VAN HALL LARENSTEIN UNIVERSITY OF APPLIED SCIENCES, WAGENINGEN

An assessment of Good hygienic practices of broiler value chain of Kaski district of Nepal

Krishna Prasad Subedi

September, 2013

A research Project submitted to Van Hall Larenstein University of Applied Sciences in partial fulfillment of the requirements for the degree of Master of Agricultural Production Chain management specializing in Livestock Chain

Wageningen

The Netherlands

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Director of Research
University of Applied Sciences
Van Hall Larenstein
Forum- Gebouw 102
Drovendaalsteeg 2, PB 6708, Wageningen
Postbus 411
6880 GB Velp
The Netherlands
Tel: +31 317 486 230
Fax: +31 317 484 884
E-mail: Research@larenstein.nl

Acknowledgement

First and foremost my sincere gratitude goes to Royal Netherlands Government for granting me with Netherland Fellowship Programme (NFP) which has given me opportunity to get this post graduate study in Agricultural Production Chain Management (APCM) specialization with Livestock Production Chain (LPC).

My special thanks go to my supervisor, Mrs. Resie Oude Luttikhuis for her continuous support and guidance with critical comments during the preparation of this whole thesis report. I would also like to express my heartful thanks to all the lecturers and staffs for their valuable support provided during my study period at Van Hall Lanrenstein University of Applied Sciences, especially my specialization coordinator Marco Verschuur for his precious help and guidance.

I would like to express my special thanks to Director of KVC, Dr. Suderson Prasad Gautam for providing me the opportunity to study and assistance during my site selection and field work period. Also, I would like to thank all my clinic colleague and staffs for their support and help specially during my field work.

I would like to thank Dr. Prakash Raj Shrestha, chief of District Livestock Service Office for his support and cooperation during data collection. Also I could not forget all the farmers, trader/processor, butchers/retailers for their kind cooperation for my field my work.

I would like to thank Suraj Dhakal, Sheeva Bhattarai Dhakal, Susmita Gautam and Rajesh Joshi for their kind help in my thesis work.

I would like to give my special thanks and gratitude to all my classmates of APCM especially Mr. Tulasi Jang Dahal, Nelben Raymunda and Omary Nkullo for their help, cooperation and sharing of information throughout the Master course.

Krishna Prasad Subedi
September, 2013
Wageningen, The Netherlands

Dedication

This research work is dedicated to my beloved parents, sweetheart wife Rajani Bastakoti and son Kirtan for their continuous patience shown in my absence, I love you all.

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Acronyms

GDP	Gross Domestic Product
AGDP	Agricultural Gross Domestic Product
ABPSD	Agri-Business Promotion and Statistical Division
CBS	Central Bureau of Statistics
CCPs	Critical Control Points
CDC	Centres for Disease Control and Prevention
CLDP	Community Livestock Development Progarm
DDA	Drug Distribution Authority
DFTQC	Department of Food Technology and Quality Control
DLS	Department of Livestock Services
DLSO	District Livestock Service Office
DOC	Day Old Chick
DOHS	Department of Health Services
ECDC	European Centre for Disease Prevention and Control
EC	European Commission
EFSA	European Food Safety Authority
EPIG	European Poultry and Meat Industry Group
FAO	Food and Agriculture Organisation
FSB	Food Standard Board
GFL	General Food Law
GHPs	Good Hygienic Practices
HACCP	Hazard Analysis and Critical Control Point
HPAI	Highly Pathogenic Avian Influenza
KVC	Kaski Veterinary Clinic
MT	Metric Ton
NASA	National Aeronautics and Space Administration
NBSM	Nepal Bureau of Standards and Meteorology
NGOs	Non-Governmental Organisations
OIE	World Organisation for Animal Health
SAARC	South Asian Association for Regional Cooperation
SPS	Sanitary and Phytosanitary Measures
WHO	World Health Organisation
WTO	World Trade Organisation

Executive summary

Poultry industry is one of the most booming industries of Kaski district. This study was carried out to assess the hygienic practices adopted by the actors related to broiler chain to improve the broiler meat safety of Kaski district.

Currently, every country in the world is increasing their effort to improve food safety to reduce the food safety risk.

The data for this research study was collected from the desk research, observations, surveys and interviews of different actors and supporter of broiler chain. Forty broiler farmers were surveyed by using questionnaire. Also four traders/processors, five butchers/retailers were interviewed using checklists. An official of chief District Livestock Service office was also interviewed.

The study revealed that the majority of the farmers are doing broiler farming as main income source. The flock sizes is 501-1000 of the larger number of farms and on an average farmer are rearing 5.57 cycles per year.

The value chain concept was used to map out the different chain actors as well as other chain supporting and or influencing organization to show how food safety is maintained within production, transportation, processing and retailing. Hygienic practices at each chain level were then assessed.

The study concludes that most of the current practices adopted by the actors were far below the standards required and also not complying with GHPs of EPIG and FAO so that these practices could cause serious food safety hazards for the consumer health of the district. Also, the government role was found to be inadequate to enhance the food safety of broiler chain of the district.

The study also found that some practices done by actors were aligned with GHPs of EPIG and FAO which can add to enhance the food safety of broiler meat of Kaski district. The farmers were found to take higher risks in comparison to traders/processors.

The study recommended some implication to improve the hygienic practices of broiler chain of Kaski district which are required for assisting the chain actors' supporters and influencers which can help to improve the broiler meat safety and to reduce the foodborne illness of the district.

Chapter 1: Introduction

1.1 Background and justification

Broiler meat is now considered as very cheap source of protein for the consumers which must be safe to devour. Recently, food safety issues in the world has emerged as one of growing importance due to a series of highly exposed food scares such as *Salmonella, E. coli, Campylobacter* and more recently Highly Pathogenic Avian Influenza (HPAI).

In Nepal, increasing population and growing income level of consumers have added to an increased demand for livestock and poultry products (CLDP, 2007). Simultaneously, there is increase in health consciousness amongst consumers leading to replacement of red meat with white in many urban households. This increase in demand has led to the rise of commercial broiler production systems in the peri-urban areas of Kaski district. Moreover, the chain provides benefits to many actors of the chain. The chain is directly and indirectly supporting the livelihood of people who are involved in the chain like farmers, traders, butchers, retailers and employees of other jobs created by the chain such as the feed industry, equipment suppliers, veterinary drug suppliers, butchers as well as eating places (Bhatta, 2008). Processing to add value is good opportunity for this industry. Bolder, (2007) stated that the primary food safety target should be production of the live birds free from pathogens and allowing to keep the processing line of slaughter house free of those microorganisms. However, due to the number of actors in the broiler meat chain, food safety control has become a challenging task in the country. Poultry products do not meet the quality standards specifically on food safety which is required in the market. There is requirement of reducing the food safety risk throughout the chain by initiating from the production level and continued to transporting, processing and retailing. After the agreement of Nepal to WTO and growing concern of consumers on quality products increase the competition of quality products in the market (FAO, 2010).

The problem of broiler handling and hygiene in Kaski district is focusing in production farm, trader/processor and retailers/butchers. Farmers do not apply hygienic practices in their farm and most of them do not have awareness about hygienic practices. Also, in processing and transportation there is lack of hygienic practices. According to Joshi *et.al*., (2003), meat quality is adversely affected by careless handling conditions in the slaughtering places as well as in the meat markets or shops. Some butchers or processors are slaughtering and processing the poultry in their premises with poor hygienic condition (Maharjan *et. al*., 2006). High majority of consumers buy meat from butcher's shop at which food hygiene and safety condition are not assured and there is no information on prevalence of *Salmonella* and other food borne infection in retail meat shops in Nepal (Upadhyaya *et. al.,* 2012). In addition to unhygienic meat in slaughter sites, there is a problem of selling meat in unsanitary environment such as open shop and unclean butcheries even without any chilling facilities.

Studies by different scientists have verified that the prevalence of meat borne zoonotic diseases in Nepal is very high as compared to those in developing countries (Majagaiya *et. al.,* 2008). Majagaiya et.al., (2008) found that, 9.2% of the poultry meat samples collected from capital city of Nepal (Kathmandu) were found to be positive for *Salmonella species* which is one of the major causes of food poisoning. Approximately 50% of the isolates were multi drug resistant. Similarly, in another study of Maharjan *et.al*., (2006), 11.4% of meat samples were found positive for *Salmonella* in Kathmandu District (Maharjan *et. al.,* 2006).

On the other hand, there are very less information due to inadequate researches about meat safety of broiler chain of Kaski District.

1.3 Problem statement

There is poor hygiene practice in broiler farm, trader and butcher/retailers level which is causing production of unsafe meat in broiler value chain that consequently causes food borne infection to the consumers.

1.4 Research objective

To assess the current hygienic practices in broiler value chain to come up with the suggestions for improvement in hygienic practices in order to improve food safety of broiler meat of Kaski district of Nepal.

1.5 Research questions

Main research question 1

What are the food safety practices applied in the broiler value chain of Kaski district?

Sub questions

1.1. Who are the actors involved in the broiler chain of Kaski district?

1.2. What hygienic measures are applied by primary producers in the broiler chain of Kaski district?

1.3. What are the hygiene practices applied by trader/processor for food safety in broiler value chain of Kaski district?

1.4. What are the hygienic practices applied by butcher/retailer in broiler value chain of Kaski district?

Main research question 2

What are the responsibilities of government (central and local) in maintaining food safety along the broiler value chain of Kaski district?

Sub questions

2.1 What are the government rules and regulations for maintaining food safety along the broiler value chain?

2.2 What the government is doing to enforce meat hygiene regulation in broiler value chain?

2.3 What are the hindering factors that the government authorities are facing in enforcing food safety regulations in broiler value chain of Kaski district?

1.6 Definitions of concepts

1.6.1 Value chain concepts

“Full range of activities which are required to bring a product or services from conception along the intermediate phases of production to consumers and final disposal after use is considered as value chain” (Kaplinsky, 2000).

1.6.2 Commercial broiler farmer

They are the entrepreneurs who are producing broiler poultry for sale to earn money. They rear a day old chicks up to 6 to 7 weeks until the average weight reached up to 2.5kg.

1.6.3 Poultry suppliers/trader/processor

The trader are those who supply day old chicks and feed to the farmer and sale live or processed poultry from farmers to retailers or butchers. Poultry suppliers are functions both trading and processing in the chain of Kaski district. They are mostly large processor. They have poultry slaughtering and processing facilities.

1.6.4 Butcher/retailer

They are the small scale processor who buy the broiler from poultry supplier, slaughter and retail the broiler poultry to their consumers by themselves.

Chapter 2: Literature review

2.1 Livestock and poultry sector of Nepal

Livestock constitutes an integral part of Nepalese agriculture system. The sector contributes 11% to national GDP and 27% to AGDP (ABPSD, 2010/11). Majority of agricultural households keep livestock. Roughly one half of the agricultural households keep cattle on their holding. 38% households have buffalo, 52% have goat or sheep, 44% have poultry and 10% of agricultural households are keeping pig in the country. The average number of poultry per household is 3.4 in the country. Poultry birds are more popular in the hills so average number of poultry birds is the highest in the hills (CBS, 2011). Poultry subsector alone contributes about 3-4% in AGDP of the country. Commercial poultry sector is providing employment opportunities to more than 0.1 million people in the country (ABPSD, 2010/11). Poultry production statistics of the country shows that there are around 55% backyard and 45% commercial poultry production.

Table 1. Poultry and meat production statistics of Nepal

Year	Commercial broiler statistics (number)	Total chicken meat production (metric ton)
2005/06	23221439	15605
2006/07	23924630	16126
2007/08	24665820	16712
2008/09	2448128	16662
2009/10	25760373	16527
2010/11	39530620	36085

Source: ABPSD report, 2010/11

According to another latest DLS report, there are 39.7 million commercial broiler poultry and total chicken meat production of the country in 2011/12 is 40,346 MT (DLS, 2011/12). Similarly, chicken meat consumption per capita per year of Nepal is 0.5 kg but that of Pokhara (headquarter of Kaski District) is 7.2kg (DLS, 2010/11).

According to annual District Livestock Service Office (DLSO) report, there are 1199530 broiler poultry birds in Kaski district. There are 238 registered broiler farmers in the district. Total broiler meat production of Kaski district in 2011/12 is 506 MT. There are 274 meat shops or retailer shops which are registered to the government (DLSO, 2011/12).

Recently, the Government of Nepal has initiated the Poultry Policy that aimed to triple per capita consumption and availability of chicken meat and eggs in 15 years, keeping poultry under priority sector to promote commercialization of this subsector. As there is increasing growth of investment over NRs. 30 billion in the poultry sector, the government of Nepal has introduced the policy to improve food security and nutrition level by encouraging competitiveness and environment-friendly poultry business in the country. The policy, which

has been recently approved by the Cabinet, predicts to triple the existing per capita consumption and availability of chicken meat (1.82 kg) and (25 eggs) by encouraging commercialization of poultry in areas where necessary infrastructures are already in place (Zootecnica World Poultry Journal, 2012).

Broiler farming is increasing day by day. There is increasing number of consumer towards broiler meat from local chicken meat. It is also a good source of income for poor marginalized and disadvantaged people. It can be used as a tool to improve poverty while also ensuring food security (FAO, 2010). People have the keen interest to rear the broiler because of its high profitability in very short period of time. Its market demand is also increasing vigorously in the country because of its quality in meat (taste, tenderness and high nutritive value) (Sharma, 2010).

2.2 Food safety

Food safety is assurance that food will not cause any harm to the consumer when it is prepared or eaten according to its intended use (Codex Alimentarius) (FAO, 2001). Food safety is a scientific discipline describing handling, preparation and storage of food in ways that prevent food borne illness. It refers to all those hazards either chronic or acute that may be injurious to consumer health which is not negotiable (FAO and WHO, 2003).

The contamination can be considered as any horrible or harmful element or material in the food for consumption. They are of microbiological, physical and chemical types that can potentially affect consumer's health.

There is increasing public health issues causing improvement of food safety issues to improve in the world. The major foodborne diseases from microorganisms of poultry meat are Salmonellosis and Campylobacteriosis. The proper handling of meat in a hygienic way in each step of meat chain can help to reduce the risk of foodborne disease (Seward, 2007).

2.3 Importance of food safety

The global importance of food safety is not fully valued by many public health authorities even though a constant increase in the prevalence of foodborne illness. Various overwhelming outbreaks of Salmonellosis, Cholera, *Escherichia coli* infections, hepatitis A and other diseases have occurred in both developed and developing countries (WHO, 2007). The food hygiene practices is not well organised in developing countries as compared to developed one. Hence, higher number of people suffered from the foodborne diseases in developing countries (FAO, 2009).

According to food Centres for Disease Control and Prevention (CDC), about 48 million of humans population, roughly one in six people in the United States, get sick from eating contaminated food every year (CDC, 2013). According to the WHO, unsafe food results to 1.5 billion cases of diarrhea in children, resulting in more than three million premature deaths yearly (Caroline and Nadine, 2005).

According to annual reports of Department of Health Services (DOHS) of Nepal, food borne infection rate in the country is always in high rank among all other cases. According to annual report of DOHS, 2010/11, there are 20,308 food borne infection cases recorded in Kaski district in 2010/11.

Table 2: Food borne morbidity cases in recent years

Morbidity case	Year	No. of patients	% in total	Rank
Typhoid and paratyphoid	2008/2009	12063	4.04	4
	2009/2010	10168	3.38	4
	2010/2011	10704	3.4	4
Diarrhea and gastroenteritis of presumed infection origin	2008/2009	18503	6.19	2
	2009/2010	17590	5.85	2
	2010/2011	14295	4.5	2

Source: Annual reports of Department of Health Service 2008/09; 2009/10; 2010/11

2.4 Food safety in broiler chain

Growth of broiler meat production is increasing both in developed and developing countries in the world. There is 269 million tons of meat production, among which poultry occupy 33% globally in 2007. Chicken is the cheap and easiest source of poultry meat globally which covers 86% of total poultry meat (FAO, 2010).

The microbiological zoonoses *Salmonella and Campylobacter* are the most important and most frequent food safety hazards in the broiler chain (Nauta *et. al.,* 2005). Microbiological risk indicates to all risk caused by bacteria which are living microorganisms which can cause food decay and possibly resulting to food poisoning for the consumer (Yeung and Morris, 2001). Since 2006, there is risk of dioxin chemical poisoning in food. Therefore, food safety regulations like General Food Law (GFL) are established in national and European level with the help of Dutch Government (Verreth, 2009).

2.5 Food safety programs and HACCP in poultry sector

All the actors in food chain will depend on food safety programs to produce safe food for the consumers which are mandatory or voluntary standards. Codex Alimentarius formulated the mandatory standards like sanitary and phytosanitary (SPS) standards and which is adopted by the government of most countries. Hazard Analysis Critical Control Point (HACCP) is an example of voluntary standards which is developed for National Aeronautics and Space Administration (NASA) for providing safe food for astronauts produced by Pillsbury Company.

HACCP is a system which identifies, evaluates and controls hazards which are significant for food safety (FAO, 2001). This system targeted to prevent or decrease the hazards which are related to food safety. All the actors of food chain are responsible to assure the food safety. The 7 principles of HACCP are as follows:

1. List the food hazards
2. Determine the critical control points (CCPs)
3. Establish the critical limits
4. Establish a system to monitor of each CCP
5. Establish corrective actions which should be adopted while CCP is not under control
6. Establish verification procedure for proving the HACCP system is working well
7. Establish documentation and records for all procedure

2.6 The potential risk factors related to poultry

Mainly there are three types of potential food borne risks for consumer health. They are microbiological, chemical and physical. Physical factors are the foreign materials or particles (Wood, glass, hair, plastic, dead insects, metal fragments etc.) which normally do not occur in poultry meat so it is not considered in this study.

2.6.1 Microbiological risks

Biological contamination of poultry meat can be occurred by bacteria, virus, mycotoxins, prions and protozoa. Among the bacteria, *Salmonella, Campylobacter, Clostridia, Listeria, E. Coli* and *Enterococci* are the most important (Corry *et.al*., 2002). The most common bacteria that cause food borne infection by consuming infected broiler meat are the *Salmonella* and *Campylobacter* (FAO and WHO, 2009).

Salmonella

European Centre for Disease Prevention and Control (ECDC) and European Food Safety Authority (EFSA) has reported 151,995 human cases of Salmonellosis in 2007 in member states of EU. During the time among the Salmonella affected 22,705 victims, 14% were hospitalized and 23 died. Among the species of *Salmonella, Salmonella enteridis* and *S. typhimurium* are the most predominant sources for human Salmonellosis which was cause 95% outbreaks (EC, 2009). *Salmonella* is one of the major foodborne causes of gastroenteritis and frequently associated with contaminated poultry meat with *Salmonella*. It is commonly found from the whole broiler production chain from production to retail level. In farm level it is transmitted by pests like rodents, contaminated food and vertical transmission from egg to chicks in hatchery (Malorny *et. al*., 2007).

The risk factors like inadequate cleaning and disinfection of broiler rearing houses causes infection to the next flock, poor level of hygiene, and contamination of feed, size of farm, rodents prevalence in the farm will help to transmit the *Salmonella*. The most common source of dressed broiler carcass is faeces because of unhygienic practices and wrong evisceration. Animal feed is also the source of contamination for the poultry flock (Heyndrickx *et. al*., 2002).

Campylobacter

Among the several food chain risk assessment have been conducted, *Campylobacter* in broiler meat is one of the most considered food pathogen (Nauta *et.al.*, 2009). *Campylobacter* is an important cause of food borne infections which is most commonly reported as gastrointestinal bacterial pathogen in humans. The reservoir of this bacterium is found in animals and environment. Based on epidemiological studies and exposure test, it is found that particularly chicken meat is also one of the most important routes for transmission of these bacteria (Havelaar *et. al*., 2007). The most common species of *Campylobacter* are *C. jejuni* and *C. coli* which are associated with gastrointestinal infection in humans. *C. jejuni* is more associated with poultry. This bacterium is transmitted by feco-oral route while consuming infected raw meat. The bacteria can be transmitted vertically from infected human to broiler poultry either in production farm or slaughter house (Havelaar *et.al*., 2007). Based on large scale population based study, it is estimated that every year, 80000 cases of Campylobacteriosis result in 18000 patients visiting to their doctor. Also, among the 600 hospitalization cases, 30 patients die due to this disease (Nauta *et.al*, 2009).

Other microbial risk factors

The Viruses, Mycotoxins, Helminths, Prions and Protozoa are the other risk factors which should be considered in the poultry sector. Similarly, some kind of bacteria such as *Listeria*, *Clostridia*, *Enterococci* and *E.coli* which may cause foodborne diseases through broiler meat contamination but can have less impact in comparison to *Salmonella* and *Campylobacter*.

Highly Pathogenic Avian Influenza (HPAI) virus is now a major public health threat in the world as well as in developing countries like Nepal. Recently there is continuous outbreak of this disease in poultry sector of Nepal. It can be very dangerous for poultry as well as human health. This virus doesn't have direct health hazard on the consumer from the processed broiler products.

2.6.2 Chemical risks

Substances in poultry meat that arise from intentionally used chemicals like veterinary medicines, food additives and processing aids are used and introduced into meat, whereas, disinfectants, heavy metals are introduced unintentionally during rearing and processing. These chemicals residue from the meat can cause serious health problems like cancer, immune deficiency and nerve damage. Antibiotics are commonly used to reduce the mortality rate, as growth promoters and to enhance feed conversion ratio. There is increasing use of antibiotics which finally causes to increase antibiotic resistant infections in human beings (Food standards Australia New Zealand, 2005). In 1999, five antimicrobials (Avoparcin, Virginamycin, Bacitracin, Tylosin and Spiromycin) were commonly used as antimicrobial growth promoter which is banned by the EU (Hughes, 2007).

Pesticides are used to control the insects, fungus bacteria and virus in crop production. The intensive use of pesticides in many developing countries has causes pesticides residue in animal feed which causes the food safety risk in animal origin food too (Kiilholma, 2007).

The common chemicals use during broiler rearing period is lime and chlorine for water treatment as disinfectants. Sometime phenol is also used in foot dipping tank in farm. Similarly, chlorine is also used in processing for treatment of water which is used for washing of carcass. However, during and after slaughter process, the most probable risk of contamination is microbiological nature while during primary production both microbiological and chemical.

2.7 Hygiene practices in broiler chain

The meat safety is the control throughout the food chain from production to consumption according to FAO. The responsibility of food safety during meat production is shared by the industry and controlling agency (FAO, 1992). All the conditions and procedures that are necessary to ensure the safety and suitability of food at all stages of the food chain comprises the food hygiene (Codex Alimentarius, 2001).

2.7.1 Hygienic practices at Farm level

The broiler farm is the most important where broiler grow from chicks to chicken. There is very high risk of infection to broiler poultry if proper hygienic precaution is not considered. Biosecurity in the farm should be maintained for preventing the infection to enter (Prabakaran, 2003). Hygienic construction of poultry building is another requirement of to prevent the infection entry to the farm. Care should be taken to build the fencing, wall and floor so that there is no any risk of entry of infections and should be easy to clean (East, 2007). Traffic control is another important aspect of biosecurity. Human movement between the infected and healthy poultry farm was found to be the most risky source of disease transmission (Ssesmatimba *et.al*., 2013).

Foot dipping in disinfectant solution, spraying disinfectant, hand washing, changing boot, clothes are some examples of biosecurity measures applied in the farm (Maslic, *et.al*., 2012). Small scale commercial farms rarely implement the biosecurity measures. So there is always the chance of disease outbreak. Unsafe disposal of poultry carcass may be one of them (Calducha, *et.al*., 2013). Segregation, cleaning and disinfection are three major steps for biosecurity. Segregation includes keeping away of the contaminated people, animals and materials from the healthy birds. Cleaning will help to remove the contaminated organic matter from the poultry food chain. Disinfection helps to destroy the pathogens of various diseases. In overall biosecurity helps to protect the poultry from various pathogens (DeBenedictis *et.al*., 2007, Hsu *et.al*., 2011 and Wanaratana *et.al*., 2010).

Managemental system and biosecurity measures are the key to the successful poultry production. Failure to do so leads to disease outbreaks and inappropriate utilization of feeds. 10% of production loss is accounted by disease alone. Rodents, wild birds and insects are very important in the transmission of infections to the poultry as they serve as reservoir. So their entry in the farm should be checked. Also, entry of another farm animals to the poultry farm can also the source of *Salmonella* infection (Yong *et.al*., 2010). Poultry manure being a chief source of fertilizer, is also a source of diseases and parasites. One gram of poultry manure can contaminate one million chickens with Avian Influenza virus. So, proper disinfection is essential (Buragohain, 2011).

Small scale poultry farmers are not found to be implementing biosecurity measures due to the lack of awareness of possible risks, Small farmers also believe that the return do not outweigh the costs involved. Implementation of biosecurity measures is the cheapest and most effective form of disease prevention, ultimately decreases the cost of production (Calducha *et.al*., 2013).

According to EPIG, (2010), following points should be considered for maintaining the good hygiene practice in the farm:

- Minimum farm distance between two farm compound should be 2 kilometer.
- Hard and durable materials should be used to build the building for keeping birds so that it could be cleaned and disinfected without difficulty. The poultry house should not have access to any types of pests.
- The external surrounding of the house should be without any vegetation which helps to prevent pest prevalence.
- Provision of washing and disinfecting hands, changing clothes, boots, head cover and mask and foot dipping before entry to farm.
- Equipment used should be easily cleanable be made up of durable materials.
- Manure should be disposed properly keeping it far from the broiler house and covered.
- Pest control planning should be maintained and implemented regularly.
- Source of water and feed should be reliable with free of contamination. The feed and water should be stored properly so that it should not be contaminated by any means. Feed and water spillage should be promptly cleaned up to discourage vermin and moulds respectively.
- Any dead and culled birds should be removed and disposed properly either burying or incinerating. After disposal, hand must be washed and disinfected.
- Monitoring and sampling for testing *Salmonella* status in the flock should be maintained.
- Record of different farm activities should be maintained properly like visitor record, health record, feed record, mortality and stock record, cleaning schedule record, pest control record etc.

In chicken industry, careful designing of feed withdrawal period is an important practice for reducing the one of the food safety risk. Feed withdrawal is essential to prevent contamination by feces during transportation and in slaughterhouse. For achieving the optimal gastrointestinal emptying of poultry bird, they should be kept 8-12 hours off feed but water should be available until the moment of catching which increases the feed transit and excretion of faeces from the bowel (Nunes, 2013).

2.7.2 Hygiene practices at trader level

Traders are the persons who transport the broiler from farmers to processor. In broiler chain of Kaski district processor will do the same function of transportations. The transportation is a vital factor which should be controlled effectively towards hygienic practices to prevent disease transmission and maintain poultry healthy in the chain.

Instructions for hygienic catching, loading, unloading and transport of live birds (EPIG, 2010) are as follows:

- Biosecurity and personal hygiene are important in catching, loading and offloading work also. So, care should be taken to prevent cross contamination between catchers and flocks or farm. Protective clothing, foot wear, hand washing and disinfectant provided by the farm should be used before handling the broiler poultry.
- The poultry should be suitably registered and the transporting firm must be fully responsible for the proper disinfection of the transporting vehicle.
- The poultry must be transported by official transporters and crates should be well cleaned disinfected and dried before use.
- Poultry should be transported to slaughterhouse using the shortest way without pass through other poultry farms.
- All the staffs of transport should be trained in catching, loading, offloading and they should know the basic hygiene practices and awareness.
- The transporter should communicate with the farmer before transportation about the schedule of slaughter for proper feed withdrawal program to obey.

Birds should be handled and transported without any jerk for preventing bruising and bone breakage. The birds should be handled gently and given enough space to reduce the heat stress during travelling. The vehicle, empty crates should be thoroughly cleaned and disinfected after each use (FAO, 1992).

2.7.3 Hygienic Practices at processing level

The development of standard hygienic facility design and equipment is a vital aspect which can meet the consumer expectation of safe meat (Seward, 2007). Anti and post mortem examination are crucial in processing the hygienic meat production by an authorized and experienced meat inspector (Joshi, *et.al*., 2003).
For the hygienic meat production in processing level, trained personnel is utmost important in every steps of processing starting from the handling to final processing. Before slaughter, place for slaughter and equipment used should also be clean. There should be clear separation of clean and dirty place in the slaughterhouse. All the machines like defeathering machine, scalding tank, chilling room or refrigerator and processing table should be cleaned thoroughly. Always ensure that the scalding water should be clean in scalding tank. Also, cleaning water for carcass should also be safe and clean. Every day before starting and after finishing the work slaughter site should be thoroughly cleaned. Chilling of carcass should be done as soon as the shortest interval of time without delay until the carcass reached to standard chilling temperature. Processing infrastructure should be managed to reduce the possible hazards and organise and monitor each steps according to HACCP principles. The slaughterhouse should apply all hygienic practices to avoid cross contamination between flocks during the slaughter process of poultry birds (EPIG, 2008).

2.7.4 Hygienic practices in butcher/retailing level

In Nepal, there is practice of selling meat in open environment without any safety measures like chilling, keeping in refrigerator, packaging, covering with clean materials in front of busy roads with dust and flies around (Joshi, *et.al*., 2003). Butchers slaughter poultry in their premised with poor hygienic conditions (Maharjan *et.al*., 2006).

Chilling is the most important hygienic precautions in retailing level. The meat should be chilled to reach the internal temperature of meat to $<7^0$C for carcass and 3^0C for visceral organs. Also using gloves during handling the meat is another precaution to consider for retailer. Similarly, keeping all the premises and instruments used should be hygienically placed and used (FAO and WHO, 2009).

2.7.5 Broiler waste management

The poultry waste during production of poultry are manure and dead birds in production farm and feather, blood, visceral content and inedible parts of carcass are from processing. These wastes if not well managed, may cause contamination to new flock in farm and contamination in processing meat. Also it may cause environmental pollution. So, it should be managed properly. Following are some points for appropriate poultry waste management: Land application as a nutrient for crops:

Worldwide poultry manure or litter is used as fertilizer for enhancing the soil productivity and which ultimately increase the crop production. This is an effective and beneficial option if, properly managed. If it is used in excess, there will be environmental pollution (Williams, n.d.)

Animal feeding:

Scientific research has documented that nutrients in manure can be safely recycled to be a component of fertilizer for crops and vegetables production especially when the pathogenic microbes are managed (McCaskey, 1995 in Williams, n.d). The using of broiler slaughterhouses waste in animal feeding is becoming difficult due to certain standard given by EU (EU, 2000 in Salminen E., 2002). Some carefulness are essential when manure is used as animal feed such as copper toxicity when poultry litter is fed to sheep, *Salmonella* and other pathogenic microbes can be found in improper processed manure. Also, antibiotics and Mycotoxins can be present in manure.

Bioenergy production:

Poultry manure contains organic matter from which bio-gas can be produced which can be used as source of energy like electricity, cooking fire and other heat source. After use of energy this manure can be used in crop field as fertilizer.

2.8 Major acts and regulations related to food safety of Nepal

2.8.1 Food act 1966 and Food rules 1970

Food act 1966 is the primary legislation governing all the regulation of food safety in Nepal. This act and rules both are continuously being amended as an attempt to comply with international standards and guidelines. The major provisions made by this act are the following:

- Ban in production, sale and distribution of inferior, contaminated or unsafe food products.
- Provision for the detention of food products under suspicion
- Prosecution for misbranding of food items by false statement
- Requirement of license for food establishments
- Provision of penalties including sanction to firms and corporate bodies if found to responsible for unsafe food production sales and distributions
- Establishes the government bodies responsible for enforcement of food safety related rules and regulations and describes their functions and responsibilities
- Set out the power and process to formulate food standards and quality
- Regulates the packaging, labelling and storage requirements of food

However, there is no any provision to regulate the traceability of the food items.

2.8.2 Slaughterhouse and meat inspection Act 1999 and regulations 2001

The animal slaughterhouse and meat inspection act is made to prevent adulteration and contamination of meat during slaughtering and to ensure slaughter of only healthy animals and birds to ensure the safe and hygienic meat production for human consumption. This law has compulsory provision of anti-mortem and post mortem examination of animals by qualified meat inspector. He has authority for giving permission to slaughter the animal or reject or hold for further examinations. Also he does same for carcass and visceral organs during post mortem examination. The meat inspector should mark the wholesome meat with stamp and has authority to condemn whole or part of the carcass during abnormal condition. If he suspects some disease, he can further send to laboratory for confirmatory tests.

This act along with food act of 1966 and the food regulation act of 1971 ban the transportation and distribution of diseased meat. It also states that meat inspectors should be appointed in each district.

2.8.3 Animal health and livestock services act 1998 and regulations 1999

The animal health and livestock services act 1998 and regulations 1999 have been formed for the enforcement of healthy production, sale and distribution of animal and their products. The act also regulates import and export of livestock, their products and even livestock production materials important for food and health purpose of human beings. This act made the provision for animal quarantine post to regulate the import of animals, animal products and production materials (DLS, 2010/11).

2.8.4 Environment Protection Act 1997

All the commercial farmers, processors and other entrepreneurs have to perform their activities according to this act. This act stated to establish a new farm and slaughter house out of densely populated area of people.

2.9 Meat quality control agencies

2.9.1 Department of Food Technology and Quality Control (DFTQC)

DFTQC is the main authority for the control of food including meat and meat products quality in the country. It prepares or set the minimum mandatory standards for meat and meat products and monitors the quality (DFTQC, 2005). To determine quality of the products in the market meet the minimum requirements, the department can perform regular sampling and analyses. But the sampling and analysis is not performed in regular interval.

2.9.2 Department of Livestock Service (DLS)

DLS under the Ministry of Agriculture and Co-operatives of the Government of Nepal aims in developing the livestock sector by diversification and commercialization. The objectives of DLS in broiler sector include increasing production of poultry meat, assisting in quality improvement of poultry meat and meat market, helping in market identification and management, encouraging livestock and poultry based industries and developing human resources in the sector. Therefore, DLS has an important role in controlling the quality of meat in the broiler chain.

2.9.3 Nepal Bureau of Standards and Metrology (NBSM)

Nepal Bureau of standards and Metrology which was established in 1980 under Quality Standardization Act. The major functions of this institute are preparation, implementation and certification of national standards. The bureau is also involved in promoting quality standards, batch certification and technical services for quality control and standards. NBSM is a legal body for providing Nepal Standard (NS) mark based on the national standards fixed by it. But none of the poultry industries have obtained NS mark for their products so far in the country except some feed companies.

2.9.4 Food standardization board (FSB)

According to the provision of Food Act 1966, a separate government institution called Food Standardization Board (FSB) is established that formulate suggestions to the Nepal government about food standards, principles and guidelines according to international practices and principles.

Chapter 3: Research methodology

3.1Study site

The site of study was the Kaski district of Nepal. Hemja, Lekhanath, Lamachaur and Birauta were selected from the district where broiler population density is comparatively high. These places are from all four direction of the district which can easily represent the Kaski district. Also, these areas are easily reachable and large numbers of customers of commissioner of this research [Kaski Veterinary Clinic (KVC)] are concentrated.

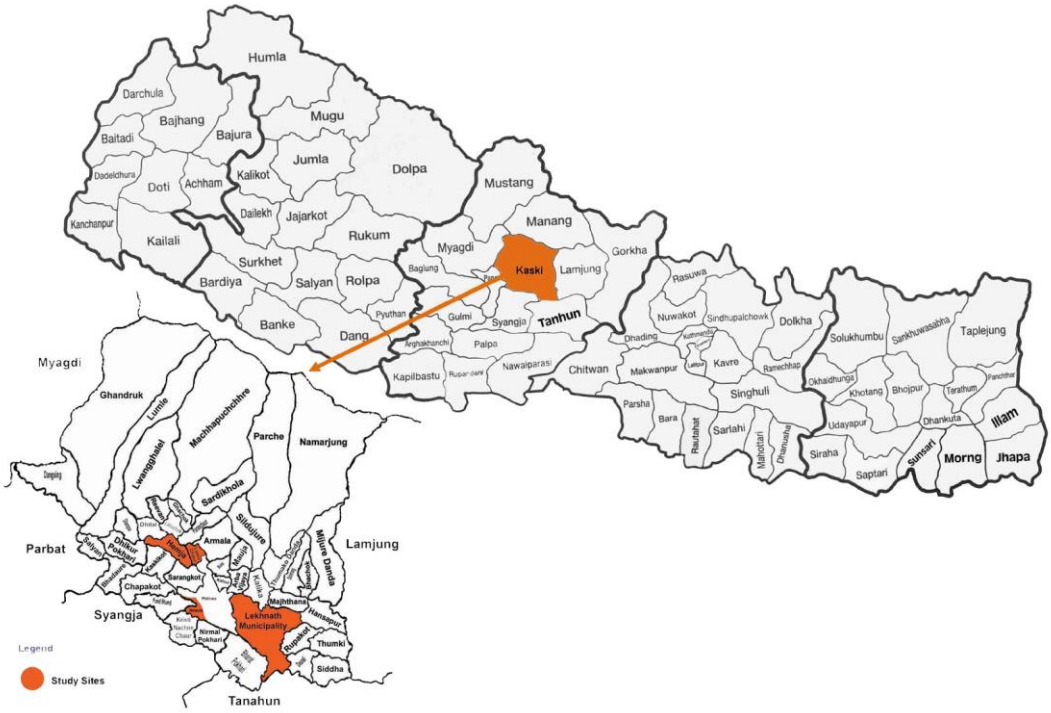

Figure 1: Study site

Kaski district is a part of Gandaki zone situated at western part of Nepal. Pokhara is a headquarter of Kaski district which covers an area of 2017 km^2 and had population 492,098 (CBS, 2011). The total number of fowl in the Kaski district is 1123015 in the year 2010/11. In the same year 2010/11, total meat production of Kaski district is 6515 MT., among which poultry meat production is 1021 MT. (DLS, 2010/11).

The district is the home district and working district of the researcher which makes easy to collect true information from the farmers as well as trader/processor and retailers. The respondents and key informants were not hesitated to give the realistic information thinking the researcher is from the same district and related to their visiting clinic.

3.2 Research methodology

The research had both qualitative and quantitative approach and was based on desk study, survey, interviews and observations. Desk study was done by collecting data from internet, library and Government reports from Nepal. The primary data collection was done through survey, interviews and own personal observations in the study area.

3.3 Research framework

The research design and framework (Figure 2) was developed for guiding the research to successful implementation (Verschuren, 2010).

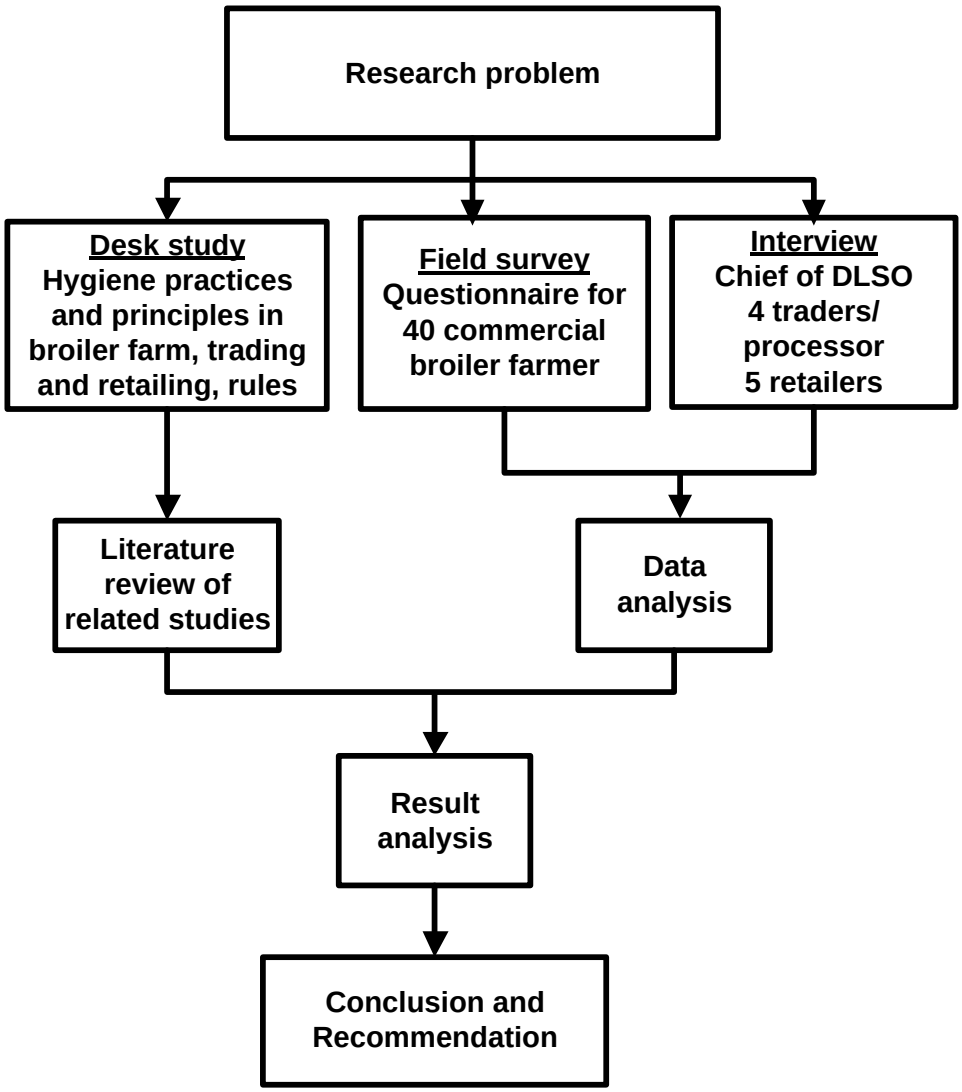

Figure 2: Research design and framework

3.4 Conceptual framework

Field study was conducted on commercial broiler supply chain of Kaski district. Research interventions were focused on hygienic practices on Farmers, poultry suppliers/trader and retailers levels. DLSO was taken as supporter/influencer. The value chain concept was used to map out the different chain actors as well as other chain supporting and or influencing organization to show how food safety is maintained within production, processing, transporting and retailing. Hygienic practices at each chain level were then assessed. The role of supporter and influencer in controlling food safety along the broiler value chain was also assessed.

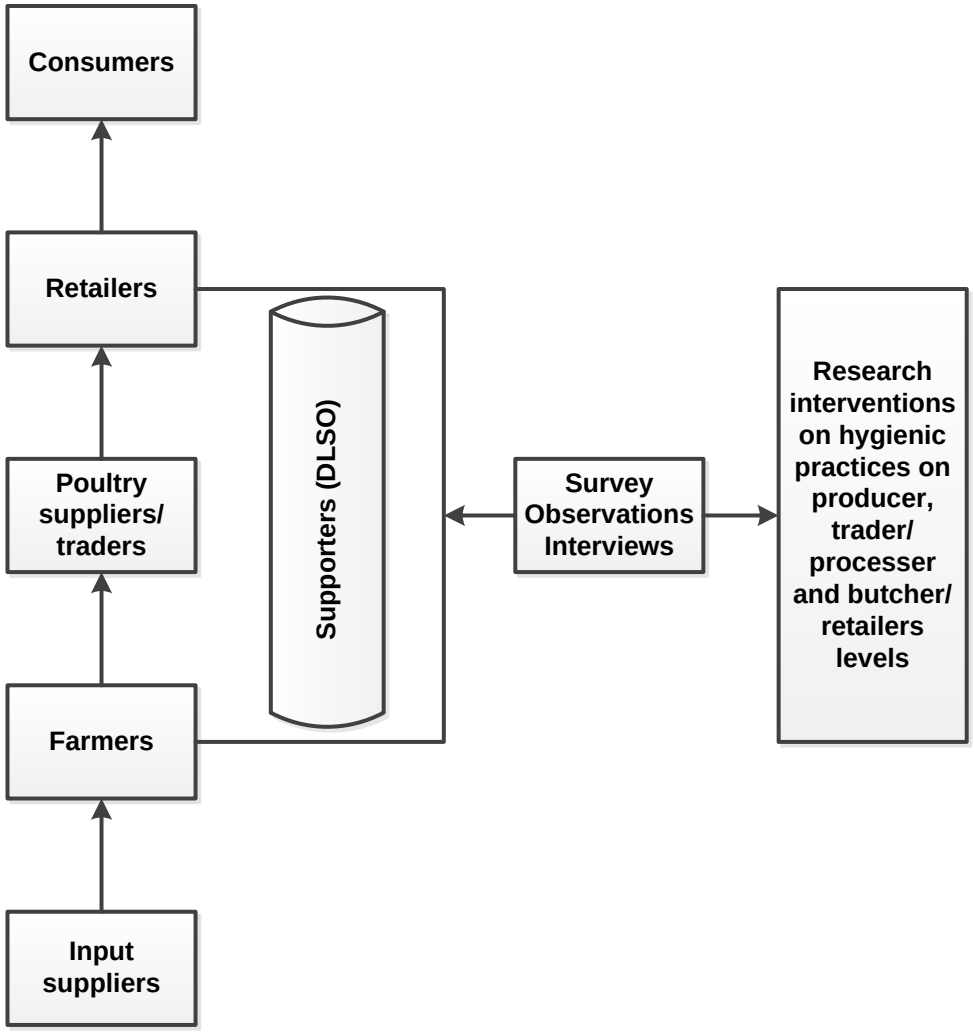

Figure 3: Conceptual framework of the research

3.5 Study design

3.5.1 Desk research

Desk research was used to collect data from existing literatures which is necessary to establish strong information for the research. In desk study, the background information related to research, the government rules and regulations, national and international food safety standards and policy related to broiler chain, other related research report on food safety practices in the area or in similar situation was searched. The source of these literatures were latest text books, journals, international and national reports such as reports from the department of livestock service, department of health services, internet websites and other related recent publications.

3.5.2 Survey

A survey was done to collect primary data by pre-structured questionnaires (Annex-1) which were designed for forty commercial broiler farmers from four places, 10 from each places of Kaski district. The questionnaire was focused on current hygienic practices applied in their broiler farms. The respondents or farmers for the survey were selected from the client list of KVC who were curious and willing to give correct answer for the research.

3.5.3 Interviews

In interviews, 4 trader/processor and 5 butchers/retailers were interviewed using semi structured questionnaire (Annex 3 & 5). These interviews were conducted face to face by using prepared checklist in order to collect data about the practices regarding meat safety measures about broiler transportation and processing.

The chief of District Livestock Service Office of Kaski is interviewed by using semi-structured questionnaires or checklist (Annex 7). The interview of Government office was aim to collect more data about the hygienic practices done by commercial broiler farmers and small processors, the government role and responsibilities in relation to the food safety along broiler value chain.

Traders/processor are transporting, processing and selling the broiler birds from farms to the butchers or retailers with or without processing (live). The interview will be concentrated on their current food safety practices to reduce the risk of food safety in the chain. Five retailers/butchers were also interviewed about their awareness and current practices in broiler meat handling.

3.5.4 Sample selection and size

The researcher consulted the director and veterinarians of commissioner of this research (KVC) who were the subject matter specialist for the district on best locations to conduct the survey. Based on discussion, Lekhanath (east), Hemja (west), Lamachaur (north) and Birauta (south) of district were selected due to their higher number of broiler farmer and clients of KVC. Within the limited time frame of only 4 weeks of field work, the researcher conducted the survey of 40 farmers and interview of 4 traders, 5 butchers and chief veterinary officer of the district who is responsible for all the animal and poultry activities of the district including public health issues, farmer awareness training, animal health, food safety of animal origin from the government. 10 farmers from each area is because there is almost equal number of farmers clients in each area for the clinic. The criteria for inclusion were farms who are the clients of KVC. Thus, a stratified sample size of 40 (10+10+10+10) farms from different area of Kaski district was chosen purposely due to logistical reasons and limitations of the short field study time. It was felt that the sample would be sufficient for the study and address the research objective because of their nearly similar circumstances of surroundings and management. The results of the study from this sample would give a clue that can be generalized to the research population of the whole district.

3.5.5 Observations

This method of data collection was done by observation during the data collection from broiler farmers, traders/processors and butchers/retailers in relation to the hygiene practices implemented in the broiler chain like building, layout of premises, personnel hygiene and their practice and processes (see observational checklists shown in Annex-2,4 &6).

3.5.6 Data tabulation and analysis

The excel sheets were used for tabulation of data collected from the survey. The pie chart, bar chart and tables were prepared for the easy interpretation of the collected data using the Microsoft Excel program. The respondents/farmers were divided into four groups according to their location/address but, the analysis in most of the cases was done on the basis of the information collected from all respondents as a single because the answer from all the farmer of different areas was more or less similar.

All the information collected from the interviews is compared with the information collected from the survey in the field. All the information collected from different methods was put side by side with related literature and was critically analysed. The experience gained before by the researcher and SWOT analysis of the broiler value chain was used for the discussion of the result found.

Chapter 4: Results

This chapter represents the results of the research conducted though survey and interviews during the field study in Kaski district of Nepal. The research findings of the survey are presented in table and graphs for an easy interpretation. The result of the interviews of traders, retailer/butcher and District Livestock Service Office of the district are also illustrated in this chapter.

4.1 Farm survey

4.1.1 Background information of farmers

This section draws the broiler farmer's characteristics of the district namely: Gender, education background, flock size, production cycles per year as well as main source of income. These basic characteristics of the broiler producers are important as they will help to shape interventions to match the circumstances of broiler farmers.
A total of forty farmers (N=40) from Birauta, Hemja, Lamachaur and Lekhanath areas were interviewed in which all location have 10 respondents.

Table 3: Background information of farmers

Address	Gender		Education level of farmers				Flock size				Production Cycle/year				Main income source	
	Male	Female	No any	Primary	Secondary	University	<500	501-1000	1001-1500	>1501	4	5	5.5	6	Yes	No
Birauta	7	3	2	3	4	1	2	4	2	2	0	2	0	8	9	1
Hemja	7	3	1	3	6	0	2	2	4	2	0	3	1	6	10	0
Lamachaur	6	4	5	2	2	1	5	3	2	0	1	6	3	0	6	4
Lekhanath	6	4	1	3	4	2	1	5	2	2	0	2	0	8	10	0
Total	**26**	**14**	**9**	**11**	**16**	**4**	**10**	**14**	**10**	**6**	**1**	**13**	**4**	**22**	**35**	**5**
%	**65**	**35**	**22.5**	**27.5**	**40**	**10**	**25**	**35**	**25**	**15**	**2.5**	**32.5**	**10**	**55**	**87**	**13**

According to the survey, there are higher percentage male respondents (65%) than female (35%) in total. There is higher percentage of male farmers in all places than female as shown in table 3. This shows that there is more involvement of male farmers than females in the poultry farming of Kaski District.

Majority of farmers (40%) were having secondary level and only 10% farmers having university level of education.

Majority of farmers (35%) were rearing 501-1000 broilers and there were least number of farmers (15%) rearing more than 1500 broiler flock at one batch

Majority (55%) of the farmers had 6 production cycles per year. The average production cycle was found to be 5.57 per annum. Majority of farmers (87%) have broiler farming as main income source.

4.1.2 Hygienic practice awareness and application in the farm

Table 4: Awareness and hygiene practices of farmers

Hygienic practices	Birauta		Hemja		Lamachaur		Lekhanath		Total	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
All in all out system follow	10	0	9	1	10	0	9	1	38	2
Having foot bath disinfection	4	6	6	4	3	7	8	2	21	19
Use of water disinfection	10	0	9	1	8	2	10	0	37	3
Experience of Pest	10	0	10	0	9	1	10	0	39	1
Awareness about disease transmission by pest	8	2	5	5	5	5	6	4	24	16
Facing broiler disease problems	10	0	10	0	10	0	10	0	40	0
Antibiotics use for the treatment of broiler	10	0	10	0	9	1	10	0	39	1
Awareness about antibiotic withdrawal	4	6	0	10	1	9	3	7	8	32
Implementation of antibiotic withdrawal period (from the aware people)	2	2	0	0	1	0	1	2	4	4
Cleaning and disinfection of poultry house thoroughly after each production cycle	10	0	10	0	7	3	10	0	37	3
Visitor allowance to the farm	4	6	3	7	6	4	4	6	17	23
Awareness about disease transmission from sick and dead broiler	10	0	10	0	10	0	9	1	39	1
Washing hands after handling sick and dead birds	10	0	10	0	10	0	9	1	39	1
Awareness of withdrawing feeds before slaughter	1	9	0	10	0	10	0	10	1	39

All in all out system of rearing

Majority of farmers (95%) were followed ‘all in all out’ system of rearing.

Foot bath disinfection

There were slightly higher percentage of farmers (51.2%) having foot bath disinfection than not having.

Table 5: Frequency of foot bath disinfectant replacement

	Daily	Less than 5 days	6 to 7 days
Number of farmers	6	13	2
Percentage (%)	28.5	61.9	9.5

From the table 5, among the farmers using food bath disinfection, majority of them (61.9%) replace the disinfection solution of footbath in less than 5 days.

Use of water disinfection

Out of 40 farmers interviewed, majority of farmers (92.5%) use water disinfection system in the farm in drinking water of poultry.

Pest experience in the farm

Almost all farmers or respondents (97.5%) had experienced pest in their farm.

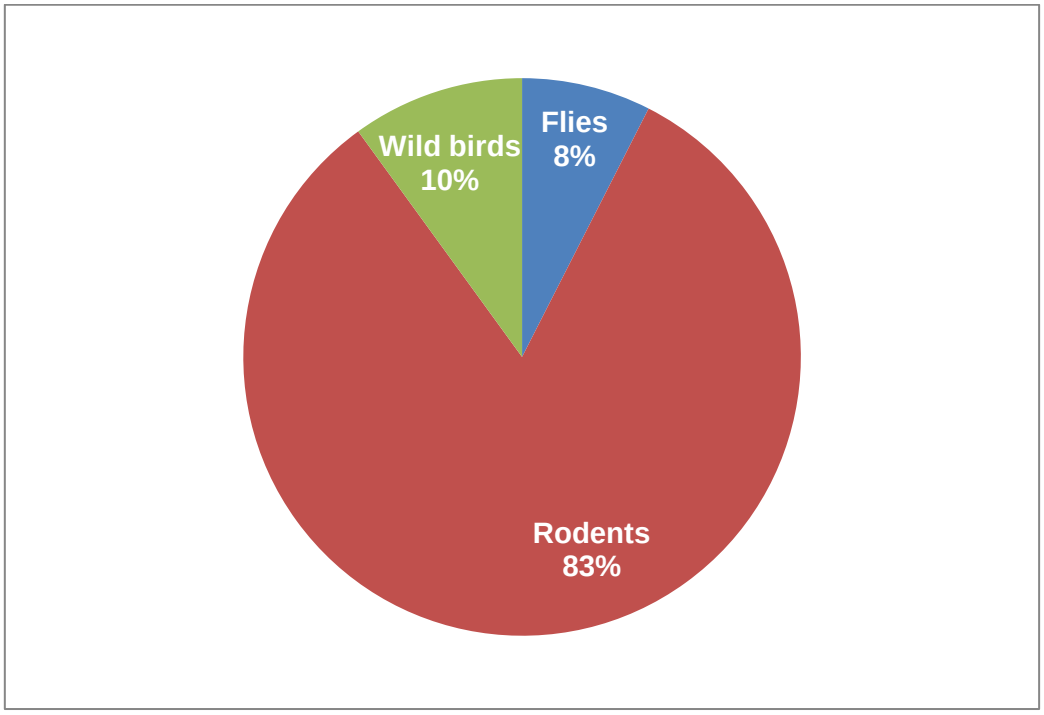

Figure 4: Different pest experience in farm

The respondents are given to choose one most common option that they suffered predominantly. Majority (82%) of the farmers had rodents as a major problem in their farm. Very few farmers had problem with wild bird (10%) and flies (8%). No any farm had pest control strategy.

Awareness of disease transmission by pest

In overall, majority of the farmers (60%) are aware of the disease transmission through pest in overall.

Common disease symptom encountered by the farmer

Table 6: Common disease symptoms encountered

	Most common disease symptoms		
	Coughing	**Diarrhoea**	**Lameness**
Number of farmer	7	25	8
Percentage (%)	17.5	62.5	20

All the farmers had faced the problem regarding broiler health, among them, diarrhoea was the most common symptom (62.5%) followed by lameness (20%) and coughing (17.5%). Farmers were given to choose most one common option only.

Measures taken to address the disease symptoms

Most commonly, all the farmers (100%) use to call or consult the veterinarian to address the disease symptoms.

Antibiotics/antimicrobial use and withdrawal period and its implementation

All the farmers use antibiotics/antimicrobials for the treatment of diseases. Very few (20%) farmers have the knowledge about antibiotic/antimicrobial withdrawal period before slaughtering. 50% of the people having knowledge to implement the withdrawal period.

Cleaning and disinfection of poultry house

Majority (92.5%) of the farmers clean and disinfect the poultry house thoroughly after each production cycle by cleaning with scrubbing, water flush and disinfecting the shade as recommended by veterinarian.

Visitors allowance into the farm

In overall, higher number (57.5%) of the farmers do not allow visitors to enter their farm.

Hygienic precautions in the farm before entrance

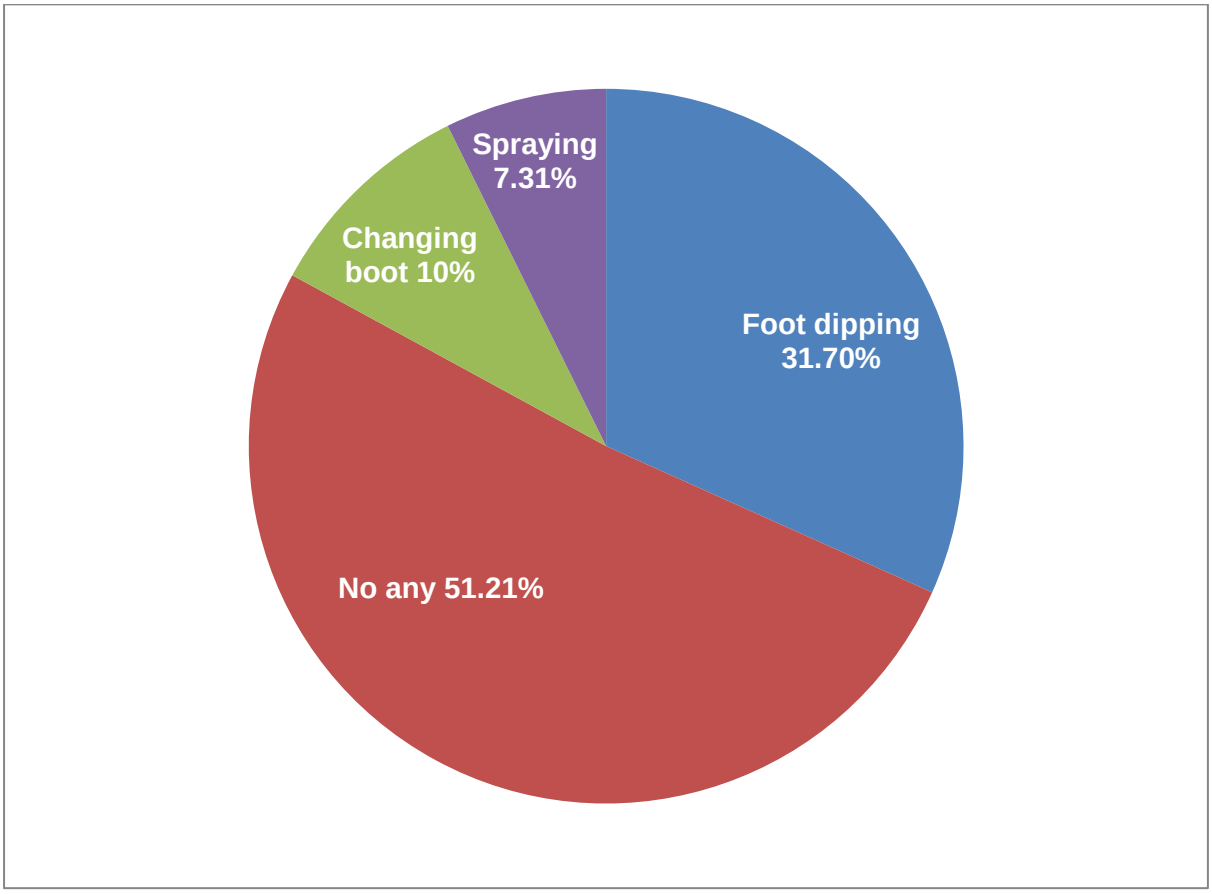

Figure 5: Hygienic precaution of applied in farm

More than half (51.2%) of the farmers do not use any hygienic precautions in the farm. One third of the respondents mostly use foot dipping which is followed by foot dipping (31.7%), changing boot (10%) and Spraying (7.3%). Farmers have given to choose one most common option only.

Manure disposal

Table 7: Manure disposal used by farmer

	Selling quickly	Storing far from the broiler house	Storing near from the broiler farm
Number of farmers	**16**	**14**	**10**
% farmers	**40**	**35**	**25**

About manure disposal farmers were given to choose most common choices among selling quickly, storing far from the broiler house and storing near the broiler house. Majority of the farmers (40%) manage manure mostly by selling quickly which is followed by storing far from the broiler house (35%) and storing near from the broiler house (25%) respectively. Also this result was confirmed by observation during farm survey too.

Mortality percentage

Table 8: Mortality percentage faced by farm

	Mortality			
	< 5%	**5 to 10%**	**10 to 15%**	**>15%**
No. of farm	2	22	8	8
% of farm	5	55	20	20

Majority of the farmers (55%) had observed the mortality rate of broiler flock 5-10%.

Carcass disposal

Farmers were asked about their most common method of carcass disposal. Majority of the farmers (92%) of the farmers dispose the carcass by burial method followed by pig feeding (5%) and throw it nearby poultry house (3%) respectively.

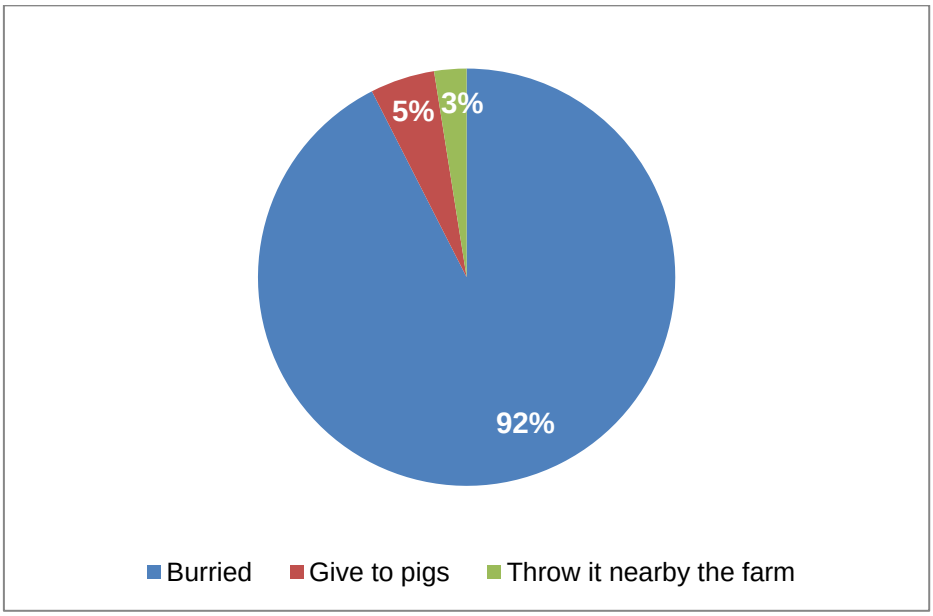

Figure 6: Carcass disposal method by farm

Awareness of disease spread by sick and dead bird

Most of the farmers (97.5%) know that disease spread from sick and dead birds.

Practice of washing hand after handling dead and sick birds

Most of (97.5%) of the farmers wash their hands after handling sick and dead birds.

Awareness of feed withdrawal before slaughtering birds

Majority (97.5%) of the farmer do not withdraw the feed before slaughter.

4.1.3 Observational results of broiler farm

Table 9: Observational results of broiler farm

Observation	Good	Poor	Observational parameters
Feed storage condition	4	36	According to risk of contamination (no spillage, clean, no access for rodents, use of separate room, prevention methods from moisture= good; otherwise= poor)
Existence of fencing	5	35	Exist= good; not exist= poor
Surface of wall and floor	12	28	Easiness to clean or not; no holes cracks and crevices on wall (presence=poor; absent=good); for floor (Concrete=good; soil=poor)
Farm distance with another farm	13	27	Nearest distance to another farm (<2km.=poor or >2km.=good)
Cleanliness of poultry house surrounding	4	36	Existence of bush, crops, manure etc. near the broiler house (presence=poor; absent= good)
Spaces given for birds	35	5	<1 sq.ft./bird (poor); 1 sq.ft./bird (good)
Availability of farm record	10	30	Available (good); not available (poor)
Cleanliness and safeties of equipment used like feeder, drinker, water storage tank	14	26	According to visually observed dirtiness (observed dirty=Poor; clean=good)
Availability of personal hygiene equipment	18	22	Visual observation of availability of clean clothes/aprons, boot, soap, disinfectant (available= good; not available=poor)

4.2 Hygiene practices at poultry trader/processor level

- No any poultry trader/processor checks the health of the bird before and after transporting. The main reasons could be attributed to the lack of rules and regulations. Furthermore, there is no demand of the consumer regarding this according to them.
- Generally the trader/processor does not want to supply the sick birds. But they do not go for veterinary check-up. They just observe visually. And there is a chance of subclinical infected birds to go to market. If sick birds are observed, they are culled and disposed. Furthermore, there are no such rules regarding dispose of sick birds.
- There are various methods of disposing sick birds died during handling. Some of the suppliers (1) send it to municipality disposal tanker, some (2) bury it (but not hygienically) and some (1) even sell the dead birds.
- There is the practice of cleaning the vehicle after bird transportation, but there is no practice of disinfecting it. According to traders/processors, the cleaning is usually done by soap and water (1), but most (3) of them were observed to use only water.
- It was found that only soap is used for hand disinfection in most of the trader/processor (3). Some trader/processor (1) tends to use separate aprons and sandals. The main reason was to maintain the hygiene in their answer.
- According to trader/processor, cleaning and hygiene maintenance is done to control the food safety risks. According to them, there is no benefit from practicing the hygiene for them.
- There is no any quality control monitoring visit by the government personnel in any trader processor firm.

4.2.1 Observational result of hygienic practices done by trader/processor

Table 10: Observational result for poultry supplier/trader/processor

Observations	Good	Poor	Observational parameters
Cleanliness of vehicle, crates for transport	1	3	By visual observation of dirtiness (clean=good; dirty=poor)
Time of transport	4	0	According to time of transport (morning and evening=good; day=poor)
Layout of processing building	0	4	Risk of contamination (existence of separation of dirty and clean area=good; no separation= poor)
Personnel hygiene	1	3	Use of boot, aprons, mask, head cover, cleanliness of clothes, hand washing facility with soap or disinfectant (used most of above things=good; no use=poor)
Safeties of water used for cleaning	1	3	Storage facility condition (open=poor; closed=good)
Veterinary inspection	0	4	Facility available=good; not=poor
Management of sick bird	0	4	Availability of separate space for sick bird=good; if not=poor
Time of bleeding	4	0	According to standard (3-5 min.) if maintained the standard=good; if no= poor
Cleanliness of scalding water	0	4	Cleanliness of water and pot used (if clean=good; dirty=poor)
Disposal facility for sick/dead bird and broiler waste	1	3	Visual observation of facility away from processing and well managed (if not observed=poor; observed=good)
Cleanliness of evisceration process	0	4	Risk of contamination during process (if used floor=poor; if used table=good)
Cleanliness of floor and wall	0	4	If found clean visually=good; if dirty=poor
Cleaning of carcass	0	4	Observation of process, cleanliness of water, frequency of cleaning
Chilling facility	0	4	If yes=good if no=poor (before transport)
Transport facility for meat	0	4	If used closed vehicle with cooling facility=good; if not=poor
Packaging	0	4	Risk of contamination of packaging during transport (if high risk=poor; if low risk=good)

4.3 Hygienic practices at butcher/retailer level

- No any butcher checks the broiler health before slaughter.
- All the butchers used observation of visible symptom is to buy the healthy bird. None of them were searched for the health certificate.
- None of them were found to slaughter clinically sick birds. But sometimes slaughter of subclinical infected birds occurs due to the lack of veterinary inspection. The sick birds are culled and disposed.
- Majority (3) of the butcher killed and disposed the sick birds. Sometimes some butchers (2) are found to slaughter and sell them.

- No any meat inspection takes place in butcheries. The client had to depend on hygienic practice followed by the butchers to believe the carcass is from healthy birds. The client had to believe the words of butchers. Some of them were also allowed clients to visit and observe the lairage for self-satisfaction.

- All of the butchers were aware that the disease transmission may take place to consumers through meat.

- All of the butchers were aware of food safety risks in their operation. Some of the food safety risks that the butchers felt were: poor hygiene, poor chilling and contamination during processing. And they believed that these can be reduced by just maintaining the hygiene.

- 40% of the butchers were found to participate in hygienic meat handling practice training. All of them were found to apply the knowledge they gained there in their slaughterhouse as far as possible.

- There is no any quality controlling visit by the government.

4.3.1 Observational result of butcher/retailer

Table 11: Observational result of butcher/retailer

Observations	Good	Poor	Observational parameters
Layout of processing retailing shop	1	4	Risk of contamination (separation of dirty and clean area= good; if no=poor)
Personnel hygiene	1	4	Use of boot, aprons, mask, head cover, cleanliness of clothes, hand washing facility with soap or disinfectant (if used most of things=good; if not=poor)
Safeties of water used for cleaning	1	4	Storage facility condition (if open=poor; if closed=good)
Veterinary inspection	0	5	Anti-mortem and post mortem examination facility (if exist=good; if not=poor)
Management of sick bird	0	5	Availability of separate space for sick bird (if available=good; if not=poor)
Bleeding time	5	0	According to standard (3-5 min.) if maintained the standard=good; if no= poor
Cleaning of evisceration process	0	5	Risk of contamination during process (if used floor=poor; if used table=good)
Cleanliness of scalding water	0	5	Cleanliness of water and pot used (if clean=good; dirty=poor)
Disposal facility for sick/dead bird and broiler waste	0	5	Visual observation of facility away from processing and well managed (if not observed=poor; observed=good)
Cleanliness of floor and wall	1	4	If found clean=good; if dirty=poor
Cleaning of carcass	0	5	Observation of process, cleanliness of water, frequency of cleaning
Chilling facility	5	0	If yes=good; if no=poor
Cleanliness of retail shop and instrument used in it	1	4	If found visually clean= good; dirty=poor

4.4 Role of government in maintaining food safety along the broiler chain

The District Livestock Service Office (DLSO) was perceived Highly Pathogenic Avian Influenza (HPAI) is currently considered as major public health concern in broiler production chain due to serious outbreaks of disease in poultry flock in neighboring districts. Similarly, *Salmonella, E. coli* and *Campylobacter* infection also perceived as public health hazard in broiler meat of Kaski district. The risk to public health starts from the farm due to poor hygienic practices and especially during the unhygienic processing, transportation and storage of the broiler meat by the chain actors.

According to DLSO, its role is to maintain these risks of microbial contamination in low level by continuous monitoring and surveillance. Also they create the awareness to the chain actors about safe meat handling practices throughout the chain.

HACCP, slaughterhouse and meat inspection act, veterinary certificate issuing practice are required in the commercial broiler chain for the food safety of Kaski district. The veterinary authority is not satisfied with the current hygienic practices applied in broiler chain for the food safety of the district because there is no any mechanism and practices of meat hygiene in current market.

According to the Chief of DLSO, the responsibilities of veterinary authority in broiler chain are to maintain hygienic practices in their business are the following:

- Training to stakeholders about biosecurity and hygienic practices in safe meat handling
- Registration of slaughterhouse and meat shops and their certification
- Monitoring of trader/processor, farm and meat shops
- Health and management services/advices to the farmers
- Financial support for the improvement of meat shops (retailer/butcher)

The constraints faced by this department are to enforce the food safety regulation in broiler chain are the following:

- Inadequate budget, technical resources and human resources
- Lack of cooperation by the chain actors including consumers
- Complicated procedure for loan
- Poverty levels among the actors
- No compensation and insurance systems
- Poor level of awareness/knowledge in actors about food safety
- Political instability
- Lack of willingness among political leaders
- Control of market by some actor in the chain and insecure market

Also he added that, slaughter house and meat inspection regulation is not passed from the parliament due to political instability. Due to this there is no implementation of any rules for meat inspection and there is no control of government over stakeholders for maintaining food safety. Also he said that there is no any system of getting additional bonus/price for the production of hygienic meat by the actors so they were not motivated to produce hygienic meat.

According to chief veterinary officer of the district, immediate application of HACCP, slaughter house and meat inspection act, farm registration and monitoring has to be put in place to improve the food safety in the broiler chain of Kaski district.

4.5 Stakeholder involved in the broiler chain of Kaski district

The stakeholder analysis of broiler chain in Kaski district is done by the researcher through his own knowledge and experience, information collected from interviews with actors along the broiler chain. It is also based on some related literatures found during the field study.

4.5.1 Role of different actors in broiler chain

Hatcheries

As the first actor in commercial poultry farming for broiler production, hatcheries source the parent stock locally and use them to produce day old chicks (DOC). There are 87 registered hatcheries in Nepal. Among them 6 are in Pokhara. They import their parent stock chicks from different countries like Srilanka, India, Malaysia, Australia etc. They produce DOC and distribute them to different poultry suppliers (trader/processor) of district. According to DLSO, Kaski, the approximate production of broiler DOC is 300 thousand per month. In Kaski district, about 40 percent DOC comes from other hatcheries of other districts too, especially Kathmandu and Chitwan districts (according to DLS staff). They also provide technical support to farmers by training and health services.

Feed mills/company

A number of feed millers supply feed to poultry farmers in the district. Mainly Nimbus feed, Pancharatna feed, Poshak feed, Daunne feed, Annapurna feed, quality feed are feed industry who supplies their feed to this district. There is no any commercial broiler pellet feed company in the district. They deliver feed directly to the stores of poultry suppliers. The types of feed delivered by various millers include broiler starter, broiler developer and broiler finisher in pellet form. They also provide the technical and extension services to the farmers about broiler management through their technical personnel.

Veterinary-input suppliers/ clinic

Veterinary input dealers are mainly responsible for supplying the veterinary medicines and vaccine to the broiler farmers either through poultry suppliers or directly to the farmers. There are 97 veterinary suppliers in the district. Some big suppliers and clinics also provide technical advices and services like disease diagnosis, treatment and advices to the farmers through their own veterinarian.

Farmers or producers

Broiler farmers are those who buy DOC and other inputs from suppliers and raise them for 45 to 60 days until the live weight reaches 2-2.5kg (marketing weight). The feed, chicks, some veterinary medicines are provided by the poultry suppliers to them. Then after, poultry suppliers are responsible to market it. Poultry suppliers give all the output or profit by deducting all the inputs provided by them. There are 238 commercial broiler producers in the district now and they keep 50 to 5000 broiler birds in one lot according to their capacity of farm (according to DLS staff).

Trader/processor (Poultry Suppliers)

They are the major actors in broiler chain of Kaski district. There are altogether 15 poultry suppliers in the district according to district livestock officer. They have very big role in the supply chain of broiler in the district (DLSO staff). They buy chicks from the hatchery, feed from the feed mills and veterinary medicines from the veterinary suppliers and sold to the

farmers. In between the farmers and poultry suppliers there is a contract that during start of business, farmers should keep deposit to them 200 thousand Nepali rupees per 500 DOC (Day old chick) and they will supply the required feed and chicks to farmers. Suppliers are responsible to sell their broiler at the time of marketing. After marketing, they calculate the cost of feed, chicks, medicine and transportations of feed and chicks provided by them to the farmers, and deduct it from the output of broiler sold and give the remaining or profit. If the farmers are in loss, suppliers will be in safe position because of deposit.

Poultry suppliers will then send the broiler to their market (fresh houses, butchers, hotels and restaurants). Generally they sell the processed whole chicken as they have the processing infrastructure and sometime live birds too.

They also provide regular feedback to the millers regarding demand supply conditions and consumer preferences. The feedback is usually in terms of customer complaints and satisfaction about feed. They also give regular feed back to the hatchery about performance and quality of chicks which are collected from their farmers.

Poultry suppliers (processor/trader), butchers and fresh houses are the main poultry processors in the district. Among them processor trader are large scale poultry processor in the district. Processor/trader slaughter and process the broiler and supply them to butchers, fresh houses, retailers and institutional consumers like hotels and restaurants.
They are the one who determine the price of live birds and meat in the district. They have strong relationship and linkages among other input suppliers, producers, others processors and institutional consumers.

Retailers/Butchers

Butchers and fresh houses act as retailer in the broiler chain of the district. Butchers and fresh houses both also act as processor and retailers too. They supply or sell the processed meat to institutional as well as general consumers. Some butchers and fresh houses receive live birds from trader/processor and processed by themselves and sell it to consumers too. They can be considered as small scale processor. There are 274 butchers/ fresh house/ retailers in the district.

Consumers

Hotels, restaurants and catering services are taken as institutional consumers (20%). These consumers buy their required amount of produce mainly from the poultry suppliers, and some may buy from the fresh houses and butchers too.

The high income consumers (10%) are those who lives in city area and consumes meat buying form the supermarkets. They pay more prices at supermarket. Especially the consumers of supermarket are high income consumers.

General consumers are those who buy their meat from butchers and fresh houses. They are usually low or middle income consumers. They are in majority about 70% in the district according to processors informal interview.

4.5.2 Role of different supporters in broiler value chain in Pokhara

District Livestock Service Office:

It has role in monitoring of poultry farms, processor and retailers in their operational areas in the districts. District livestock office provides technical extension services about effective broiler management to the farmers. It is one of the government offices. It is responsible for applying government rules and regulations at farmer's, processor and retailing level. It provides awareness program to the actors about the importance of hygienic poultry production and its safety procedures for the different actors.

Department of Livestock Service (DLS):

This department decides to be strict on the safety of chicken sold by enforcing government regulation related to safety of livestock products including poultry. It is responsible for issuance of movement and import permit prior to transport of poultry and poultry products. It is responsible for quality control of feed mills, hatchery, meat processing company, meat shops, butchers, poultry suppliers and fresh houses through monitoring and routine laboratory analysis and inspection of poultry slaughter facilities to insure the use of GHPs.

Regional Animal Disease Diagnosis Laboratory:

It is also another government office which works in poultry sector too. It helps in diagnosis and treatment of disease related to broiler. It also carries out disease surveillance on poultry. Also it provides some technical advices to the farmers and others poultry suppliers.

Regional Livestock Training Centre

This provides the training and awareness programs to all stakeholders in the chain about good hygienic practices and new technologies according to their needs.

Nepal Poultry Entrepreneurs' Forum (NPEF):

The NPEF is playing important role in coordinating the private sector with the government. They have vital role in increasing investment and employment and are demanding with the government to make 'Poultry Development Policy' with the provision to create a National Poultry Development Board with sufficient representation of the private sector and with a mandate to serve as a bridge between the government and the private sector on matters related to the industry. They have important responsibility in developing and observing code of practices for industries, quality regulation of the feed and other production inputs. But till now, NPEF is not getting success for its objectives of forming Poultry Development Policy and Poultry Development Board.

Non-government organizations (NGOs):

Non-government organizations (NGOs) and programs including the Food and Agriculture Organization (FAO), Stamping Out Pandemic and Avian Influenza (*STOP AI*), Agriculture Enterprise Centre (AEC), Academy for Educational Development (AED) are working to create facilitating circumstances for the poultry industry in Nepal. These organisations are working by improving capacity and strengthening competitiveness of different actors within the poultry value chain including farmers, producers, processors, hatcheries and feed entrepreneur.

Other supporters and influencer:

Banks provide credit to most of actors of the chain. But it's hard for the farmers to get loan because of poor economic status.
In collaboration and partnership with municipality and DLSO, processors are modernizing their businesses in terms of improvement in hygiene and sanitation, increasing handling capacities, product development etc. The Community Livestock Development Programme (CLDP) under DLS is supporting meat enterprise development activities mainly in the municipal areas of the district. Government is taken as influencer who acts in formulation and implementation of the Meat Inspection and Slaughter House Act, 1998 and regulation 2001. This would regulate the quality and hygiene of meat in the district. It also acts as monitoring and evaluating and supporting their activities of each and every actor in the chain.

Broiler value chain of Kaski district

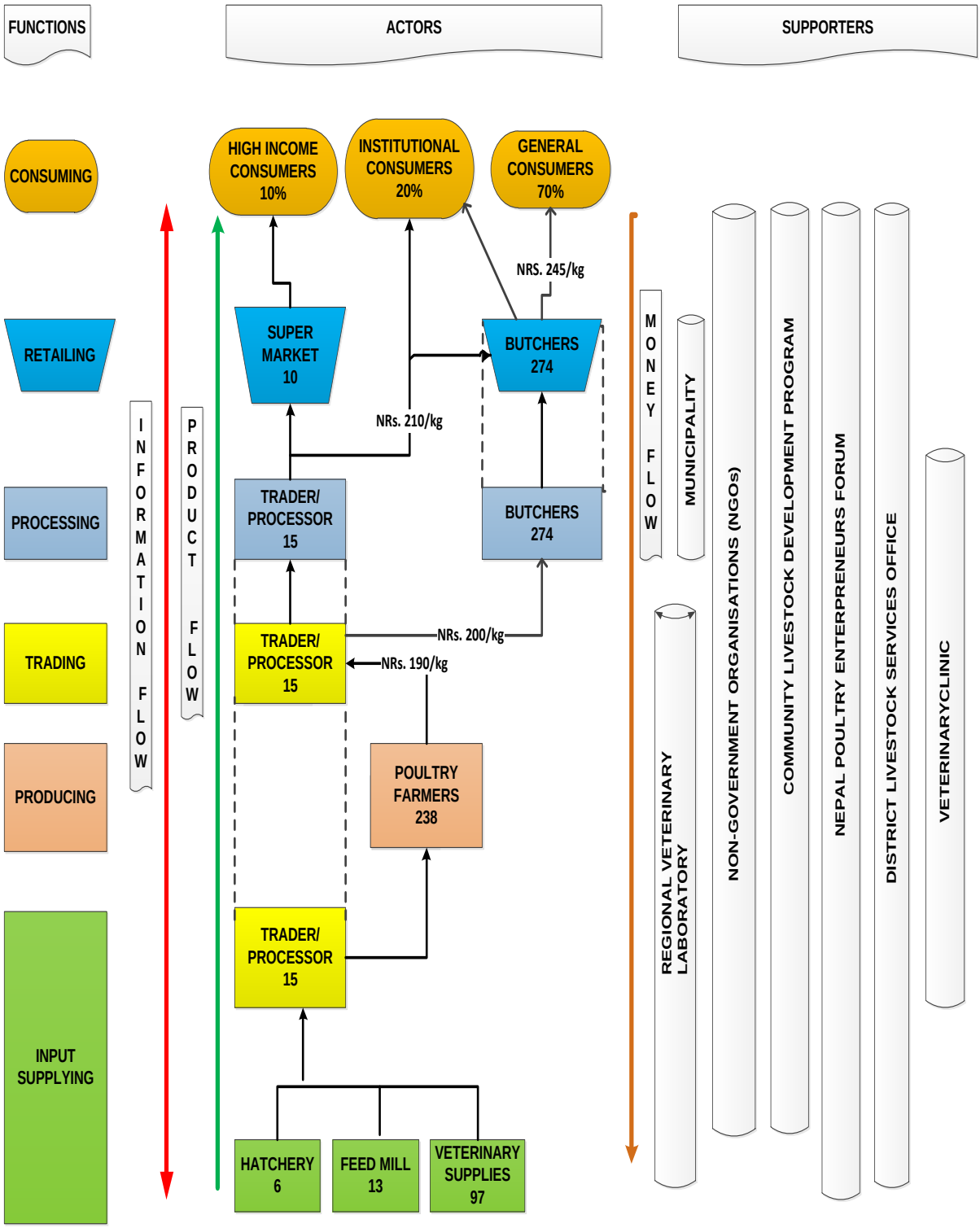

Figure 7: Broiler chain of Kaski district

Chapter 5: Discussion

This chapter explains the results obtained from the survey and case studies (interviews). Besides, it relates and compares the different situation on the basis of relevant literature reviewed in the previous chapter. The information gathered through primary and secondary data is critically analysed taking into consideration the institutional setting of the broiler supply chain in the district. Own experience of the researcher is also used to analyse the findings. Besides, this chapter attempts to discuss the issues that were expected to be answered by this research as mentioned in research sub questions on the basis of the available information and the researcher's previous experience.

5.1 SWOT analysis of the broiler value chain of Kaski district

The SWOT analysis of the broiler value chain in general is done by taking into consideration that all the actors and factors affecting the broiler value chain especially the production of hygienic broiler meat for the consumers. The rapid analysis of the broiler value chain of Kaski district has recognized the followings strengths, weakness, opportunities and threats.

Table 12: SWOT analysis of broiler chain of Kaski district

Strengths	**Weakness**
• Good source of income for poor marginalized and disadvantaged people • Quick return on investment. • Increasing meat production trend of the nation • Increasing demand of consumers • Good relationship and information sharing among most of actors of supply chain	• Lack of organised farming in large scale • Poor knowledge about effective broiler management hygiene and biosecurity • Poor infrastructure development by actors • Difficulties to get the loans for the poor farmers • Adoption of old technologies • Unhygienic processing, transportation and storage • Unavailability of capital for expansion • Lack of implementation of government policy, rules and regulation and their implementation for quality control of the chain • Lack of government monitoring in the chain
Opportunities	**Threats**
• Poultry can be used as a tool to alleviate poverty while also ensuring food security • Processing to add value to chicken products • Changing consumer tests towards broiler meat • Support from the NGOs and Government for this sector through the provision of free trainings, consultations and veterinary services for farmers and other actors • Urban consumers are conscious about high quality meat and meat products • Poultry sector is in priority list of the government	• Continuous outbreak of bird flu and other epidemics in recent years • Poor supply of electricity (load shedding/power cut) • Political instability • All the risks during rearing is taken by the farmers only, whereas profit is shared by the traders/processors

By analysing the broiler chain and role of different actors, the traders/processors were found to be coordinator in the chain (as described in 4.5.1). It is because they are doing most of the major functions (as shown in figure 7), have control over price of live birds and meat and have linkage with most of the actors. They even know the most of the information's of the chain.

Farmers are made to deposit the capital to traders/processors before the start of business. This shows that only farmers are taking higher risks in comparison to traders/processors and retailers/butchers (as described in 4.5.1). This may imply that farmers are working in low profit margin. This may be one of the main reasons for the farmers for not investing in the proper biosecurity measures.

5.2 Hygiene practice at producer level

Buildings constructed for poultry house without considering basics of biosecurity in the study area increase chances of disease outbreak in the farm as it plays important role for the entry of infections into the farm (East, 2007). Besides that, biosecurity measures that need to be followed before entry of farm such as appropriate use of foot bath, changing boots and clothes is lacking, which is also important for the hygienic poultry production as these are the essential biosecurity steps that needs to be followed for hygienic broiler production (Maslic, et al., 2012). All these observations are indication of a lower awareness regarding the housing management of broiler flocks for hygienic production. Similarly, high prevalence of infection symptoms such as diarrhea in the farm (Table 6) may be due to the soil floors as these floors are very difficult to clean and disinfect. Also, Buragohain, (2011) found that there is high prevalence of reinfection of subsequent flocks by previous infected microbes in the same farm, if the farm is constructed by mud or soil floor. But all in all out system followed by majority of the farmer is a positive factor that helps to reduce the transmission of infections to the subsequent flock. Prabhakaran, (2003), also found that there is increase in profit percentage in the farm that followed all in all out system.

Very poor farm distance with another nearby farm (Table 9) causes high risk of contamination between the farms causing poor biosecurity for the flock. This does not align with the EPIG, (2010) standard which states that there should be minimum broiler farm distance of 2 km. This may be due to the lack of awareness about the importance of minimum farm distance among the farmers. The research found that some farmers use to keep manure very near to the broiler house (Table 7). However, Buragohain, (2011) indicates that poultry manure is cheap source of disease and parasite, one gram of infected poultry manure can infect one millions of chicken. The existence of such kinds of practice may be due to the lack of sufficient space with them or lack of awareness about the hazards of it.

Breach of biosecurity by the unnecessary entry of humans and other farm animals might be present in the farms because majority of the farmers were not found to construct the fences (Table 9). A previous study done by Yong *et.al*., (2010) mentioned that introduction of other farm animals were also one of the source of *Salmonella* infection for the poultry. Poor economic condition, higher financial risk and lack of awareness about the biosecurity measures and its importance may be the reasons for the absence of fences around the poultry farms.

Pest experienced by the entire farm (Figure 4) is also the result of lack of hygienic practices (Table 9) and control strategy in the farm. Very poor situation of feed storage may attract the pests, and there is easy chance of contamination by bacteria and fungi. The rodents are very important source of transmitting *Salmonella* in the broiler flock (Buragohain, 2011). Very high presence of disease problem (Table 4) and high mortality percentage in broiler flock in the district (Table 8) is due to the poor hygiene practices and structure and poor maintenance of

broiler house. This result is also supported by Prabhakaran, (2003) and Sharma, (2010) who mentioned that high disease prevalence and mortality is indicative of poor biosecurity in the poultry farm.

Current study reveals that, there is lack of awareness regarding the hygienic management of broiler farm in farmers. However, aware farmers were not found to adopt the hygienic measures due to different practical reasons. For examples: may be due to the lack of money and complicated procedures for loan, farmers are reluctant to build scientific housings. Unsecured market, frequent threat of highly contagious disease such as bird flu, lack of compensation and insurance policies might discourage farmers for investment for biosecure constructions. On top of that there is no regular monitoring and inspection by the government authorities, which has further increased the problem. There is lack of training for the workers and farmers about the broiler production and management. Though some of the farmers applied personal hygiene measures in the farm, many others may feel that the procedures are cumbersome. For example, regular manual washing of cloths add additional cost and time and machine washing is not available due to lack of money or shortage of regular electricity supplies. There may be lack of motivation and willingness in the workers as a result of low incentives, which is also an important factor in hygienic management.

5.3 Hygiene practice during pre-slaughter period

Also, lack of awareness in majority of farmers about feed withdrawal before slaughter (Table 4) may increase the risk of contamination of meat with intestinal content, which contains hazardous microbes for human health during processing. This finding is supported by Nunes, (2013) who point out that lack of feed withdrawal period in poultry meat industry may cause contamination of meat by faeces. Unawareness and lack of implementation of antibiotic withdrawal period (Table 4) by majority of farmers resulted potential risk of contaminating broiler meat with drug residues. It may be due to absence of any monitoring or surveillance system from the Government (Interview results processor and butcher). Food standards Australia New Zealand, 2005 also stated that there was increasing use of antibiotics which ultimately causes increase in antibiotic resistant infections in broiler meat consumers. Poor awareness in both feed withdrawal and antibiotic withdrawal may be due to lack of farmer awareness programs like training, workshops etc. on the topics by the government due to lack of sufficient resources.

At the trader/processor level, the results indicate that there is some awareness and compliance of safe broiler handling practices especially during transportation time. This may be due to fact that there is high mortality during transportation at day time due to high temperature (Prabakaran, 2003). But, lack of use of disinfectant by trader/processor for cleaning the vehicle may be due to lack of awareness level. This cleaning practice without disinfectant may not remove the microbes efficiently and could attribute to spread of pathogens to new flock which is transported by the same vehicle. Although, there is low chance of mortality due to quick slaughter but still there is probability to infect the consumers as a result of cross contamination due to unhygienic slaughtering process. FAO, (1992) also support the finding of the research which mentioned that in small scale processing there is very less practice of disinfection of transport vehicle because of lack of knowledge.

No any processor and butcher had facility to separate sick birds (Table 10 and 11). So, worker some time slaughter them either knowingly (due to carelessness) or unknowingly. This may be the very important cause of food borne infection for the consumers. This may be due to lack of awareness program for the workers about the importance of separate handling of sick and healthy bird in the processing. Although there is legislation regarding slaughterhouse and meat inspection, there is lack of implementation; which may be due to weak government and political instability. Therefore they do not follow the proper hygienic procedure. Slaughtering of sick and dead birds without inspection in unhygienic place causes foodborne infection for the consumers (Kiilholma, 2007).

5.4 Hygienic practices during processing

Lack of post mortem examination by veterinarian or meat inspector and no involvement of DLSO during the processing may further lead to high chances of slaughtering and selling of the subclinical infected birds. This may be due to lack of implementation of law and willingness in stakeholders. Verreth, (2009) mentioned that, there was high risk of transmitting the zoonotic disease from broiler to humans like Salmonellosis, Campylobacteriosis from consumption of uninspected meat.

The unhygienic way of evisceration by most of the processor and butcher (Table 10 and 11) may be due to lack of training and awareness programs about the GHPs and risk of contamination of meat. However, evisceration is most important critical control point during processing where there is a high chance of contamination of meat by faecal microbes (Nauta et. al., 2009).

As the processor and butcher do not separate healthy and sick bird (Table 10 and 11), there is risk of cross contamination during slaughtering and washing practices due to use of same equipment, place and same bucket of water to wash many carcass (Table 10 and 11). This washing process can not sufficiently remove the microbes present on the carcass (Havelaar *et.al*., 2007). Use of unsafely stored water to clean the carcass as given in Table 10 and 11, may be further contaminating the carcass. FAO, (n.d.) also said that water used for processing and cleaning the meat carcass should be of drinking quality.

Slaughtering and processing without cleaning and disinfecting floor, wall and instruments by processors (Table 10 and 11) could result in high risk of cross contamination of meat (Young *et.al*., 2010). This kind of practice may be due to lack of motivation and willingness in workers as a result of low incentives.

5.5 Hygienic practices at storage

No use of any chilling facility by trader/processor, before transport and during transport (Table 10) may be due to lack of awareness about the importance of chilling and hygienic transportation of meat and lack of monitoring system. This may cause high risk of contamination because of poor packaging, open transport system without chilling and no consideration of duration of transport (Corry *et.al*., 2002). These malpractices may cause the growth of *Staphylococcus, Campylobacter* in meat to undesirable levels and it leads to unsafe meat for consumption and can causes foodborne infection to the consumers (FAO/WHO, 2003).

Although all the butchers have chilling facility, there is no efficient chilling can occur because of long load shedding hours in the country as told by butchers in interview (Chaudhary, 2013), which may causes to growth of unacceptable microbes causing foodborne illness in the consumers. This further leads to spoilage and development of off odour and slime formation which make the product undesirable to the consumer and finally reduced the shelf life of the meat (Seward, 2007).

Although, all the butchers were aware of transmission of disease to consumer by contaminated meat, they were not found to applying hygienic practices in their processing. They even know that poor hygiene and poor chilling are the food safety risk for the meat to consumers but also they were not applying in their processing and retailing which is increasing the food safety risk in meat causing food borne illness (Heyndrickx *et.al*., 2002).

Despite the fact that, most of the butchers were aware about the food safety risk in their operation, none of the butchers were applying the hygienic precautions during processing and retailing of meat as shown in Table 10. This may be due to discouragement, lack of compulsory and punishment system. These practices might cause the unsafe meat production resulting foodborne illness for consumers (Havelaar *et.al*., 2007).

5.6 Problems in broiler meat safety

Actors in the chain were not getting any incentive for applying hygienic procedure (4.4). There was no differentiation in price and visual outlook between hygienic meat and unhygienic meat for consumers. Very few actors were practicing some hygienic procedure for only ethical concern which instead is increasing cost of production without any benefit from it. Unhygienic meat producer did not have any problem with producing unhygienic meat. This showed the discouragement of actors to apply the hygienic practices in processing.

Lack of implementation of government rules and regulations may result in unclear demarcation of the responsibilities between the different organisations for maintaining the broiler meat hygiene practices in the chain. This has negative impact on enforcement of food safety measures as the actors are practicing without any control mechanisms to ensure the food safety throughout the broiler chain of Kaski district. All the quality control agencies (2.9) may have difficulty to give their effort for broiler meat safety in this case. This may be causing high food safety risks throughout the chain. Also, they cannot be forced to apply the hygienic practice in broiler chain because of lack of implementation of government rules and regulations.

Department of Livestock Service (DLS) was conscious about objectionable situation of unhygienic practices along the broiler meat chain of the district so they were trying for positive change towards meat safety; however the improvement is very slow. The major hindrance for the improvement may be the lack of implementation of meat safety regulation and inadequately available resources (human, economy, technical) for this department. This aligns with the study of Lupien (Lupien, 2007), which presented that “assuring the quality and food safety needs adequate legislation and properly funded and staffed government organization, laboratories facility with proper and adequate equipment that meet food safety risk challenges of today.”

Chapter 6: Conclusions and recommendations

Based on the above discussions, this chapter gives the following conclusions and recommendation.

6.1 Conclusions

This research assessed the good hygienic practices in broiler meat of Kaski district to come up with a clear vision about broiler chain involvement to food safety enhancement in the district of Nepal. Furthermore, the researcher also wanted to evaluate the government roles in quality control mechanism in the district.

The study concludes that, the hygiene practices used by the different actors of broiler chain are still too far from the standard recommended by EPIG, FAO/WHO.

Farmers lack the awareness and infrastructure related to biosecurity, whereas trader/processor and butcher/retailer don't have proper hygienic infrastructure and measures. Processors and butchers are not doing even a minimum and hygienic practices which is causing more food safety risk in broiler meat chain. Farmers were found to take higher risk than the processors/traders.

There is no implementation of rules and regulations for monitoring and inspection of farm, processor and retailer. Poor awareness about importance of hygienic meat production and lack of reward system for hygienic meat might be the important reasons for this kind of poor hygiene by all the actors in the chain, which hampers the food safety in broiler meat chain of the district.

Government role is inadequate to improve the food safety of broiler chain of Kaski district.

6.2 Recommendations

As the research was done only over a six week period, a further scientific risk evaluation needs to be done to find out the risks and where it belongs in the broiler chain. Thus, such assessment would enable the concern authorities to step forward to reduce the risk factors to an acceptable level.

To obtain the objective of this research, all the actors, supporters and influencers of the chain need to work together and take these results of research into their consideration and then apply the correction measures/ recommendations accordingly. In a moment, following recommendations are provided for the production of hygienic broiler meat to improve the food safety of the district:

- Regional Livestock Training Center (RLTC) should provide trainings to traders/processors and retailers/butchers on GHPs for controlling food borne illness. These trained personnel should only be provided with the license for opening the processing enterprise and meat shop (retailing shop). Training should be organized in collaboration with all related agencies (including private, Government and Non-Government Organizations) to make it more effective and economic. The training topics should include personal hygiene practices, development of layout of hygienic slaughterhouse, cleaning procedure, hygienic processing, storage and distribution. Processors and butchers should encourage in applying the hook system of slaughtering and processing method which reduces the risk of cross contamination from the floor. This would be the most effective, cheap and hence applicable method for reducing the risk of cross contamination.

- The producers should be provided with the trainings on GHPs. This training course, under the leadership of (RLTC), should be made mandatory for registration of the farm. Other related organizations (including private, Government and Non-Government organizations) can also be included to make it more effective and economic. The training course should be about importance of hygienic/biosecure infrastructure, pest prevention and control strategies, Personal hygiene practices like use of boots, soap and disinfectant, visitor control, importance of feed withdrawal, disease prevention and control, antibiotic withdrawal, proper record keeping, manure management and regular cleaning and disinfection of broiler house.

- KVC should develop a standard guideline for establishment and operation of hygienic broiler farm for their clients who is really interested to make hygienic farm and guide and monitor accordingly. The guideline should try to improve the problems shown in this research. There will be lead role of myself for development of this guideline. This will attract other farmers to rear poultry under the technical guidance of KVC.

- KVC should increase its effort in prevention of disease instead of control by treatment. For this, it should focus in creating more awareness by giving advice related to hygienic practices.

- Minimization of the risk of the farmers should be done immediately. This can be done by establishing farmer's cooperatives. KVC can play a role of motivator. The roles of input supply played by traders/processors can be handled by the cooperatives. This may help to reduce the unnecessary risks being taken by the farmers.

- Food Standard Board (FSB) should broadcast and implement food standard for broiler meat for the country. Veterinarians should be involved for making these standards.

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Annexes

Annex-1: Questionnaire for broiler farm

Farmer's address:…… Sex….. Age:……..

Q.N.	Statement							
1	What is your education background?							
	No any		Primary		Secondary		University	
2	What is your flock size of farm?							
3	How many production cycles do you have per year?							
4	Is broiler farming your main income source?							
	Yes				No			
5	Are you following all in all out system?							
	Yes				No			
6	Do you have foot disinfection bath?							
	Yes				No			
7	If yes, how often do you replace the disinfection solution?							
	Daily		< 5 days		6-7 days		>7 days	
8	Do you use water disinfection for drinking water?							
	Yes						No	
9	Do you experience any pests in your broiler farm?							
	Yes						No	
10	If yes, which is most common one? How do you control?							
	Rodents		Wild birds		Flies		Other	
11	Do you aware about disease transmission by pest?							
	Yes						No	
12	Have you ever been faced disease problem regarding to broiler health?							
	Yes						No	
13	What is the most common disease sign that you encounter during the broiler growing period?							
	Diarrhea		Coughing		Lameness		Other	
14	Which most common measures do you take to address the symptoms?							
	Consult veterinarian		Self-treatment		Slaughter		Other	
15	Do you use antibiotics/antimicrobials for the treatment of poultry disease?							
	Yes						No	
16	Do you know about the antibiotics/antimicrobials withdrawal period before slaughtering ?							
	Yes						No	
17	If yes, do you implement the antibiotics withdrawal period and why?							
	Yes						No	
18	Do you clean and disinfect the poultry house thoroughly after each production cycle?							
	Yes						No	
19	Do you allow visitors to enter your farm?							
	Yes						No	

20	If yes, what hygienic precaution do you follow before giving entrance to visitors and staffs? Choose most common one							
	No any		Spraying disinfectant		Foot dipping		Other	
22	How do you manage broiler chicken manure? Choose most common one.							
	Selling quickly		Storing near the poultry house		Storing far from the farm		Others	
23	What is the mortality percentage do you have in farm?							
	<5		5 to 10		10 to 15		> 15	
24	How do you dispose the dead birds in the farm? Choose most common one that you follow.							
	Buried		consume		Throw it nearby broiler house		Others	
25	Do you know about spread of disease from sick and dead birds?							
	Yes						No	
26	Do you wash your hands after handling sick and dead birds?							
	Yes						No	
27	Are you aware of practice of withdrawing feeds before selling to slaughter?							
	Yes						No	
28	If yes, do you apply in your farm?							
	Yes						No	
29	If yes, how long is your withdrawal period?							
30	If not, why you do not apply it?							

Annex-2: Broiler farm observation checklist

Observation	Good	Poor	Observational parameters
Feed storage condition			According to risk of contamination (no spillage, clean, no access for rodents, use of separate room, prevention methods from moisture= good; otherwise= poor)
Existence of fencing			Exist= good; not exist= poor
Surface of wall and floor			Easiness to clean or not; no holes cracks and crevices on wall (presence=poor; absent=good); for floor (Concrete=good; soil=poor)
Farm distance with another farm			Nearest distance to another farm (<2km.=poor or >2km.=good)
Cleanliness of poultry house surrounding			Existence of bush, crops, manure etc. near the broiler house (presence=poor; absent= good)
Spaces given for birds			<1 sq.ft./bird (poor); 1 sq.ft./bird (good)
Availability of farm record			Available (good); not available (poor)
Cleanliness and safeties of equipment used like feeder, drinker, water storage tank			According to visually observed dirtiness (observed dirty=Poor; clean=good)
Availability of personal hygiene equipment			Visual observation of availability of clean clothes/aprons, boot, soap, disinfectant (available= good; not available=poor)

Annex-3: Checklist for the poultry trader/processor

1. Do you check the bird health before and after transporting and why?
2. If yes, do you mix the sick bird with healthy bird and why? What do you do for sick bird?
3. What do you do when the sick birds die during your handling?
   a) Slaughter and eat b) buried c) sell d) other
4. Do you clean and disinfect the vehicle after use?
   a) Yes b) No
   and why?
5. What personal hygiene practices do you follow in your work?
   a) Soap and hand disinfectant b) uniform/clothes c) Other.....
   and why?
6. How is food safety risks controlled in your operation?
7. Is there any quality control monitoring visit by the government? If yes, how frequent?

Annex-4: Observational checklist for trader/processor

Observations	Good	Poor	Observational indicator
Cleanliness of vehicle, crates for transport			By visual observation of dirtiness (clean=good; dirty=poor)
Time of transport			According to time of transport (morning and evening=good; day=poor)
Layout of processing building			Risk of contamination (existence of separation of dirty and clean area=good; no separation= poor)
Personnel hygiene			Use of boot, aprons, mask, head cover, cleanliness of clothes, hand washing facility with soap or disinfectant (used most of above things=good; no use=poor)
Safeties of water used for cleaning			Storage facility condition (open=poor; closed=good)
Veterinary inspection			Facility available=good; not=poor
Management of sick bird			Availability of separate space for sick bird=good; if not=poor
Time of bleeding			According to standard (3-5 min.) if maintained the standard=good; if no= poor
Cleanliness of scalding water			Cleanliness of water and pot used (if clean=good; dirty=poor)
Disposal facility for sick/dead bird and broiler waste			Visual observation of facility away from processing and well managed (if not observed=poor; observed=good)
Cleanliness of evisceration process			Risk of contamination during process (if used floor=poor; if used table=good)
Cleanliness of floor and wall			If found clean visually=good; if dirty=poor
Cleaning of carcass			Observation of process, cleanliness of water, frequency of cleaning
Chilling facility			If yes=good if no=poor (before transport)
Transport facility for meat			If used closed vehicle with cooling facility=good; if not=poor
Packaging			Risk of contamination of packaging during transport (if high risk=poor; if low risk=good)

Annex-5: Checklist for broiler butchers/retailers

1. Do you check the bird health before entering to your lairage?
2. How do you know the bird you buy is free from disease?
   a) Observation of visible symptom b) health certificate from the source c) advice from trader
3. Do you slaughter the sick bird? Do you slaughter the sick and healthy bird in the same premises and why?
4. How do you manage the sick birds?
   a) killed and disposed b) mixed with healthy bird, slaughter and sell c) keep in separate place, treat and wait until recovery d) other
5. How do you assure your clients that the meat is from healthy bird?
6. Are you aware of contamination of meat causes disease to consumers?
   a) Yes b) No
7. Are you aware of food safety risks in your operation?
   a) Yes b) No
   If yes, what are they? And how these are controlled in your operation?
8. Have you ever attend the hygienic meat handling practice training?
   a) Yes b) No
   If yes, are you applying it in your process? And if no, why?
9. Do there any quality control monitoring visit by the government? If yes, how frequent?

Annex-6: Observational checklist for broiler butcher/retailer

Observations	Good	Poor	Observational indicator
Layout of processing retailing shop			Risk of contamination (separation of dirty and clean area= good; if no=poor)
Personnel hygiene			Use of boot, aprons, mask, head cover, cleanliness of clothes, hand washing facility with soap or disinfectant (if used most of things=good; if not=poor)
Safeties of water used for cleaning			Storage facility condition (if open=poor; if closed=good)
Veterinary inspection			Anti-mortem and post mortem examination facility (if exist=good; if not=poor)
Management of sick bird			Availability of separate space for sick bird (if available=good; if not=poor)
Bleeding time			According to standard (3-5 min.) if maintained the standard=good; if no= poor
Cleaning of evisceration process			Risk of contamination during process (if used floor=poor; if used table=good)
Cleanliness of scalding water			Cleanliness of water and pot used (if clean=good; dirty=poor)
Disposal facility for sick/dead bird and broiler waste			Visual observation of facility away from processing and well managed (if not observed=poor; observed=good)
Cleanliness of floor and wall			If found clean=good; if dirty=poor
Cleaning of carcass			Observation of process, cleanliness of water, frequency of cleaning
Chilling facility			If yes=good; if no=poor
Cleanliness of retail shop and instrument used in it			If found visually clean= good; dirty=poor

Annex-7: Interview with the Chief of District Livestock Service Office

1. What are the major public health food safety risks associated with meat produced from broiler chain?
2. What the hygienic practice regulations required in the commercial broiler chain for the food safety of Kaski district?
3. Are you satisfying the hygienic practices applied in broiler chain for the food safety of Kaski district? And why or why not?
4. What are your responsibilities in the broiler chain to make the chain actors to apply the hygienic practices in their business?
5. What are the constraints in enforcing the food safety regulation regarding broiler chain? Could anything be put in place to alleviate these constraints (if applicable)?
6. Which stages of the broiler chain have the food safety risks been associated with? How have you gone about minimizing these risks? Are there any regulatory actions that in place to help to minimize these risks?
7. What do you suggest to improve the food safety in the broiler chain of Kaski district?

Annex-8: Clips of field study

Picture 1: Farmer working in the farm after changing boot

Picture 2: Improperly placed manure and unclean surroundings

Picture 3: Farms very close to each other

Picture 4: Farm with foot bath disinfectant and sandal for changing before entrance

Picture 5: Farmer showing the farm record

Picture 6: Trader/processor cleaning the vehicle

Picture 7: Trader/ processor cleaning the poultry crates

Picture 8: Unhygienic bleeding cones and processing place

Picture 9: Unhygienic evisceration in floor

Picture 10: Unhygienic manual defeathering and evisceration

Picture 11: Unhygienic transportation and packaging of meat

Picture 12: Chilling of meat by retailer in refrigerator

Picture 13: Selling meat by retailer

Picture 14: Interview with Chief of District Livestock Service Office (DLSO)

Annex 9: Name list of interviewees

Name list of trader processor interviewed

1. Kaski poultry supplier
2. B.S. Poultry supplier
3. Kishan Poultry supplier
4. Pokhreli Poultry supplier

Name list of butcher/retailer interviewed

1. Pokhara meat supplier
2. Annapurna meat shop
3. Kalika meat shop
4. Asmita meat shop and fresh house
5. Mount valley meat zone

Name of Chief District Livestock Service Office interviewed

Dr. Prakash Raj Shrestha

Name of DLSO staff for getting related information of broiler chain

Mr. Prem K.C.