/IEC 17025:2017 by National Accreditation Board for Testing and Calibration Laboratories (NABL), India. These scientific laboratories of NBSM provide in house calibration services, on-site calibration services and calibration trainings to food businesses upon their request. In a study conducted in western food processing industry, more than half of the surveyed enterprises did not calibrate their processing and laboratory equipment. The factors behind low levels of calibration besides lack of awareness include lack of service providers and qualified personnel to operate calibration equipment (NABIC, 2019). Currently, most of the calibration services are at present voluntary and only available through the scientific laboratory at Kathmandu. Hence, enhancing the capacity of private agencies will obviously further improve the calibration capacity, skills and knowledge of individuals and the overall food sector eco-system.

USDA's 2018 SPS study also found that while there are various testing labs in Nepal, their capacities are not consistent with the needs. On one hand, available capacity is underutilized and on the other, needed capacity in certain areas is completely missing. Their report, therefore, suggests improving lab capacities in accordance with needs.

Relevant Laboratories	
Governmental	**Services**
National Food and Feed Reference Laboratories	Food and Feeds, Accredited 81 parameters
Central Veterinary Laboratory	Veterinary drugs/residues; and animal quarantine related tests
National Forensic Science Laboratory	Forensic testing, advance molecular testing
NBSM laboratory	
Analytical Service Centre (of NAST)	Some parameters of food including mycotoxins, molecular testing, Water Quality, Environmental

Food Research laboratory of NARC	Food
Organization/Private	
ENPHO Lab	Water, Soil, composts, food and feed and air pollutants
ZEST Lab	Pharmaceuticals, Medical consumables, Microbiological tests of Medicines, Food and Water
Nepal Environmental Scientific Services (NESS)	Water, Wastewater, Food products, liquors, soil, fertilizers, pesticides
Poultry Diagnostic Lab	
Research Laboratory	
Nepal Bio Science Research Laboratory	
RIBB lab (research lab)	

Food testing in Nepal is not new but food testing extensively for the safeguard of public health is not widely practiced. Only one-third of the food business interviewed had their products lab-tested. Food testing is more common for imported and exporting food items but testing Nepalese food products for domestic market are not frequent. In Nepal, Department of Food Technology and Quality Controls is the sole authority to dictate food quality. It has central food laboratory, regional food laboratories, and food laboratories at custom points (DFTQC, 2020). In Kathmandu corridor two Food Technology and Quality Control laboratories are present, one central laboratory and one regional food laboratory in Hetauda. Besides these government labs, ENPHO lab tests water quality, ZEST lab is specialized in pharmaceuticals, and Kalamati Fruits and Vegetables market tests pesticides.

DFTQC labs are equipped to conduct analysis of chemicals and nutrient content in food items. The central lab has tested 56 samples of green and dry leafy vegetables, other vegetables, roots and tubers, meat and meat products, in the year 2020 (DFTQC Bulletin, 2020). The laboratory in Chitwan corridor tested 100 samples of food, meat and fish products in the same period. DFTQC labs, across country, tested 1054 fruits and vegetables samples of which 3.80 percent were found substandard. Similarly, 137 samples of meat and meat products were tested of which 20.44 percent were identified as substandard. In its bulletin, there is no report of egg standard testing.

Accreditation of testing/certification bodies: At present, Nepal doesn't have its own national Accreditation Authority. Most of the laboratory accreditation in Nepal has been done by India's National Accreditation Board for Testing and Calibration Laboratories (NABL). One of the Non-governmental organizations, Accreditation Education Research & Scientific Service Center (AERSSC) has established itself to be an independent international and multi-economy accreditation body. The AERSSC accredits independent third-party conformity assessment bodies (CABs) such as Testing Laboratories, Calibration Laboratories and Medical Laboratories to ensure their competence to carry out specific tasks as per the International Standards. AERSSC is an Associate Member of International Laboratory Accreditation Cooperation (ILAC) and Full Member of (APLAC) Asia Pacific Laboratory Accreditation Cooperation (AERSSC, 2019).

Training and technology services: DFTQC's vision is (a) to enhance food safety capacity of Nepal, (b) to motivate food businesses to adapt food safety culture within their businesses, (c) to decrease sub-standard food production, and (d) provide training related to food safety to the businesses under its license services through various community-based programs and donor-funded projects. DOA and DLS provide training on Good Agriculture Practices and Good Animal Husbandry practices as well as training related to Safe Meat production practices respectively. NARC provides trainings on post-harvest handling and technology of agri-produce throughout its research centers and stations. Besides that, few foods business member professional associations, organizations and some private institutions provide food safety, food safety management systems training, consultancy, and advisory services to existing and potential large to small and medium food businesses, majority are exporters who requires the certification.

In 2015 Provincial Ministry of Land Management, Agriculture, and Cooperative (MOLMAC) launched the mobile agricultural application, 'Hamro Krishi' for sharing information on climate, agricultural and technological information. Another mobile application, 'Smart Krishi' provides daily price information, success and failure stories, agricultural documents and e-books, agricultural farm contact details with GPS tracking, and weather information. They also upload all types of technical information that include complete management practices of any agri-products, plant protection measures, harvesting and postharvest handling in their publication and make them available to concerned food businesses via radio and television programs.

Digital technologies offer opportunities to aggregate and scale Nepal's agricultural production as well as post-harvest handling and management in ways not possible before. Distributed small farm holdings, small processors and higher number of intermediate traders are the core challenges in maintaining food safety throughout the supply chain. However, digital technologies can help overcome these challenges, aggregating production by eliminating information asymmetry, connecting buyers and sellers, relaying information, and facilitating agri-business trade. Hence advances and access to digital technologies like block chain, food safety information platforms, data and analytics, FS management system, and process monitoring would make it possible for GFBs to be competitive in the food safety space.

Annex 4. List of key actors engaged in nutrient-dense perishable foods

VC Nodes	Key Food Businesses/Actors	Counts
Collectors	Fruits and Vegetables	6
	Goat meat:	2
	Eggs	4
	Total	**12**
Transporters	**Total**	**6**
Wholesalers	Fruits and Vegetables	10
	Goat Meat	1
	Total	**11**
Cold storages	Goat Meat	3
	Fruits and Vegetables:	6
	Total	**9**
Retailors	Fruits and vegetables	6
	Goat Meat:	2
	Eggs	2
	Total	**10**
Importers/Exporters	Fruits and Vegetables	**6**

*Original list of companies that were to be interviewed with the FSSA survey instruments. Due to Covid shutdown, the FSSA team was unable to due lengthy interviews. Some of the above participated in the rapid COVID survey. During FSSA II, the team will implement the food safety survey instruments.

Annex 5. Risks and hazards associated with FFV, eggs, and goat meat

Prioritized Food Segment	National Status	Current trends	Food Safety Risks, Hazards and Concern
Perishable Fruits and Vegetable Produce and Processing	30% contribution of AGDP Major fruits: Apple, Citrus, Banana, etc. Major vegetables: Cauliflower, cabbages, green bean, tomatoes, leafy vegetables,	Collected unwashed, ungraded, not cleaned, no proper packing No cold storage, transport in conventional trucks/vans and even public buses Packed in jute sacks, plastic sacks, crates, and sometimes in cartoons Smaller fragments are consumed by SMEs like pickle industry, ketchup industry, Jam producing industries Many fruits and vegetable processing industries are small and medium enterprises. Nepal imports almost all types of fruits Nepal imports vegetables	Chemical contamination (Pesticides, fungicides, herbicides, rodenticides, machine lubricants from forklifts or packing line equipment, heavy metals (Lead, Mercury. Arsenic) industrial toxins compounds used to clean and sanitize equipment (may contaminate produce during production handling or storage) Microbial hazards (*Salmonella, Escherichia coli, Staphylococcus aureus, Campylobacter* and *Listeria monocytogenes* are the most common pathogens that contaminate fresh produce. Pathogenic viruses (*Hepatitis, Enterovirus*) through wash water. Protozoans (Consumption of improperly washed, uncooked, raw fruits and vegetables) Food Standard of Nepal includes specification for just 17 fruits and vegetable products, which is scant.
Goat Meat and its processing	3.17 AGDP contribution Second highest meat produced in Nepal Goat meat demand is growing and currently fulfilled from importing meat goats/sheep	Goat meat is consumed fresh Conventional slaughterhouses are popular Limited number of cold storages, to store goat meat Frozen meat share is negligible	Excessive usage of antibiotics and other veterinary drugs; Chemicals/toxic components from wash water. Unregulated, unofficial, and unhygienic slaughter sites and improper supply logistics causing high chances of microbial contamination, visceral contamination and temperature related spoilage. Nepal food Standard does not have any specification for the goat meat or its products (DFTQC, 2018).

		Testing of fresh meat is almost nil	
Poultry Eggs	1 % AGDP contribution In March 2021 Nepal declared self-sufficient in egg production Cannot import eggs unless authorized by government	Poultry and egg s production is one of the most structured food value chains of Nepal. Testing of eggs is absent No proper egg transport trucks No temperature control while storing	Chemicals passed to eggs from the feed, water, and sanitary conditions. High veterinary drug residue due to uncontrolled usage. Microbial Contamination through feces, improper cleaning, handling, storage, and distribution. Absence of National Eggs' Standard and legislation.

Annex 6. A case description of Kalimati market illustrating food safety limitations and opportunities

KFVM - busy wholesale section; Photo credit: Manju. Chhetri.

Given the characteristics of fruits and vegetables such as perishability, seasonality, bulkiness, and delicate nature of the products coupled with inadequate postharvest handling, lack of standardization, outdated marketing, and distribution practices, it is very challenging to ensure food safety in their supply chains. This has been a long-standing issue with the country's largest fruits and vegetable wholesale market; Kalimati Fruits and Vegetables Market (KFVM). KFVM is the central point for the trade of Nepal's domestic as well as imported fruit and vegetables. Current KFVM trade share includes 84 percent of vegetables, 10 percent of fruits, 5 percent of spices and 1 percent of fish. In normal situation, 700-800 MT of commodities are traded daily, which make KFVM a vital part of the supply chain for Nepalese agricultural products and has achieved the founding vision of becoming the largest wholesale market for agricultural products in Nepal. Thirty years ago, KFVM was established by then government with small-scale infrastructures. Today the KFVM market occupies 22,893 square meters of land on heart of Kathmandu but still with the limited infrastructures. Yet complete alternative to this market is not available, thus, making the presence and impact of KFVM trade the most influential fresh agri-trades of Nepal. KFVM doesn't have any FS preventive measure in place. However, increase in establishment and operation of few private wholesale markets throughout or nearby Kathmandu Valley have raised the challenges for this public wholesale market to sustain both quality as well as food safety wise.

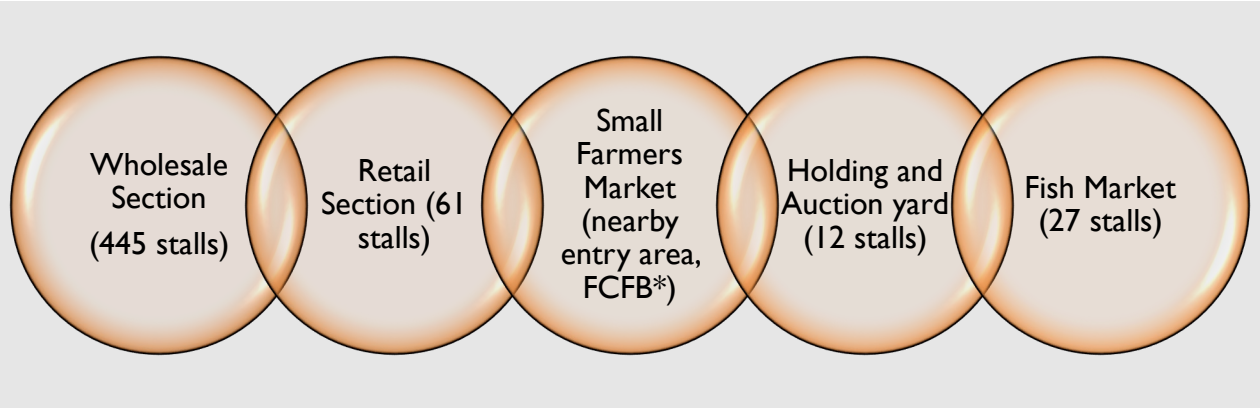

Figure 6. KFVM Market facilities (as of July 2021). Source: Schematic prepared by survey team.

Key Food Safety Challenges in KFVM

Food Safety Infrastructure Limitations

Kalimati Market lacks both FS infrastructure and required investment for it. Some of the FS challenges faced by KFVM are:

- Lack of adequate area of operation (with current holdings)
- Missing quality control measures
- Inadequate testing parameters, process, and facilities

- Inadequate FS awareness among traders and market staffs
- Lack of modern transportation system
- Lack of adequate storage facility including cold chain
- Absence of good post-harvest practices
- Unhygienic water and sanitation supply
- Improper waste management
- Inadequate laboratory testing facilities
- Difficulty in enhancing and strengthening the skills of manpower involved in the market, both traders and staff
- Minimal use of technology and machineries for handling, packaging, and grading of produce.
- Lack of linkages with other agro-markets, including government and nongovernment sectors and
- Shortage of food safety related information.

The market is already congested and operating beyond its normal capacity. Commodities handled in Kalimati market increased from 0.74 MT per square meter in 1989 to 10.01 MT per Square meter in 2018. Located in the heart of the city and surrounded by residential/commercial houses, Kalimati Wholesale Market has no scope for expansion (area wise) and have very less scope of vertical expansion with no planning of it available till date. Entry and exit points of the market are directly linked with the main road, creating traffic congestion in the vicinity of the market.

While Maximum Residual Limits for various pesticides group are in place, the Rapid Bioassay for Pesticide Residue Laboratory (RBPR) in the premises of KFVM at present, tests only two groups of pesticides organophosphates and carbamates. Although the National Laboratory of the DFTQC collects and tests market samples for some other pesticides too, it is just the part of market monitoring and doesn't control in the daily basis. The Kalimati lab lacks adequate laboratory infrastructures, limited test parameter and testing scope doesn't address all the potential food safety hazards.

Market operation and management limitations

New Chobhar Market; Photo source KFVMDB.

KFVM is managed and operated by Kalimati Fruits and Vegetable Market Development Board (KFVMDB). The food safety regulation of the market is limited to just pesticide control and occasional combined cleanliness program (which is better than not having any); However, an adequate regulation to address all potential food safety hazards and their control measures should be of prime focus to market development board. The market management of the KFVM is interventionist in approach. The management board officers are nominated by the government with few representatives from the traders and thus discourages private investment. The services provided by the management to the traders are not adequate in context of food safety or as such in general. The shared responsibilities of different actors within the management doesn't seem efficient.

Peripheral Infrastructure limitations

The loading and unloading docks are poorly designed, worn out and very congested. Parking areas of the market is very small and haphazardly managed. The waste management system within or outside the market is missing and/or ineffective. No cold storage is available in the vicinity of the wholesale markets (nearest one is 7.5 KM away). Temperature controlled transport for perishables is yet to be introduced. Marketing information service is in place and managed by KFVMDB through which they disseminate the collected price information, as well as via their website, email, and Nepal Telecom's notice board services (1618070766666); however, they only address the price information.

Kalimati wholesale market during lockdown; Photo source: KFVMDB.

New prospects for KFVM

To expand agriculture centers across the country, MOALD in coordination with KFVMDB is establishing Chobhar Markets for fruits, vegetables, and flowers just 6 KM away from KFVM. The market is spread across 11701 square meters and will includes two five storied buildings and one three storied building. This market holds greater potential to enhance food safety capacity of the fruits and vegetable wholesale market provided there is effective regulation from government and board, with investment in market-led infrastructure for collection, storage, sorting, grading, and postharvest management including cold chains as well as facilitating private sector to invest in logistics services or infrastructure.

Impact of Covid in KFVM

The COVID-19 pandemic causes supply chain disruptions of KFVM on both the demand and supply sides of fruits and vegetables. Retail section and small farmer market was completely shut down for months whereas the wholesale market was allowed to open for limited period per day. Arrival of produce dropped 50% during the lockdown period (from 800MT per day to 400-500 MT per day) which has been recovering to in an average 600 MT/day in present days. This reduction in supply is also due to reduction in Kalimati market demands for that period as well as difficulties faced in transport services during initial time. Generally, management and transportation problems in fresh produce occurred during initial 2-3 weeks of the lockdown in first phase and 1 week during second phase because of the abrupt announcement of the lockdown by the government due to COVID-19, a measure the government had to take, to control the spread of the virus. This abrupt and strict lockdown didn't give market development committee and traders enough time to find the solutions to the situation initially. Also, after the lockdown announcement, people who had migrated to cities and urban areas started going back to their cities and villages leading to a huge drop in consumers. Restaurants, hotels, party palaces and hostel businesses were abruptly closed due to which the demand for vegetables and other agricultural products in the Kathmandu city decreased immensely. Many traders have personally avoided to return or have only partially returned to trade due to fear of Covid and its uncertainty. Pesticide residue monitoring was also temporarily halted during lockdown as lab was shut down citing safety of the technicians in the absence of basic safety facilities. Due to decrease in demand, market observed oversupply of produce leading to "dump or charity" situation. Majority of the traders collaborated with various social organization for the charity to avoid the food wastage by dumping during strictest period of lockdown.

After the first week of lockdown, the DOA along with other departments of MOALD and various provincial and local governments took the initiative to find necessary data regarding demand and supply of necessary products and urged the government to allow the opening of vegetables and poultry markets and shops following necessary social distancing norms, rules and regulations. While it eased daily business in KFVM, the problem is still unabated because major buyers like restaurants, hotels, hostels, party palaces, etc. are still closed.

To reduce the overall impact and to assure health and safety of their traders, KFVMDB provided COVID awareness program to all their traders maintaining safety protocols, started miking alert system in the market premises, supplied hand washing facilities, initiated PCR tests in collaboration with KMC and DOH and now facilitating vaccination to its traders. In addition, to avoid overcrowd and oversupply in the market and to support the traders, KFVMDB with DOA started operating temporary markets in various prime hubs of Kathmandu.

Way forward to KFVM

Standardization of Fruits and Vegetables and their Post-Harvest Handling: MOALD and KFVMDB and concerned department should develop/update standards, rules, regulations, directives and guidelines incorporating national FS policy for fruits and vegetables produce specifications and post-harvest handling process specifications. Meanwhile when national standards are not available, board can encourage and facilitate traders to adapt global best practices, voluntary /technological standards to ensure food safety.

Effective Implementation of FS preventive measures: Effective food safety monitoring begins from control and mitigation of FS hazards from primary production/import level to throughout the supply chain till it reach consumers. Testing and control of hazards at end of supply chain is leading to huge food loss /dump. Thus, assuring quality at production/collection site (sorting, grading, laboratory analysis, good practices, maintaining cold chain and other FS preventive measures) is the current requirement. Once quality and safety at primary level is assured, it can compel all the secondary traders, processors, supply chain facility providers to adhere to FS practices to maintain the quality and safety of the produces.

Invest in FS infrastructure in KFVM and its prospective new market: Investment in quality assurance laboratories/capacity enhancement of existing ones, ware housing including cold storages, water treatment facility and common effluent treatment plants are the present needs. Produce- suitable customized packaging and logistics is another important immediate requirement to make logistic effective (for example, Large old storage facilities require huge investment, whereas cold chamber can be customizable, can be established in larger production/collection sites and budget-friendly. This reduces the cost, facilitates the maintenance of quality of the produce and fulfills the requirements of targeted customers.

Develop technology-friendly supply chain: Logistic and value-added supply chains should take advantage of technology improvements in data capturing and processing, product tracking and tracing, synchronizing freight transport transmit times along the supply chain and supply-demand matching. Incorporation of FS information in current MIS for better coordination among different stakeholders from producers to consumers is the need of the hour. The internet and mobile communication/application can also be used to enable information and financial transfer between the stakeholders.

Develop integrated supply chain approach: The supply chain needs to be designed and built in an integrated manner. Establishing adequate linkage with majority of agro-production, agro-traders, and processing industries in clusters in areas where there is predominant production of processable agriculture products seems a like a good solution to minimize postharvest food loss and in implementing food safety preventive measures in efficient and coordinated way. There must be structural changes at different levels – producers, intermediaries, and consumers. The government, private, public-private partnership, cooperatives, technology providers, and even media can play a crucial role in developing this.

Promoting public-private partnership: This is another strategic solution. Supply chain services/logistics like washing, waxing, grading, sorting, packaging, pre-cooling, handling facilities, storage, cold chain facilities, insurance, finance, transport, and processing facilities under PPP model would add value to supply chain functioning and ensuring FS throughout it.

Annex 7. Recently released Food Hygiene/Safety and Quality Bill-2020: A synopsis

A bill to amend and consolidate the law on food safety, hygiene, and quality of Nepal, has been approved by the National Assembly of GON on August 10, 2021, unanimously, however it has its course of amendments as per request for amendments according to the parliament law of Nepal before it fully comes to execution. Introduction and approval of this bill was long due; thus, Nepal has reached one more food safety milestone after the release of Food Safety Policy-2019. In this bill, arrangement has been made to determine the periodic food safety and quality of the food commodities and their regulation in their area by the central, state, and local level governments. It has the provision of formation of a committee Chaired by the Secretary of the MOALD to provide suggestion to GON to determine the Food Safety and Quality. To ensure Safety and quality, following arrangements are mentioned into their details:

- To get recommendation to produce and processed.
- To get permission to run the food business.
- To get approval to import.

Similarly, to stop the sale and distribution of contaminated and substandard food items, the responsibility of all the food businesses (producers, manufacturers and processors, importers, transporters, accumulators, sellers, and service providers) has been determined. This hygiene bill also addresses the provision for the inter-agency coordination to maintain food safety and arranging a committee to make suggestions to the GON on food safety policy-19 thus determining the clear roles, responsibilities, and rights of the DFTQC. Necessary arrangements have also been made for a food laboratory for reliable food analysis services.

The bill also provides the clear roles of DFTQC and all offices under it or Inspection officer, which/who can give necessary orders to inspect/investigate, to conduct emergency inspection, to collect samples and to test and to prevent sale and distribution of the substances on doubt, where state and local level can also conduct monitoring and inspection activities. Depending upon nature and extent of the offense, provision of immediate penalties has been arranged to those who commit various acts contrary to maintaining food safety, hygiene, and quality; the offender will be fined immediately up to a maximum of 5 years imprisonment or a fine of up to NRs 500,000. The bill also stipulates that a firm, company, agency, or any legal person that has criminal liability; a compensation should be paid to those who have suffered losses due to offense. The Government of Nepal will be plaintiff in this case and the officer in charge of the case will be the Chief District Officer and the district Court.

This Bill has the provision to empower the MOALD to make necessary rules for the implementation of the Act and to make directives subject to laws and regulations by the GON, and to repeal/reject the existing Food Act-2023 after this bill is converted to an act.