

Food Safety Concerns in Broiler Sub Sector

Understanding Potential Hazards Arise in the Herat Broiler Vertical Chain that Impact on Poultry Meat Safety



Research Project Submitted to the Van Hall Larenstein University of Professional Education in Partial Fulfillment of the Requirements for the Degree of Master of Agricultural Production Chain Management Specialising in Livestock Production Chain



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ACRONYMS

CCP	Critical Control Points
FAO	Food and Agricultural Organisation
FDA	Food and Drug Administration
GDP	Gross Domestic Profit
HACCP	Hazards Analysis Critical Control Points
HPAI	Highly Pathogenic Avian Influenza
RAMP	Rebuild Agriculture Market Program
UNDP	United Nations Development Programme
USA	United States of America
USDA	United States Department of Agriculture
VFU	Veterinary Field Unit
WHO	World Health Organisation

ABSTRACT

The purpose of this study was to contribute to the improvement of the food safety in the broiler sub sector in Enjil in the suburb of the Herat city, a district in centre of the Herat province in western part of Afghanistan.

Data for this study collected through surveys and case studies with different actors along the vertical broiler chain which consists of two large commercial farmers, ten small commercial farmers, two processing units, 30 retailers, and 30 consumers. Furthermore interviews conducted with the Herat government Food Safety Boards (Herat Agriculture Directorate, Environmental Health Directorate, Market Arrangement Directorate of Municipality) deal with food safety issues in Herat province. The Vertical Chain Analysis, Tables and Excel Graphs, Questionnaires and Risk assessment were used to analyse the collected data.

The study revealed that each actor in every stage of the broiler vertical chain (pre-harvest, harvesting, and post – harvest) in contribution to the food safety issues are having practices to assure consumers their products are safe.

Also the study discovered some practices which were not in line with food safety issues and as the result of risk assessment a number of microbiological hazards (bacteria e.g Salmonella and Campylobacter spp with Mycotoxins) and chemical hazards (pesticides and drug residues) identified as the potential hazards in the broiler sub sector in Herat.

The study concludes, although each actor has practices in contribution to the food safety issues but these practices cannot completely eliminate all contamination of poultry from the potential hazards and it is always chance for the foodborne disease prevalence due to poultry meat consumption. Thus the study proposed some recommendations for each stage of the broiler vertical chain (pre-harvest, harvesting, and post – harvest) to enhance the food safety issues practices and thereby minimise the foodborne disease prevalence.

CHAPTER1 INTRODUCTION

1.1 Introduction of the topic

The food safety trends are increasing in developed and developing countries. The poultry sector is associated as one of the causes for foodborne disease outbreak among the consumers due to poultry meat consumption. Thus, this research was designed to study food safety concerns in the Herat broiler sub sector. The study was carried out in suburban of Herat city within the Enjil district of the Herat province of Afghanistan. Herat province is located in the western half of Afghanistan, a province with small and big commercial broiler production farms. The Herat province is also the major gateway of frozen poultry meat to Afghanistan.

The key actors of this study were broiler farmers, processors, wholesalers, retailers and consumers. The supporters of this study were the Food Safety Board (Herat Agriculture Directorate, Environmental Health Directorate, and Market Arrangement Directorate of Municipality) which deal with food safety in broiler sub sector in Herat, Afghanistan. The reason for including all the chain actors in this study was to observe and understand which actor exposes more risks regarding the poultry meat safety in the broiler chain by studying hygienic practices of each actor along the chain. Further, the objective was to study (interview) the food safety board as the supporter of the chain from the government's side in order to measure its efforts for poultry meat safety and its results.

The tools used to analyse the collected data included the broiler vertical chain analysis, tables, excel sheets, questionnaires, and risk assessment tool to give a better understanding of field research. Furthermore, these tools help the researcher to make a conclusion and recommendations for this thesis.

The study expectation was to find potential hazards that may occur along the broiler vertical chain that have impacts on food safety, thereby threatening consumer's health. Recommendations have been given based on the hazards found in order to contribute to food safety improvement along the chain within each actor. The research was interest of the government as well as the other stakeholders because it helped the government food safety board and stakeholders to adjust their performance according to the findings and recommendations of this study; therefore they facilitated all the requirements of the research during the data collection in the field for the study.

1.2. Background

1.2.1 Country's background

Afghanistan is a country located in central of the Asia boarded in north by Turkmenistan, Tajikistan, Uzbekistan, east and south by Pakistan and in west by Islamic Republic of Iran. (Figure1)The total surface area of Afghanistan is 652,230 sq. km. (251,827 sq. mi.) and the terrain is Landlocked; mostly mountains and desert. The total population is 28.396 million (July 2009 est)

Kabul is the capital and other major cities are Kandahar, Herat, Mazar-e-Sharif, Jalalabad and Kunduz. Ninety nine percent people religion is Islam and one percent is others like Hindu or Christian. Main ethnic groups are Pashtun, Tajik, Hazara, Uzbek, Turkmen, Aimaq, Baluch, Nuristani and Kizilbash.

Figure 1 Map of Afghanistan



Afghanistan's economy was destroyed due to the Soviet invasion in 1979 which ensued civil war, damaged all infrastructures and disrupted normal patterns of economic activity. However, Afghanistan's economy has grown at a fast pace since the 2001 fall of the Taliban, albeit from a low base. Gross domestic product (GDP) growth exceeded 12% in 2007 and 3.4% in 2008; growth for 2009-2010 was 22.5%. (United State, Department of state, 2010)

85 percent of Afghan people are involved with agriculture and related agribusinesses for their livelihoods while only 12% of Afghanistan's land area is available for agriculture. The major food crops produced are: corn, rice, barley, wheat, vegetables, fruits, and nuts while the major industrial crops are: cotton, tobacco, madder, castor beans, and sugar beets. Agricultural production is constrained by an almost total dependence on erratic winter snows and spring rains for water; irrigation is primitive. Relatively little use is made of machines, chemical fertilizer, or pesticides.

The main exports of Afghanistan are fruits, nuts, lambskins, gemstones, and hand woven carpets; however the main imports are, foodstuffs, manufactured goods, petroleum products and machinery. Traditionally Afghanistan has been trading with India, Pakistan and the United States. (United State, Department of state, 2010)

Poultry rearing is one of the main livestock productions and an important source of poultry meat for Afghan people. Poultry has been raised by women in Afghanistan under traditional systems for over a millennium. As with passage of time, poultry husbandry has been evolved from extensive to intensive systems. Current system covers include: scavenger or free range, semi-scavenger, intensive semi-commercial and commercial systems. (Rahman, 2010)

1.2.2 Herat's background

The Herat province is located in the western half of Afghanistan and belongs to the Harirod River basin (34.51-3604 degrees latitude of and 62.67-65.07 degrees longitude). The province shares international borders with the Islamic Republic of Iran to the west and Turkmenistan to the northwest and internal boundaries with Farah province to the south and Badghis and Ghor provinces to the east.

Herat is divided into 16 districts that encompass 19,043.12 square kilometers of which 113,212 hectares are used for agricultural purposes.

Herat is home to a total of 1,182 villages with an estimated population of 1,830,000 people as of 2008. The majority of Herat's inhabitants raise sheep, cattle and goats, backyard poultry. The province is famous for producing pistachios, cashmere and wool. (Karimi, 2006)



Figure 2 Map of Herat province, Afghanistan

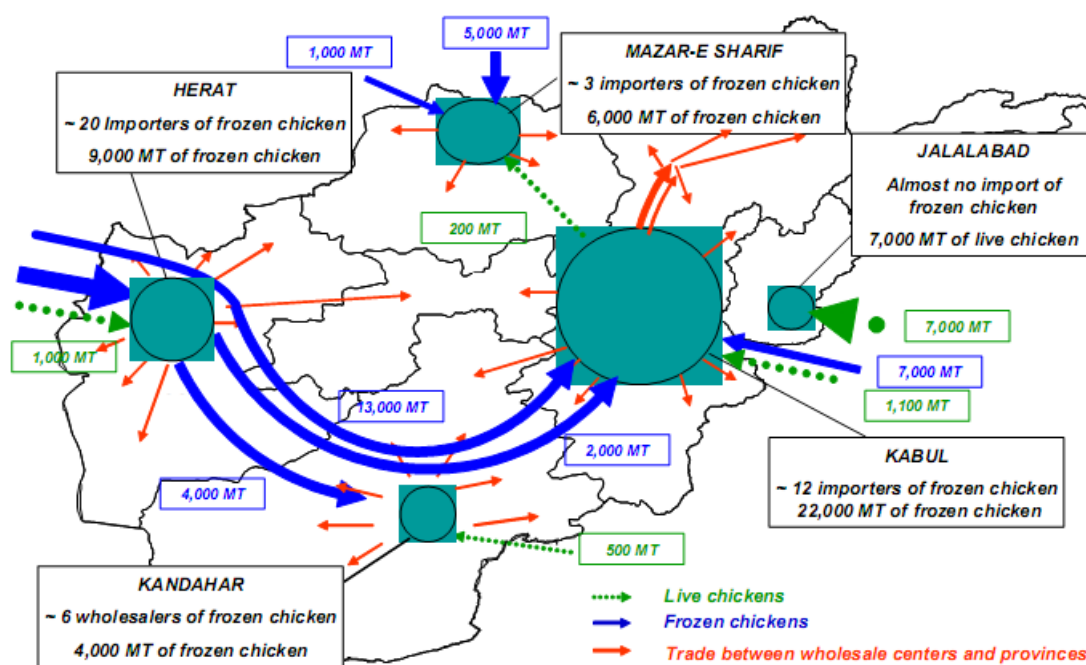
1.3 Broiler sub sector's background

In Herat the concept of commercial broiler farming was not known a few years ago and backyard poultry was the only source of enriched poultry meat. Herat broiler sub sector has been raised as a new enterprise for Herat's traders since 2003. The sub sector was initially started by the importing of frozen poultry meat from Iran; and afterwards with high customer demand, gained rapid growth.

According to the assessment conducted by RAMP on the Afghanistan Poultry Sub sector in 2004, the Herat province revealed the major gateway for frozen poultry meat imports into Afghanistan. The reports also indicated that at least five cold storage facilities (150 to 200 ton capacity) have been built and there are reportedly 15 to 20 active frozen poultry meat importers/wholesalers in Herat which work closely with distribution agents (sellers) in neighboring provinces and market centers along the main road to Kandahar. (Inc, April, 2004)

Also assessment conducts in 2005 stated Herat as the major gateway of poultry meat supply to Afghanistan compared to other supply channels in Afghanistan. The Figure 3 presents the imports supply channels of poultry meat to Afghanistan with estimated yearly volume. (UNDP, 2005)

Figure 3 Poultry meat supply to Afghanistan



Source: UNDP report 2005

As shown above, imports of frozen meat mainly come from Iran through Herat province and flows into Kabul while the live chicken (birds) come only across the interested border.

As the broiler sub sector became a significant enterprise for generating income for traders, commercial broiler production established through private sector in Herat and local commercial broiler production started. Now there are three big commercial broilers' farms and there estimated around 60 – 80 small commercial farms as well as. (Sharifi. 2011)

With respect to this, it must consider that improving poultry sub sector either by imports or enhancing self-production inside the country is a positive trend to food security related to

animal products especially about protein source which is a critical requirement for Afghan consumers' diet.

Aside from that, there would be risks exposed to the health of consumers regarding consumption of poultry meat that maybe common problems in a country like Afghanistan which include threats of outbreak of foodborne disease in consumers.

Therefore, as the broiler sub sector is growing, food safety becomes a significant component of its vertical chain and pressure to produce safe food for consumers is increasing simultaneously with it from the government side as well as consumers' perception.

In addition, as it illustrated previously, Herat is the major gateway of the poultry meat supply to Afghanistan and has its own production of broiler meat. It is very important to understand how the poultry meat is stored, transported and distributed because if a failure arises in relation to the food safety issue, it is somewhat critical with a broad impact on all poultry meat consumers' health.

1.4 Problem statement

The broiler sub sector has shown phenomenal growth, mainly due to active participation of the private sector in the last few years in Herat. However, among the different concerns that exist to this development in developing countries, food safety is one issue related to consumer's health using the poultry meat.

Therefore, the microbiological risks such as *Salmonella spp* related food poisoning, pesticide residues from feed production and treatment of poultry with antibiotics become the focus of attention along the poultry vertical chain in developing countries. (Kiilthoma 2007)

Government policy is to enhance public awareness about poultry meat safety and minimise the food safety risks to consumers that may occur along broiler chain due to consumption of unsafe poultry meat¹. (Payman 2011)

According my own observation in 2008 people in Herat formed an independent kind of association to monitor and check the performance of different wholesalers, retailers dealing with foodstuffs like butchers, poultry meat sellers, bakers, hotels, restaurants regarding food safety issue to push the government enforce those who do not implement or have not a proper food safety close down their business or activities. Hence, it illustrates that consumer' perceptions and concerns relevant to food safety issue is increasing.

Therefore, assessing the existing practices regarding the food safety issues in the Herat broiler sub sector is one way to figure out the potential hazards along the vertical chain of the broiler sub sector concerning consumers' health in the Herat province of Afghanistan.

¹ There is the legislation of food safety in Afghanistan like other countries in the world and all foodstuffs are included, poultry meat as well as and food safety board is responsible to monitor and control foodstuffs.

1.5 Research objective

The research objective is to contribute to the improvement of food safety in Herat broiler sub sector by assessing the existing practices of the each actor regarding the food safety issues in the three stages of broiler vertical chain (pre-harvest, harvesting and post- harvest) to identify potential hazards may arise in the each stage of broiler vertical chain that impact on poultry meat safety.

1.6 Main research questions

1. What are the existing practices on food safety issues in Herat broiler sub sector?

- 1) What is the existing practices regarding food safety issues in the pre – harvest stage of the Herat broiler vertical chain?
- 2) What is the existing practices regarding food safety issues in the harvesting stage of the Herat broiler vertical chain?
- 3) What is the existing practices regarding food safety issues in the post harvest stage of the Herat broiler vertical chain?

2. What are the potential hazards in Herat broiler sub sector?

- 1) What is the source of contamination of poultry meat with potential hazards in the pre – harvest stage of the Herat broiler vertical chain?
- 2) What is the source of contamination of poultry meat with potential hazards in the harvesting stage of the Herat broiler vertical chain?
- 3) What is the source of contamination of poultry meat with potential hazards in the post – harvest stage of the Herat broiler vertical chain?

CHAPTER 2 LITRETURE REVIEW

2.1 Introduction to food safety issue

Food safety can be defined in many aspects in regards to food and food products. WHO defines that the purpose of food safety is to secure food for consumers in the process of handling, preparation, and storage that prevents foodborne disease (WHO). Also taking food safety precautions has proven to drastically reduce the threat of serious contamination of food by biological, chemical, and physical agents that expose consumers to food borne diseases. (WHO, Terrorist Threats to Food -May 2008).

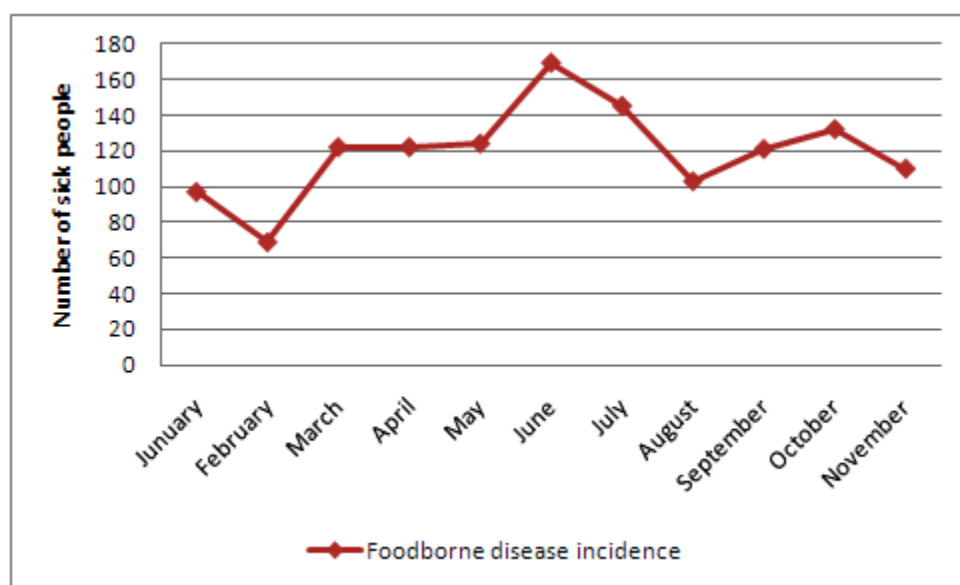
2.2 Importance of food safety

The most important concern related to food safety is food borne disease among humans due to consumption of contaminated food (via biological, chemical, and physical agents) which threaten the health of consumers. (Kiilthoma 2007)

WHO reported a yearly morbidity rate of 1.5 billion cases of diarrhea in children resulting from consumption of unsafe food. This results in more than three million premature deaths every year worldwide. These deaths and diseases are shared between developed and developing countries in the world. (Food Safety Around the World - June 2005)

Also according to the Herat General Hospital's yearly report, foodborne disease is one of the most common diseases associated in the city. Yearly foodborne prevalence rate is estimated to be between 1000–1500 persons because of consumption of unsafe food.² Figure 4 shows the recorded occurrence of the foodborne diseases in 2010 in Herat General Hospital.

Figure 4 Foodborne diseases in Herat (2010)



Source: Herat Hospital Annual Record Keeping Book

Also economic cost of foodborne diseases is another factor burden economy of consumers like cost of medical, legal and other expenses as well as absenteeism at work or school. It contributes the stability of the poverty for many consumers for their life.

² Economic cost of foodborne disease per person is in average is 1000 – 1500 Afghani with free services from government.

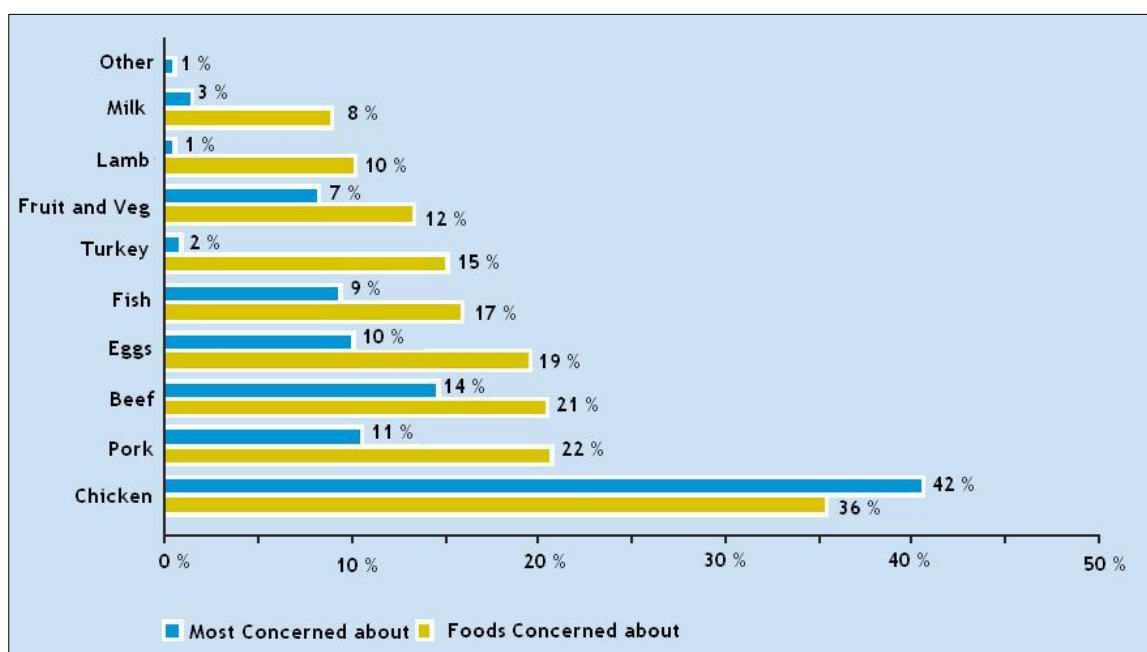
2.3 Food safety in poultry sector

The poultry sector is one of the most important industries worldwide. As it is a cost-effective source of protein for consumers, it has had increasing growth every year especially in developing countries like Iran, Pakistan and recently in Afghanistan. With this mass consumption, however, it has grown to play a vital health risk to the well-being of consumers. If it is not properly prepared in accordance to strict guidelines in a sterile environment it may expose consumers to health risks. (Tokhi, Nazir Ahmad 2008)

Research on this subject has been conducted by Safe Food, commissioned in September, 2004 in Ireland. The study identified foods consumers were most concerned about and how the foods were produced, packaged, sold in shops and or handled in home. Different types of food commodities such as milk, lamb, fruit and vegetables; turkey, fish, and eggs; beef, pork, and chicken; among others were all listed as foods under this inquiry. Chicken was indicated as the food that consumers were most concerned about among all other aforementioned foodstuffs. Figure 5 shows foods consumers are most concerned about in terms of how they are produced, packaged, sold in shops, and handled in the home. (Safe food, October 2005)

This supports the theory that even relatively affluent European countries like Ireland are not immune to anxiety over the safety of foodstuffs. Being present in the developed world, it is very possible that this anxiety is shared among developing countries such as Afghanistan, Pakistan, Iran, Bangladesh, and India as well as developed countries.

Figure 5 Foods consumers are concerned about



Source: Safe food Research Report 2005, Ireland

2.4 Food safety principles in poultry sector

In order to ensure food safety in the poultry sector, most poultry producers have food safety programmes that are based on a system called HACCP (Hazard Analysis Critical Control Points).

HACCP is defined as a quality assurance guideline for the development of an effective Food Safety Management System (FSMS). Existing as an international system, HACCP dictates that each company build its own specific FSMS based on a list of general principles. (Pieternel and Willem 2009)

The HACCP control system was developed by the Pillsbury Corporation in conjunction with NASA (National Aeronautics and Space Administration) in 1960 in order to ensure food safety for the first manned space missions. In 1990, Codex Alimentarius Commission³ endorsed HACCP as an international system for implementation of food safety along the food chain.

Codex has not only approved the inclusion of HACCP into the codes of practice but has also allowed development of HACCP individually for each product in the processing and distribution steps. The objective of the Codex codes of practice is to specify the conditions needed for each step of the chain from production through distribution that assures the product is safe for people. The HACCP system is used for identification of potential food hazards⁴ that threaten consumers' health. HACCP principles can be applied to any stage of the production, processing, storage and preparation of food.

Basically there are seven principles for implementation of HACCP for any product: (1) identifying hazards to food safety, (2) determining critical control points (CCP), (3) setting critical limits to ensure each CCP is under control, (4) establishing monitoring procedures for each CCP, (5) developing corrective actions to eliminate or reduce food safety problems, (6) establishing verification procedures to prove that the control program is working, and (7) developing a record-keeping system to monitor the effectiveness of the HACCP system.

2.5 Potential risk factors in poultry sector

There are three categories of potential risk factors with the poultry industry that could affect the health of consumers. The first category of these risk factors is microbiological factors. The second category of risk factors consists of chemical factors. Finally the third category is physical hazards.

2.5.1 Microbiological risk factors

Microbiological risk factors consist of bacterial, viral, protozoan, helminthian, prionic and myco-toxin organisms. The most important of these risk factors from this group with respect to the poultry sector are bacteria such as *Salmonella spp.*, *Campylobacter spp.*, *Listeria*, *Clostridia*, *Enterococci* and *E. coli*. (Kiilthoma 2007)

2.5.1.1 Bacteria

Poultry is by far the most important category of foods cause food poisoning in high level yet and the most pathogens associated within are bacteria such as *Salmonella spp* especially some serotypes like *S. enteritidis*, *S. typhimurium*, *S. virchow* and two species of *Campylobacter* which are *C. jejuni* and *C. coli*.

³ The Codex Alimentarius Commission was created in 1963 by FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme.

⁴ Hazards in food chain could be physical, chemical and biological.

The *Salmonella* and *Campylobacter* bacteria families are repeatedly deducted from poultry meat in developed countries. Other organisms causing poisoning are *Clostridium perfringens* and *Staphylococcus aureus*, both of which are capable of producing into toxins which are not diagnosable. Generally when poultry meat is stored in unsafe condition there is a potential chance for growth of microorganisms that affect the health of consumers. (Ali Raza 2006)

Chicks are very susceptible to *Salmonella* and spread easily *Salmonella* among the birds in intensive poultry production. Possible contamination pathways with *Salmonella* could include as following:

- Through chicks produced from contaminated parent stocks with *Salmonella* in the hatchery
- Through feces of contaminated birds with *Salmonella*
- Through rodents and some kind of the birds

Infection with *Salmonella* can be for long time without any clinical signs in poultry. *Salmonella* proliferate in caeca⁵ in large intestines and their population range between $10^8/\text{gr}$ - $10^9/\text{gr}$ in contents of the caeca. Hence excessive *Salmonella* can contribute contamination of the environment and birds' feathers. Rate and intensification of the *Salmonella* contamination reduces by growth according to age, but contamination of the skin and feathers remains for long term. (Table 1) - (Zohari 2005) Experimental result on remaining of *Salmonella typhimurium* in two different production system

Table 1 Remaining of *Salmonella typhimurium* after experimental contamination on broiler in two different production system

Production system	In Caeca		On feathers	
	2 nd week	6 th week	2 nd week	6 th week
Litter	34	5	26	53
Cage	65	15	64	56

Figures in table indicates the percentage of contaminated birds, 200 birds examined and one day old chicks inseminated with 10^5 of *Salmonella typhimurium*.

Salmonella multiplication reduces in low temperature (less than 7°C) especially in carcasses. Thus chilling of the carcass has major effects in prevention of *Salmonella* infection. It is also observed that in 10°C growth of *Salmonella* continues slowly. Despite this, processing of poultry meat carcasses includes chilling by using cold weather in the same temperature. (Salahi, 1999)

Campylobacter is another type of bacteria associated in poultry production and one of the common causes of foodborne diseases in human. Two species of *Campylobacter* found in poultry production are *C. jejuni* and *C. coli*. *C. jejuni* is the most important cause of human *Campylobacteriosis*. This type of *Campylobacter* is living in gastrointestinal tract of the birds without clinical signs and spread to the environment by feces. (Tanha 2006)

Contamination of the poultry flocks with *Campylobacter* is more than *Salmonella* and researchers have found the number of *Campylobacter* bacteria in some conditions counted as 10^5 gr in the neck skin of birds. *Campylobacters* need less oxygen for their growth and

⁵ In poultry, the caeca are two blind-ended tubes at the junction of the small and large intestines, where undigested food particles are subjected to microbial breakdown.

normally are not able to proliferate below 30 °C. Therefore, multiplication of the *Campylobacters* are not expected in the processing level (Razavilar, 2007)


Contamination of poultry with *Campylobacter* remains unclear, but there are some common theories. *Campylobacter* has possible routes of infection through feed and water, vectors such as rodents and flies, horizontal transmission between birds, and contamination in the hatcheries. Vertical transmission is not recognized yet but in experiments, birds transmitted the organism from the oviduct of the chicken and the semen of the rooster. (Kiilhoma 2007)

Campylobacter transmits to the raw poultry meat during slaughter or processing and from other sources to human foods. Rates of contamination could increase from 10 to 100 levels on the skin of the poultry during slaughter. Although *Campylobacters* are more sensitive in improper conditions like a dry environment and freezing and cold weather, in comparison to other microorganisms these factors cannot eradicate *Campylobacter* in raw poultry meat and the organisms remain alive inside of the poultry meat. (Razavilar, 2007)

Campylobacters are more susceptible to chlorine and mono chlorine in comparison to *E. coli*, but in order to completely clean the *Campylobacters* from carcass surfaces, washing only with chlorine water is not sufficient. The carcass should be in chlorine water at least 15 minutes.

Based on research conducted by food safety standards in 7 December 2005 in Australia, the major risk factors and their relative importance for *Salmonella* and *Campylobacter* contamination on-farm are associated as shown in the Table 2

Table 2 Risk factors and importance for *Salmonella* and *Campylobacter* contamination

Risk Factors	Increasing Importance 				
Biosecurity ⁶					<i>Salmonella</i> <i>Campylobacter</i>
Vertical transmission from breeder flocks	<i>Campylobacter</i>				<i>Salmonella</i>
Positive chicks	<i>Campylobacter</i>				<i>Salmonella</i>
Previously positive flocks		<i>Campylobacter</i>			<i>Salmonella</i>
Litter/Insects		<i>Campylobacter</i>	<i>Salmonella</i>		
Contaminated Feed	<i>Campylobacter</i>				<i>Salmonella</i>
Age of birds		<i>Salmonella</i>			<i>Campylobacter</i>

Source: Adapted from Food Safety Standards Research

Clostridium perfringens, *Listeria monocytogenes*, *Escherichia coli* and *Staphylococcus aureus* are other bacteria found in poultry products. However, these bacteria cause foodborne disease in less than two of the above described pathogens in humans.

Poultry meat can be contaminated with *C. perfringens* at the end of processing, but the level of contamination is low. Also, in order for growth of this pathogen to reach such a level that disease results, temperature abuse and mishandling are required. Besides, these risk factors occur mainly in the retail, foodservice/catering, and in the home rather than in the production and processing steps of the chain.

⁶ Threats to biosecurity includes factors such as partial depopulation, other animals/birds, personnel, proximity to other poultry sheds etc.

L. monocytogenes is occasionally found in products such as raw meat, raw fish, soft cheeses and raw vegetables and is rarely cited as a cause of foodborne disease following poultry meat consumption. However, it is always very serious and is very often fatal. Among pregnant women, it very often leads to abortion.

As one of the few pathogens, this organism is able to survive low temperatures in the refrigerator and multiply but still there is not enough evidence indicating that reproduction of *L. monocytogenes* on raw poultry meat is a major risk factor in humans during the storage. Mainly the concern regarding *L. monocytogenes* as a cause of foodborne disease among ready-to-eat poultry meat products may be due to inadequate heat treatment (i.e. cooking) or occur post processing either directly from the processing environment or via cross-contamination at retail (e.g. sliced ready-to-eat meats).

Escherichia coli belongs to a family of microorganisms called coliforms. *E. coli* O157:H7 strains are associated with causing a distinct and sometimes deadly disease in humans. Ground beef is the food mostly associated with *E. coli* O157:H7, but it can be found in poultry products as well as. (P. Kendall. 2011)

Staphylococcus aureus is notably dangerous because this bacterium is able to produce seven types of toxins that are responsible for food poisoning. Contamination of chicken with *St. aureus* can have several causes. Since the origin is not clear, the presence of *St. aureus* on chicken meat cannot be used as an indicator of poor hygiene as with some other products. Normally this bacterium could be present on the skin and in the noses of up to 25% of healthy people and animals. Staphylococcus food poisoning may come about as a result of foods contacting dirty hands or animal surfaces.

2.5.1.2 Mycotoxins

Mycotoxins are secondary metabolites produced by various types of fungus when they grow on agricultural products before or after harvest or during transportation or storage. Thus in this feed supply to the poultry, the entire toxins produced by fungus are capable not only of affecting the quality of the birds' meat, but also of affecting the health of consumers through consumption of toxin residues that can be deposited in poultry meat. (FAO, 2010)

The common mycotoxins listed by the Food and Agriculture Organization (FAO) showing the importance of poultry feed are indicated in Table 3

Table 3 Origins of major mycotoxins found in common feedstuffs

Mycotoxin	Fungal species
Aflatoxins	<i>Aspergillus flavus</i> ; <i>A. parasiticus</i>
Ochratoxins	<i>A. ochraceus</i> ; <i>Penicillium viridicatum</i> ; <i>P. cyclopium</i>
Trichothecenes	
- Deoxynivalenol	<i>Fusarium culmorum</i> ; <i>F. graminearum</i>
- T-2 toxin	<i>F. sporotrichioides</i> ; <i>F. poae</i>
Zearalenone	<i>F. culmorum</i> ; <i>F. graminearum</i> ; <i>F. poae</i>
Fumonisin	<i>F. moniliforme</i>

Source: Adapted from poultry feed availability and nutrition in developing countries report (FAO)

Aflatoxins, especially *aflatoxin B1*, can cause liver cancer in humans and *Orchatoxins* are known to cause some toxic effects in animals; in particular kidney damage, hindrance of fetal development, and negative impacts on the immune system are considered to be the important impacts on animal and human health. As with most *Mycotoxins*, *Fusarium* toxins are chemically stable, survive food processing stages, and may pose a potential risk to human health as well as livestock. *Trichothecenes* can be acutely toxic to humans, causing sickness and diarrhea. (Food Standards Agency)

In order to control and prevent the risks that may be posed to animal and human health as a result of the contamination of animal feed with *Mycotoxins*, different food safety agencies have developed codes and practices to assist producers in minimizing these risks (e.g. Good Agriculture Practices or Recommendations on the prevention and reduction of *Fusarium* toxins in cereals and cereal products, published by the European Commission).

2.5.1.3 Other microbiological risk factors

Other microbiological risk factors having major impact on human health due to consumption of poultry meat and products are viruses, parasites, and prions; but these very rarely occur as a factor that threatens consumer health at a high level. Although the viruses such as *Influenza* could be a major risk to the health of workers dealing with the poultry chain, but it is not directly a hazard for the consumer of the processed poultry product. (Kiilhoma 2007)

2.5.2 Chemical risk factors

Chemical risk factors can be found in poultry meat and poultry products are substances like residues in poultry due to antibiotics fed to chickens and the remnants of agricultural chemicals in animal feed eaten. These chemical factors in poultry meat and products may cause cancer, immune deficiencies, chronic fatigue syndrome, and lung and nerve damage for the consumers. As use of the chemical is increasing the worries regarding the risks of poisoning are increasing too. (Ruth M.W. Yeung and Joe Morris, 2001)

Another remarkable chemical risk factor is the pesticide residues from feed production. Pesticides are a human concern and many researchers have done much to understand the range of diseases and disorders linked with use of pesticides in crop productions fed to the animals. It is known that many chemical pesticides cause food poisoning, infertility, and birth defects; as well as damage to the nervous system in humans. (Sustainable table, 2009)

2.5.2.1 Antibiotic residues

Use of the antibiotics to enhance growth, feed efficiency and reduce diseases is common in poultry industry by farmers. Antibiotic usage brings out efficient poultry meat production, reasonable price of chicken, increasing the health of poultry by declining the diseases outbreak and good quality meat and eggs for the consumers. Although these positive aspects usage of antibiotic; there is consumer perceptions about the contamination of the poultry meat with harmful concentration of antibiotic residues.

Kiilhoma stated that there would be only two ways in which antibiotic residues threaten consumer health. First it would be by the direct effects of the antibiotic residue in poultry meat and egg, and indirect through selection of antibiotic resistant strains of pathogenic bacteria.

A. M. Shareef, Z. T. Jamel and K. M. Yonis have tested the poultry products (liver, breast and thigh muscle) for the presence of antibiotic residue such as oxytetracycline, sulfadiazine, neomycin, and gentamycin in Iraq under the College of Veterinary Medicine, University of Mosul. The results revealed 39 (52%) positive samples in which the level of antibiotics may

be used in poultry industry in developing countries. The details of the positive results, number, percentage of positives for antibiotic type and sample type were given in Table 4.

Table 4 Number (%) of positive samples for 4 antibiotics

Antibiotic	Poultry products			Total samples (N=25)
	Breast muscles (N=25)	Thigh muscles (N=25)	Liver (N=25)	
Gentamycin	0	0	0	0
Neomycin	0	0	0	0
Sulfadiazine	7(28)	4 (16)	7 (28)	18 (24)
Oxytetracycline	7(28)	4 (16%)	7 (28)	18 (24)
Total	14(56)	11 (44)	14 (56)	39 (52)

Source: Iraqi journal of veterinary science

Antibiotic residues in animal products pose a serious threat to human health due to existence of the antibiotics belong to class of human medicine, therefore risk of antibiotic resistance in humans by consumption of these animal products increased particularly people who have problems in immune systems including kids, old people and patients with cancer receiving chemotherapy.

The European Union has regulated use of the non-therapeutic antibiotics (specifically used in human medicine), and has banned the use of this kind of drug in animal feed. Although the United State of America hasn't developed policies about antibiotics in livestock production, in 2005 the Food and Drug Administration (FDA) of America decided to prohibit use of the antibiotic fluoroquinolones in the poultry industry because this antibiotic is used to treat severe foodborne disease in humans and thereby increase the risk of bacterial species that can survive fluoroguinolones antibacterial agents. However, in developing countries use of the antibiotics in the poultry industry has not been regulated, though concerns due to overuse of the antibiotics are somewhat considerable.

2.5.2.2 Pesticides residues

Pesticides are used to control the growth of weeds, crop protection from insects, rodents and molds; or it may be used on food crops after harvest to prolong their storage life. In animal farms pesticide may be used to control insect pests. The primary concern with pesticide use is related to the toxicity which may result tin carcinogenic, teratogenic, mutagenic, immunotoxic, immunopathological, and/or neuropathic effects in humans as well as animals.

Nowadays in developing countries the exposing of populations to increasing use of pesticides is opposite the trend with developed nations. There have been many studies on pesticide residues and impacts on human health. About 67,000 pesticide poisonings resulted in an estimated twenty-seven accidental fatalities reported each year in the United States (D. Pimentel, T. W. Culliney, and T. Bashore¹).

Although use of the pesticides is regulated in many of the farms of the United States and European Union, the test which have been done by the United Stated Department of Agriculture in 2006 on poultry breast in domestic conventional and organic farms show seven

types of pesticide residue found in poultry breast produced by conventional poultry farms (Table 5). Therefore, it shown that concern regarding the pesticide residues in poultry meat is not only limited to the developing countries.

Table 5 Pesticides residues in poultry breast (USA)

Pesticides	Percentage
Piperonyl butoxide	2.3 %
MGK-264	2 %
DDE p,p'	1.4 %
Carbaryl	1.4 %
Boscalid	0.2 %
Fipronil	0.2 %
Pyrethrins	0.2 %

Source: United States, Department of Agriculture

2.5.2.3 Other Chemical risk factors

The other chemical risk factors that may be found within poultry meat could be the detergents used for cleaning of the equipment at the processing plants, disinfectants used in farms and slaughterhouses. Also chlorine which is added to the water for rinsing the carcass now spreads concern among consumers. It is forbidden to use the chlorinated water in the European Union, but in other countries it is not regulated by law. Even in the United States of America, it is a common practice.

2.5.3 Physical risk factors

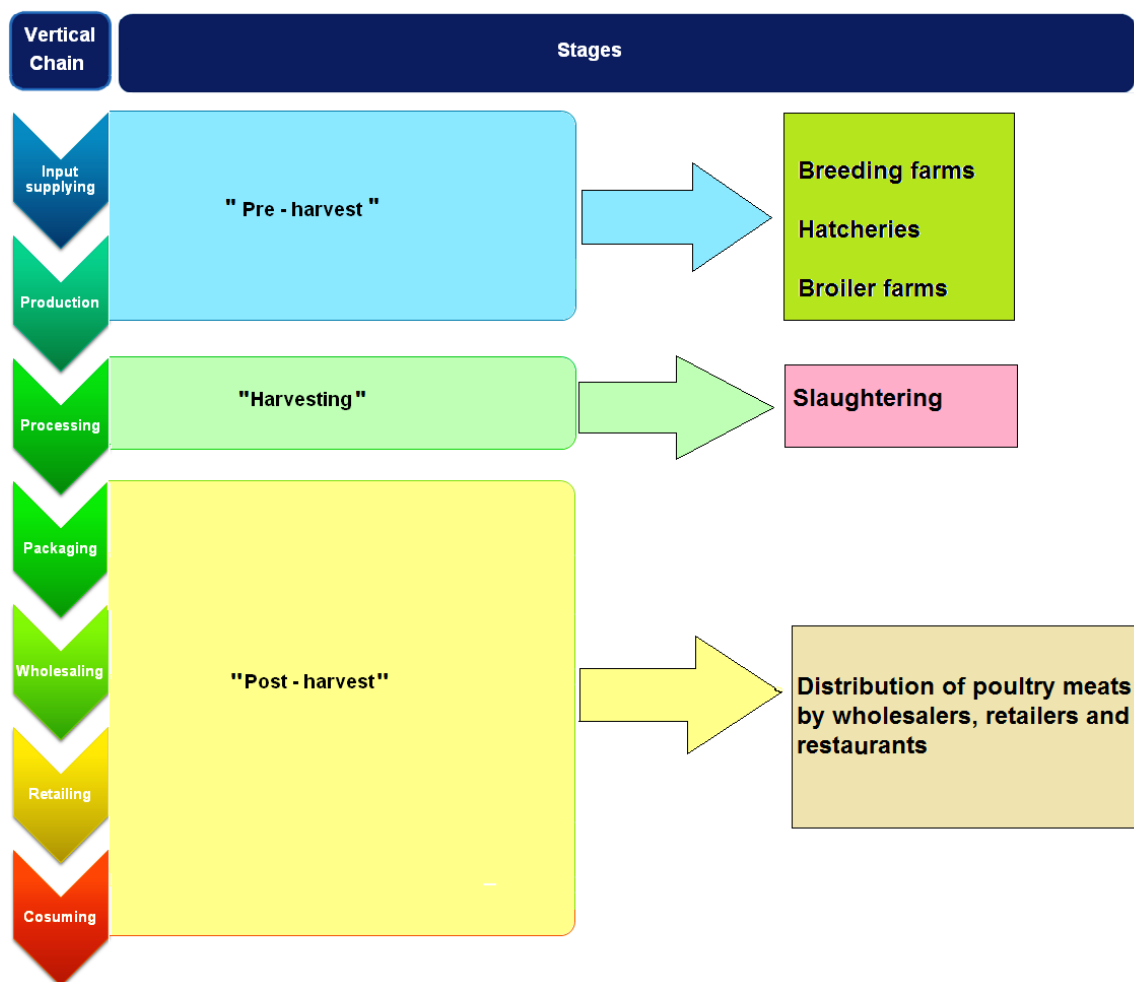
Physical risks factors refer to the foreign particles not normally found in the poultry meat that can cause disease or injury to consumers. Physical hazard can arise from different sources, such as contaminated raw materials, poorly designed or maintained facilities and equipment, faulty procedures during processing, and improper employee training and practices. (USDA 1997)

2.6 The vertical chain

The term vertical chain is used to determine the different steps of a product from producing until finished by the end consumers. (Farm – to – fork) However, WHO defines these steps into three stages in poultry sector which are (1) Pre – harvest stage (2) Harvesting stage (3) Post – harvest stage. (Figure 6)

Pre – harvest stage consists input supplying and producing of the vertical chain and deals with farmers' practices. Harvesting stage consists the processing (slaughtering) of the product which deals with poultry slaughterhouse practices by slaughterhouse workers. Post – harvest stage consists the packaging, wholesaling, retailing and consuming of the product and deals with distribution of the poultry meats by wholesalers, retailers, restaurants and consumers.

Figure 6 The broiler vertical chain



Source: adapted from WHO

CHAPTER 3 METHODOLOGY

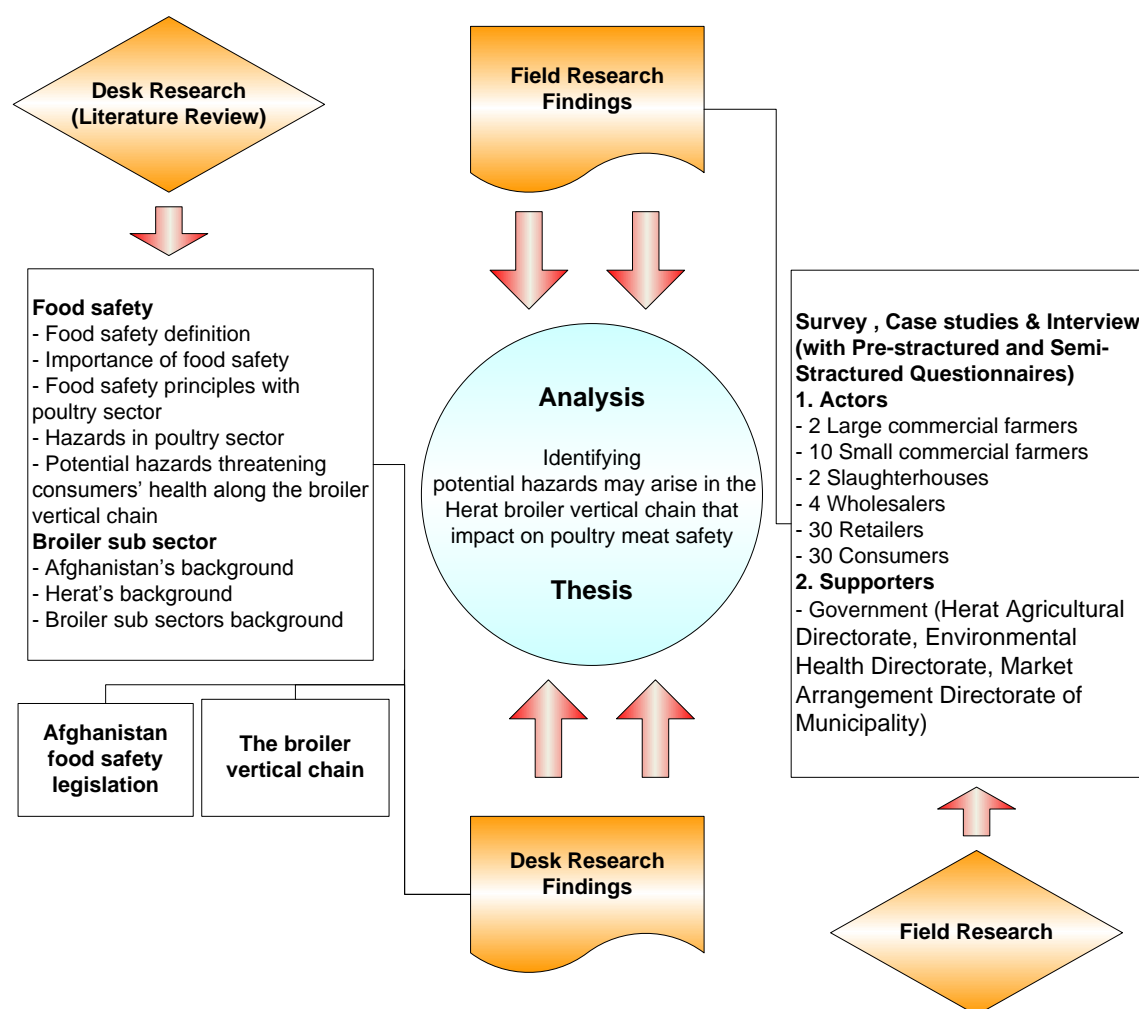
3.1 Research framework

This research was based on desk and field research. Desk research deals with the key concepts of the study such as food safety issues (i.e. food safety definition, Importance of food safety, food safety principles with poultry sector, hazards in poultry sector, hazards threatening consumers' health along the broiler vertical chain). Also it deals with the Afghanistan background, in particular Herat province in the western part of Afghanistan and broiler sub sector's background in Herat. Furthermore, seeks to obtain information about Afghanistan food safety legislation and the broiler vertical chain. Field research conducted through surveys and case studies with different actors along the vertical broiler chain which consists of two large commercial farmers, ten small commercial farmers, two processing units, 30 retailers, and 30 consumers.

Furthermore interviews conducted with the Herat government Food Safety Boards (Herat Agriculture Directorate, Environmental Health Directorate, Market Arrangement Directorate of Municipality) deal with food safety issues in Herat province.

Field research findings and desk research findings were analysed with Vertical Chain Analysis, Tables and Excel Graphs, Questionnaires and Risk assessment. The research framework (self-explanatory) is as presented in Figure 7.

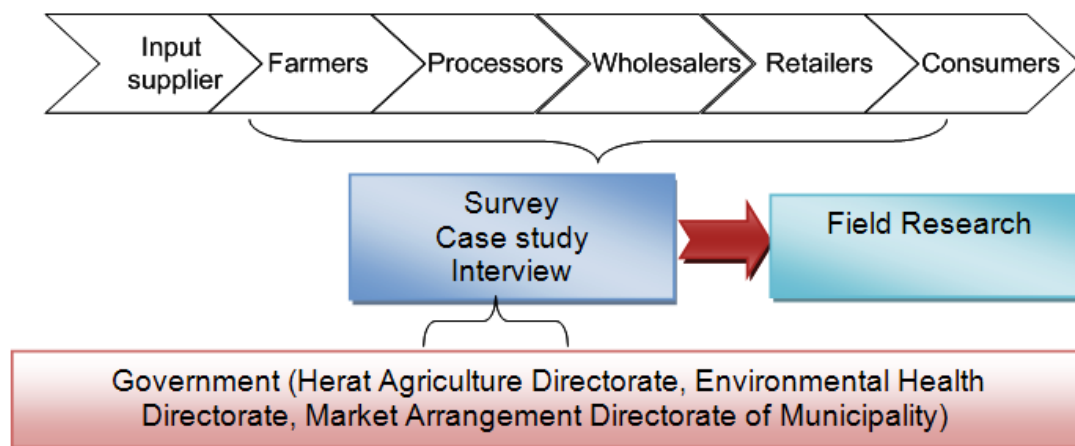
Figure 7 Research framework



3.2 Conceptual framework

The field research of this study is based on broiler vertical chain. Therefore the key actors (farmers, processors, Wholesalers, retailers and consumers) and the supporters [Government (Food safety board)] were being focused on as key respondents for field research. (Figure 8)

Figure 8 Conceptual Framework



3.3 Study area

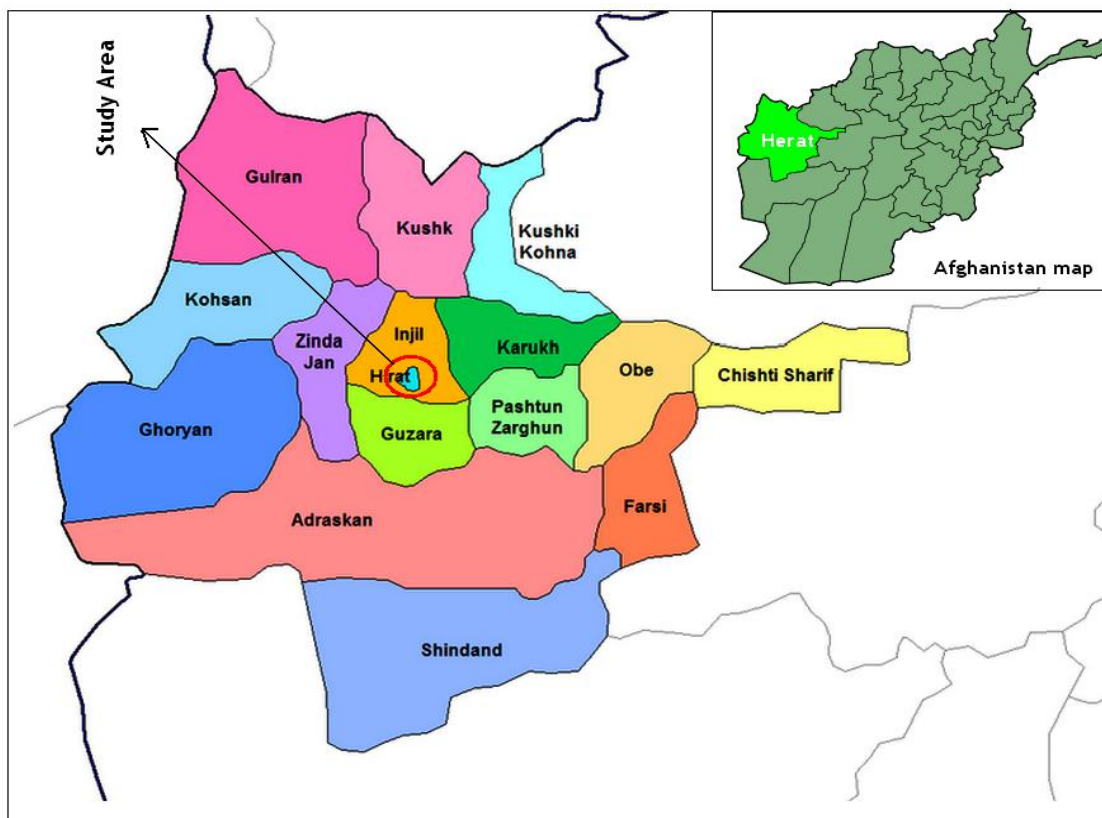
Enjil is a district in the center of Herat province with the capital of Herat selected for this study. It is a district blocked with Kushk and Karukh districts from north and east and Guzara and Zinda Jan from districts from the south and west (Figure 9). Its latitude is 34.3 (34° 17' 60 N) with a longitude of 62.25 (62° 15' 0 E), A 100 square kilometer area around Enjil has an approximate population of 1,694,468 (0.016945 persons per square meter) and an average elevation of 1200 meters above sea levels.

The study area was selected due to following reasons; in comparison to other districts Enjil, with the capital of Herat, has higher population (Figure 10). Mostly the commercial broiler farms are located in this area. From a socio- economic perspective, different categories and ethnic groups settled in this region, this gives an opportunity to researchers to cover all these aspects.

The study area of the suburbs of Herat city in Enjil district was selected because mostly the broilers' farms exist in this area. Access to the Herat poultry market is one reason that the farms are located around the city to bring the products in proper time for the customers. Broiler farmers sell their products as live birds, slaughtered, and different specific cuts after slaughtering, to the consumers through wholesalers as well as retailers.

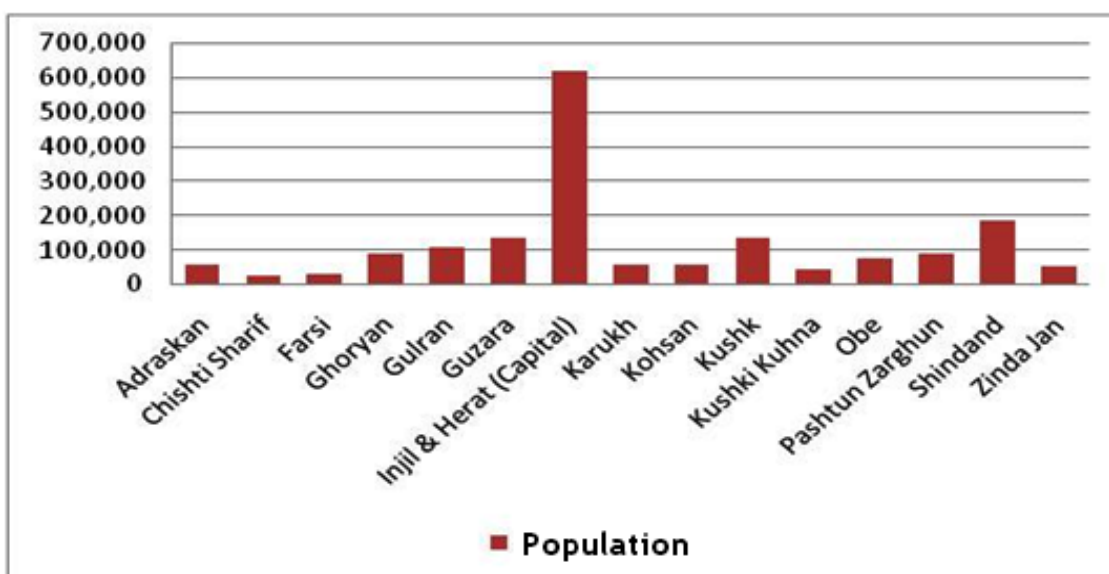
People in Enjil district prefer to purchase poultry meat as a cheap source of protein in their daily diet. Other factors contributing to this issue is the low price of poultry meat compared to other types of meat in the market (i.e. sheep, goats, and cattle), healthy nature of poultry meat, and availability in all seasons of the year.

Figure 9 Districts of Herat Province



Source: Wilikepedia (4 July 2011)

Figure 10 Herat Districts Population 2006



Source: Wilikepedia (4 July 2011)

3.4 Study design

The study design aims to give a clear insight into the strategy that the field research carried out and to show the tools used to analyze the results of the field research. The study involved surveys, case studies, interviews and observations of the researcher along vertical value chain of the broiler sub sector in Herat. (Figure 11)

3.4.1 Survey

The survey consisted of 30 consumers and 30 retailers of poultry meat in Herat. Consumers selected were 15 literate female consumers from the city of Herat and 15 illiterate female consumers from suburban villages of Herat who deal with cooking of poultry meat at home in order to collect data related to hygiene practices during the cooking of poultry meat.

Also 30 retailers of poultry meat in 5 location (i.e. Darwaze kandhar, Darwaze Khosh, Darwaze Malak, Shahr-e Naw and Howz-e-Karbas,) were selected for survey in order to collect data related to practices about food safety (handling and storage of poultry meat and personal hygiene) in Herat city. The above six locations are in twelve region of the municipality of Herat city.

Questionnaires about food safety practices for consumers and retailers survey are presented in the Annex (5. Questionnaires for retailers & 6 Questionnaires for consumers)

3.4.2 Case study

Case studies were carried out with 2 commercial farms (11000-50000 birds), 2 slaughterhouses, and 10 small commercial farms (1000-10000 birds) in the suburbs of Herat city in Enjil district and 4 wholesalers of poultry meat inside Herat city. This was done in order to collect data related to practices regarding food safety issues during production at the farm level, processing at the slaughterhouse, storage and handling of poultry meat after processing, transmission to the wholesalers and distribution to the retailers. General background information and two types of questions (open and closed questions) conducted by the researcher for data collection about food safety practices by each actor in the case studies. Questionnaires are presented in the annex: (1) Questionnaires for farmer, (2) Questionnaires for slaughterhouse, and (3) Questionnaires for wholesaler.

3.4.3 Interview

Interviews conducted with the Government's Food Safety Board (Herat Agriculture Directorate, Environmental Health Directorate, and Market Arrangement Directorate of Municipality). The objective of interviews with the Government's Food Safety Board was to collect data about common hazards associated from poultry meat source. Yet in Herat, government rule and policies related to food safety and some secondary data exist regarding the food safety in the broiler subsector in Herat. Checklist for data collection from the government also presented in the annex (6. Checklist for the government)

3.4.4 Observation

Through observations of 5 small commercial farms, 2 big commercial farms, 2 slaughterhouses, 4 wholesalers and 30 retailers were examined for their practices and status regarding food safety issue. Criteria for observation and method for justification of each actor practices and status regarding the food safety issues with details are presented in the tables (1) Observation of the farm, (2) Observation of the slaughterhouse, and (3) Observation of the wholesaler and retailer respectively in the annex.

Table 6 Summary of surveys, case studies and interview participants

#	Actors/ Stakeholders in broiler chain	Surveys	Case studies	Interview	Observations
1	Small commercial farmers		10		5 Small commercial farms
2	Big commercial farmers		2		2 Big commercial farms
3	Slaughterhouse owner		2		2 Slaughterhouses
4	Wholesalers		4		4 Wholesaler
5	Retailers	30			30 Retailers
6	Consumers	30			
7	Government's Food Safety Board			3	
Total		60	18	3	43

3.4.5 Tools used for data analysis

The collected data analysed through, Vertical chain analysis, Tables and Excel sheets, Questionnaires and Risk assessment to give better understanding of field research and help researcher to make conclusion and recommendations for this thesis.

3.4.5.1 Vertical chain analysis

The concept of vertical chain was used to study the existing practices within each actor in three stages of broiler vertical chain in Herat. Furthermore, it helped to understand how the current broiler chain is organized and what the role of each actor along the chain is, and which stages of the chain may pose more potential hazards to the poultry meat and thereby threaten consumers' health.

3.4.5.2 Tables, Excel Sheets and Questionnaires

The Tables, Excel sheets and Questionnaires used to process the raw descriptive data into processed data which gives better picture about the food safety practices by each actor along Herat broiler vertical chain.

3.4.5.3 Risk Assessment

Risk assessment is a tool for determination of hazards in HACCP (Hazards Analysis Critical Points) quality system.

Risk = Estimation of probability

$$\text{Risk Assessment} = S * O$$

Where; S: Seriousness index **O;** Occurrence /Frequency index

	1	2	3	Frequency
1	I	II	III	
2	II	III	IV	
3	III	IV	IV	

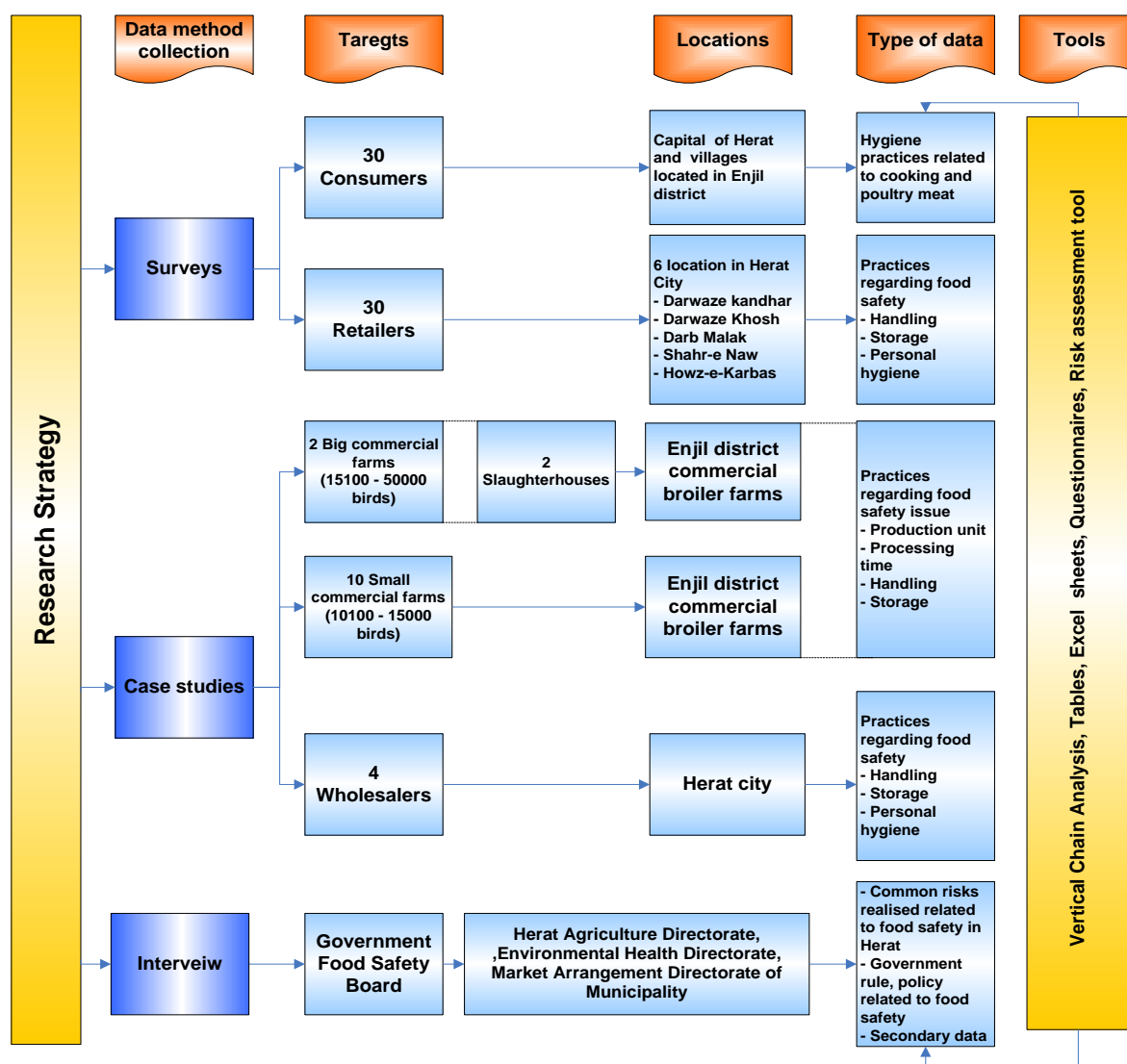
Severity

I = No risk II = Low risk III = Moderate risk IV = High risk

The aim to use this tool was to identify potential hazards may arise within each actor practices regarding food safety in the three stages of the Herat broiler vertical.

The high risk and moderate risk was considered as potential hazards in the Herat broiler sub sector based on case studies, surveys and interview results especially on observation and the researchers' experiences.

Figure 11 Study design



3.5 Literature review

The literature review consists of a number of books published in the Dari and English languages; reports, journal and magazines in other countries with similar conditions to Afghanistan and internet sites were used to achieve better insight into the food safety issue in broiler sub sector. The literature's focus was narrowed down to what are the possible hazards in poultry meat along the vertical chain, what type of food quality system adapted to minimise these risks, what type of research conducted yet about this issue?; how does the industry assure supplying safe meat for consumers ? And what is the current situation of the food safety in broiler sub sector in developing countries? Have there been any foods borne diseases associated from consumption of unsafe poultry meat recently?

CHAPTER 4 RESULTS

4.1 Pre – harvest results

4.1.1 Background information of farmers (Case studies) in Enijl district

As shown in Table 7, only four of the farmers have never attended school at any level, while the other farmers have either primary, secondary and/or college level educational backgrounds. The minimum number of birds raised by any of the farmers is 1,000, and the maximum number is 50,000 birds. The farmers who have the largest flocks of birds have 5 – 6 cycles of production per year, while for the others the cycles of production fluctuate from 1 – 2, 3 – 4 and 4 – 5 per year. The sources for purchasing the chicks for the various farms (defined with A, B, C and D⁷ in Table 7) reflects that seven of the farmers bought one day old chicks from source (C) that were imported from Iran or Pakistan, and five of the farmers bought from source (D), meaning that they bought one day old chicks produced in Herat.

Table 7 Farmers' background

Education Background	#	Number of birds per production cycle	#	Cycle of production per year	#	Source of farm chicks	#
Never been to school	4	1000 - 5000	4	1 – 2	1	A	0
Primary	2	5100 - 10000	4	3 – 4	4	B	0
Secondary	5	10100 - 15000	2	4 – 5	4	C	7
College	1	15100 - 50000	2	5 – 6	3	D	5
Total	12	Total	12	Total	12	Total	12

4.1.2 Hygienic practices by farmers

Hygienic practices applying in broiler farms in the Enijl district of Herat province are presented in Table 8

Table 8 Farmers hygienic practices

#	Hygienic practices by farmers	Yes	No	Total
1	Is feed of poultry protecting from rodents?	9	3	12
2	Is the clean water available all the time for chicken?	12	0	12
3	Do you vaccinate the chickens?	11	1	12
4	Do you disinfect the poultry house?	12	0	12
5	Do you disinfect the vehicles' wheels before enter to the farm?	9	3	12
6	Do you have any rule for visitors regarding hygiene at the farm?	12	0	12
7	Do you wash your hand with soap before entering to the farm or handling of poultry?	12	0	12
8	Do you have problem of pests inside the poultry house?	0	12	12
11	Do you have mortality of chicken?	12	0	12

⁷ A= Eggs produced by the farmer and the chicks derived by himself

B= Eggs imported from Iran or Pakistan, and chicks produced by himself

C= One day old chicks bought by farmer from market (imported from Iran or Pakistan)

D=One day old chicks produced in Herat bought by farmer

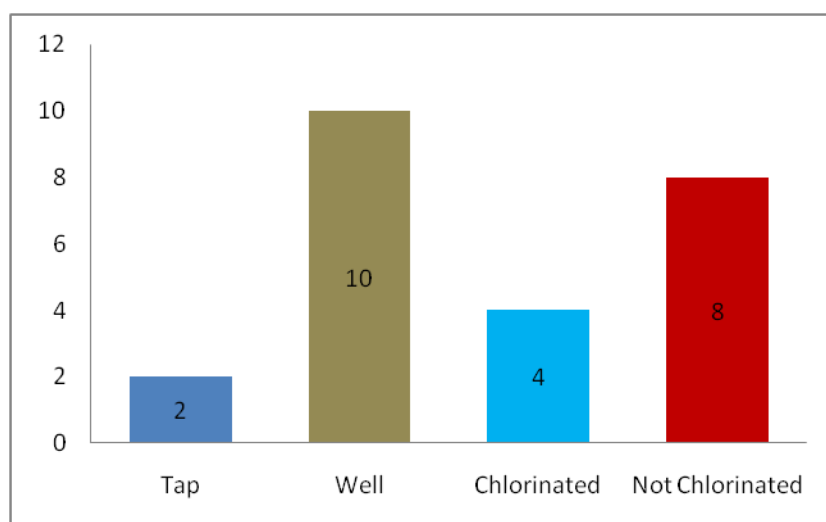
As reflected in Table 8, most of the farmers are applying hygienic practices at the broiler farms in the Enjil district of Herat. Out of all of the farmers, only three farmers do not utilize all of the suggested hygienic practices at the farms. These farmers did not protect the poultry feed from rodents, nor disinfect the vehicles' wheels before entering broiler farm gate. For hygiene purposes at the broiler farms, there have been provisions for workers to wash their hands with soap, change their clothes before entering the poultry house, and prohibition of visitors to enter the poultry house. Other practices relate to supplying the nest litter from a reliable source free from contamination, and disinfection of the poultry house and equipment in each cycle of the production.

After each cycle of the production, birds are loaded into the loader in special crates (6-8 birds per crate) and delivered to the slaughterhouses, or as live birds to the Herat poultry meat retailers' shops in the city. The workers out of the farm are not allowed to enter the poultry house. They receive the poultry crates at the gate of the poultry houses, and then deliver them to the cars for transport to the slaughterhouses or retailers' shops in the city.⁸

4.1.3 Broilers' farm water supply

Water sources used by the Herat broiler farmers are city tap and well water. Few farmers chlorinate the well water for their broilers on the farms in the Enjil District of Herat Province. Figure 12 represents the number of the farmers that are using city tap and well water sources, as well as depicting the number of farmers both chlorinating their well water, and those who do not chlorinate their well water.

Figure 12 Water source supply to birds



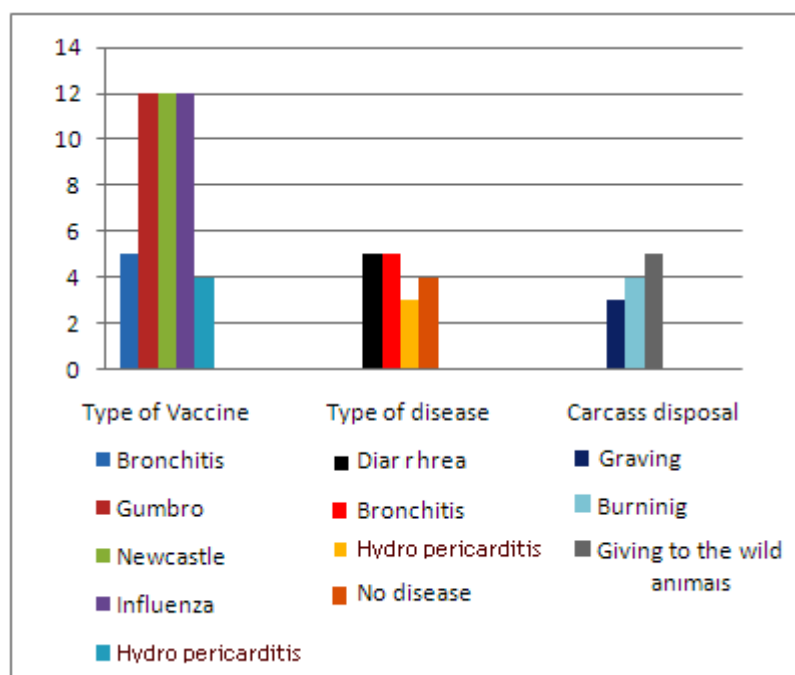
4.1.4 Vaccination, Diseases and carcass disposing

All of the farmers vaccinate their poultry flocks against Newcastle, Influenza and Gumbro, and some additionally vaccinate against Hydro pericarditis and Bronchitis diseases too. The types of diseases most commonly experienced by the farmers are diarrhea, bronchitis and hydro pericarditis. Diarrhea and bronchitis are the most common diseases in the broiler farms. Antibiotics are administered to the poultry in case of disease outbreaks. The dead birds are burned, interned, or given to the wild animals. Figure 13 shows the vaccination, disease and carcass disposing activities used by the farmers.⁹

⁸ Majority of the farmers hired experienced workers for their farms who have worked on poultry farms for many years in Iran, and know how to observe personal hygiene, feed the chickens, keep the farm clean, and take care of the birds very well.

⁹ Average mortality rate in Herat broiler farms associated 9 %. (farmers' case study results)

Figure 13 Vaccination, Diseases and carcass disposing in broiler farms



4.2 Harvesting results

4.2.1 Poultry slaughterhouses' result

Herat poultry slaughterhouses are located in Robat Paryan village in the west part of the Enjil district in Herat. One is Safid Par Tarki Slaughterhouse and another is Tiyan Ayoubi Slaughterhouse. These two slaughterhouses owned by two commercial broiler farmers which are actively have the role in wholesaling of poultry meat in Herat.

There are 22 personnel in Safid Par Taraki Slaughterhouse and 19 personnel in Tiyan Ayoubi Slaughterhouse which is working in line of slaughtering in every slaughtering. These personnel mostly have the primary education background and have not have the academic knowledge background about work in slaughterhouse but they have been worked in poultry slaughterhouses for many years during the span of their refugee lives in neighboring countries, particularly in Iran and Pakistan.

They learned skills and experiences of working in poultry slaughterhouses in Iran or Pakistan and by establishment of these poultry slaughterhouses in Herat they find the opportunity to work in their previous field of work during their refugee lives. Therefore they used these skills in the Herat slaughterhouses, and other new workers learned from them as well as.

Table 9 shows the background information and food safety practices of these two slaughterhouses in comparison to one another.

Table 9 Poultry Slaughterhouse practices & background

#	Questions	Tiyorani Ayoubi	Safid Par Taraki
1	What is your education level?	Secondary	College
2	What is the slaughtering capacity in your slaughterhouse?	2500-3000/ hr	2000/hr
3	How many chickens do you slaughter per week?	5100- 10000	5100-10000
4	How do you receive live birds?	By truck	By truck
5	Are the chickens inspected before slaughtering?	Yes	No
6	Are you aware of food safety in your slaughterhouse?	Yes	Yes
7	Do you clean and disinfect all the surfaces and facilities before and after slaughtering?	Yes	Yes
8	What is your water source?	Well	Well
9	How are the chickens de-feathered after being slaughtered?	Machine	Machine
10	Is there an expert to inspect internal organs and carcasses for disease concerns?	Yes	No
11	Do you chill the carcasses for the secondary processes?	Yes	Yes
12	How do you chill the carcasses?	With ice	With ice
13	Do you have a storage place for meat after packaging?	Yes	Yes
14	How many days/ hours do you store meat after packaging in slaughterhouse?	12 hours/ 2-3 days	6-7 hours/1- 3 days
15	Do you provide protective clothing for workers during slaughtering procedures?	Yes	Yes
16	Do the workers wash their hands with soap after going to the restroom and before entering the slaughtering unit?	Yes	Yes
17	Have you been providing basic hygiene training for your workers?	No	No
18	Do you allow visitors to enter the slaughterhouse?	Yes	No
19	Do you have any criteria for them to follow like changing their clothes, hand washing, foot baths, etc?	No	No
20	Do you allow the workers or visitors to eat, drink or smoke inside the slaughtering unit?	No	No
21	Is the slaughterhouse constructed well to minimize or prevent access by rodents, birds, cats and other pests?	Yes	Yes
22	Are the equipment and facilities suitable to avoid cross contamination of meat from dirt?	Yes	Yes
23	Does the slaughterhouse wall, ceilings, floors constructed well easy to clean?	Yes	Yes
24	How is the meat delivered from the slaughterhouse to the retailers?	By cooling car	By cooling car

4.3 Post – harvest results

4.3.1 Poultry meat wholesalers' background

There are four wholesalers of poultry meat in Herat. Two of them are dealers of the frozen poultry meat that is imported from Brazil and the United States of America, while the rest are Herat broiler production wholesalers. Herat frozen poultry meat wholesalers are the Summit Associates Company¹⁰ and the Said Mojtaba Hashimi Company, and the Herat broiler production wholesalers are Tiyoran Ayoubi and Safid Par Taraki wholesalers. Three of these wholesalers have secondary education backgrounds, and only Safid Par Taraki has the college education background and gave positive answers concerning their awareness of safe poultry meat handling practices to the researchers' question.

4.3.2 Wholesalers hygienic practices

Hygienic practices by poultry meat wholesalers are characterized as follows: the poultry meat is delivered and distributed through loader cars equipped with cooling facilities at -18 °C for frozen meat, and 0 – 4 °C temperatures. The storage length of time associated between 1 – 3 months for frozen poultry meat and 1 – 2 days for Herat fresh poultry meat in the same temperatures of transportation.¹¹ As was observed and stated by wholesalers, the Herat poultry meat wholesalers built sufficient cooling facilities with necessary equipment for cleaning purposes. Tap water is available for cleaning, and wholesalers clean storage of Herat fresh poultry meat everyday while the storage of frozen poultry meat cleans between 10- 30 days. Table 10 shows Herat poultry meat wholesalers' hygienic practices regarding food safety issues.

Table 10 Herat poultry meat wholesalers' hygiene practices

#	Criteria	Summit Associates Company	Said Mojtaba Hashimi Company	Safid Par Taraki	Tiyoran Ayoubi
1	Education background	Secondary	Secondary	Collage	Secondary
2	Safe meat handling awareness	Yes	Yes	Yes	Yes
3	Meat delivering	refrigerated loader	refrigerated loader	refrigerated loader	refrigerated loader
4	Storage & distribution temperature	-18 C ⁰	-18 C ⁰	0 - 4 C ⁰	0 - 4 C ⁰
5	Storage volume	1000 tons	100 tons	3 tons	3 tons
6	Length of chicken meat storage	3 months	1 month	1- 2 days	1- 2 days
7	Storage cleaning facilities	Exist	Exist	Exist	Exist
8	Water source for cleaning of the storage	Tap	Tap	Tap	Tap
9	Experienced poultry meat spoilage	Nope	Nope	Yes	Nope
10	Using protected clothes	Nope	Nope	Nope	Nope

¹⁰ This company imports 500 – 1000 tons of poultry meat in a month and distributes to majority provinces of Afghanistan, while Said Company imports about 100 tons of poultry meat in a month and sell only in Herat.

¹¹ Safid Par Taraki mentioned that experienced poultry meat spoilage due to improper storage temperature in 2008 and obliterated 2000 kg poultry meat in one day.

4.3.3 Poultry meat retailers' background

The number of the retailers who have never attended school is 6; those who have only a primary level of education is 8; those who have the secondary level of education is 14, and those who have a college education level is 2. The average ages of the retailers who never been to school is 33; for those who have the primary level of education the average age is 29.5; for those who have the secondary level of education the average age is 29, and for those who have a college education level their average age is 41.5. The average meat selling quantity by retailers in Howz-e- Karbas is 37.5 kg/day; in Darwaze Kandhar it is 131.66 kg/day; in Darwaze Khosh it is 168.33 kg/day, and in Darwaze Malak it is 108 kg/day. In Shahr-e Naw the average is 85.83 kg/day and the average live bird selling quantity by retailers only associated in Darwaze Kandhar is 23.33 kg/day, in Darwaze Khosh it is 30 kg/day and in Darwaze Malak it is 53.33 kg/day. The retailers' backgrounds are reflected respectively in Figures 14, 15 and 16.

Figure 14 Age and education background of the retailers

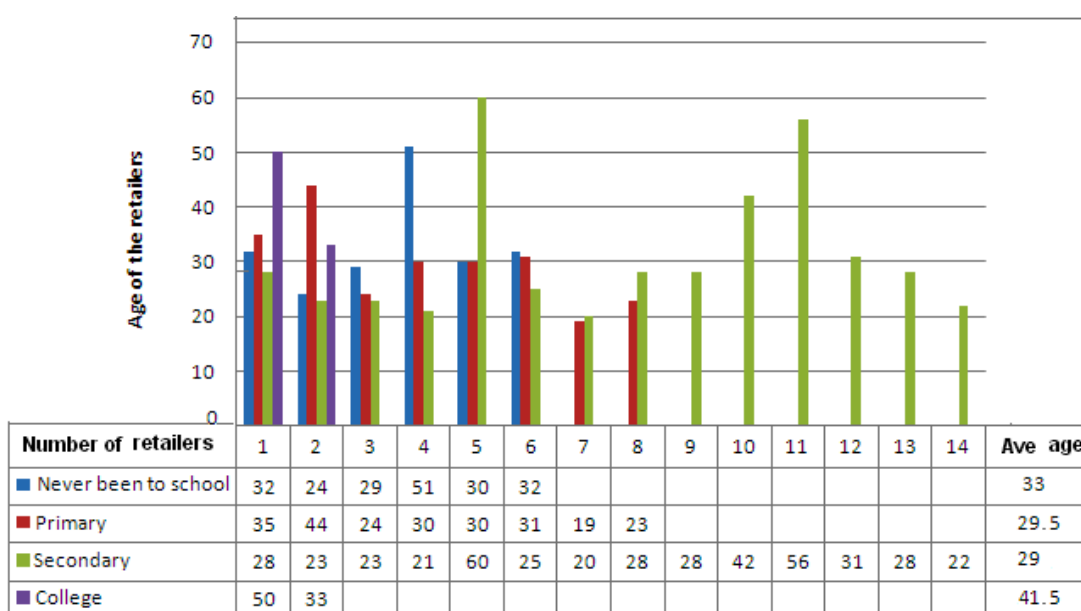


Figure 15 Poultry meat selling quantity per day

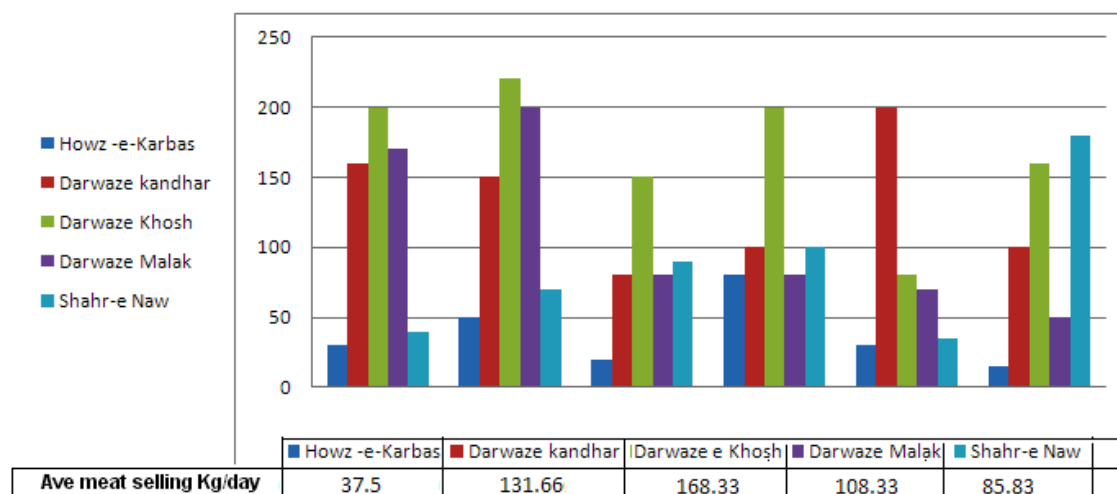
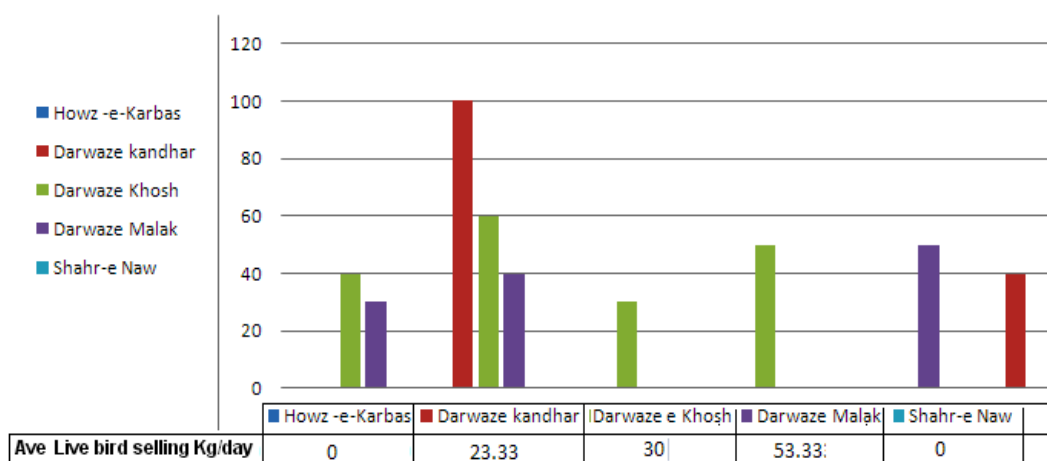


Figure 16 Live bird selling quantity per day



4.3.4 Retailers' shops monitoring by government (Food safety board)

All of the poultry meat retailers in Herat city received job certificates from the government, but they do not receive any medical health certificates yet. However, only one retailer stated that he has received medical health certificates from the government.

In terms of government shop inspections for sanitation, required cooling & cleaning of the facilities, shop structure construction, and personal hygiene of the personnel, 9 of the retailers said the government inspects them 1- 2 times per month; 10 of the retailers said 3 – 4 times per month; and 7 said above 5 times per month. However, 4 of the retailers mentioned the government never inspects their shops for sanitation and required cooling & cleaning facilities, shop construction structure and personal hygiene purposes. (Table 11)

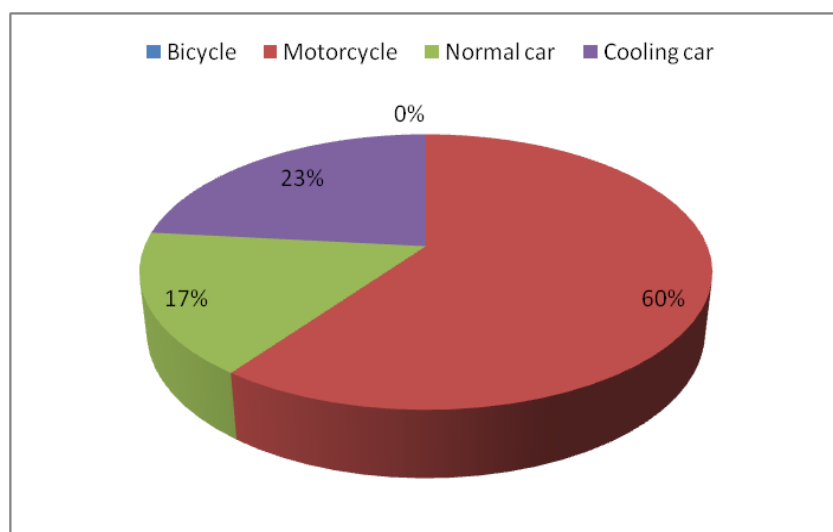
Table 11 Retailers' monitoring by government per month

Locations	1-2 times/month	3-4 times/month	Above 5 times/month	Never/month
Darwaze khosh	1	4	1	-
Darwaze Malak	4	1	1	-
Darwaze Kanhar	-	2	1	3
Howz –e-Karbas	4	1	-	1
Shahr-e-Naw	-	2	4	-
Number of retailers	9	10	7	4

4.3.5 Meat receipt by retailers

In On average, sixty percent of the retailers mentioned that they deliver the poultry meat from wholesalers' storage to their shop by motorcycle (Tricycle). (Figure 17)

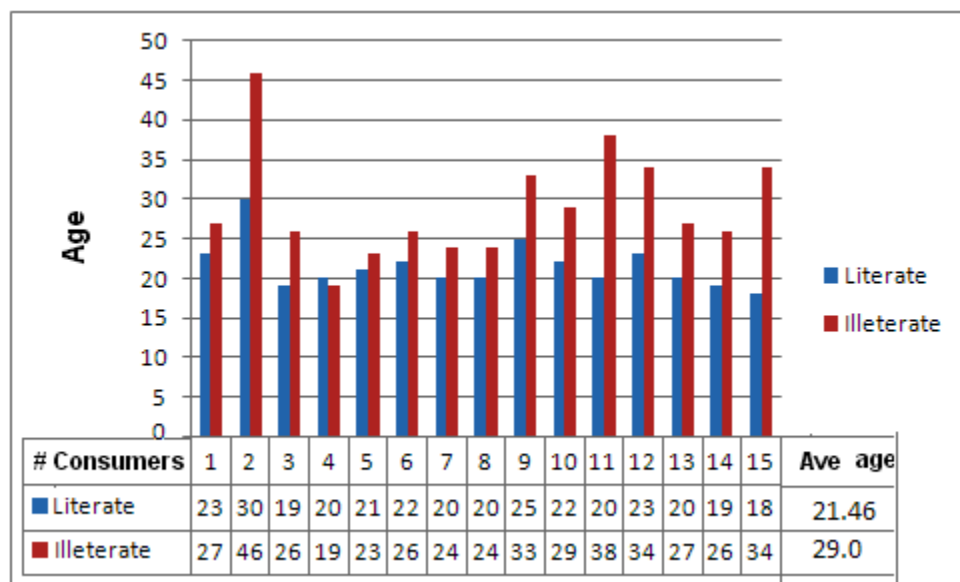
Figure 17 Meat delivering by the retailers



4.3.6 Consumers' background

The Figure 18 shows, the average age of the literate consumers is twenty one, and the average age of the illiterate consumers is twenty-nine years old.

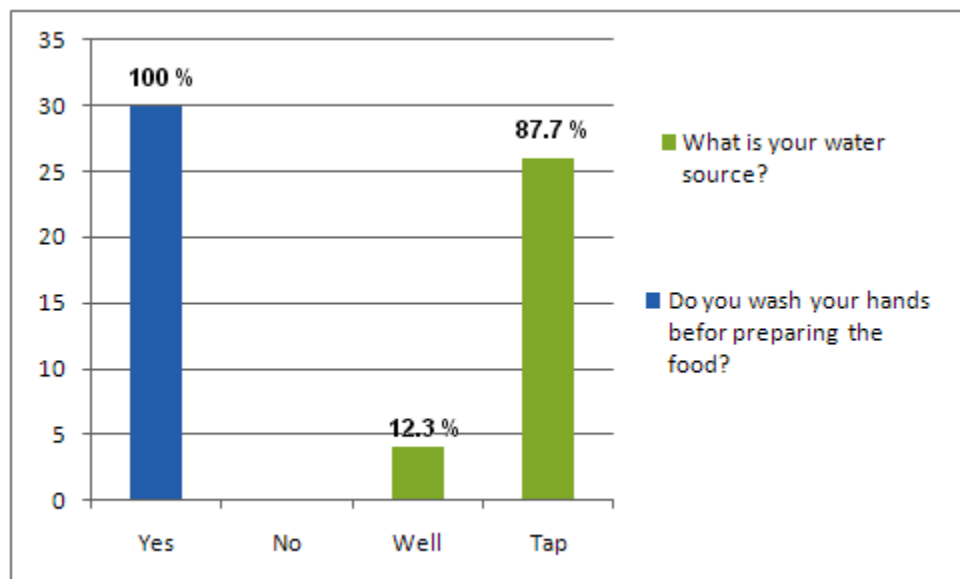
Figure 18 Average age of consumers



4.3.7 Consumers' food safety practices

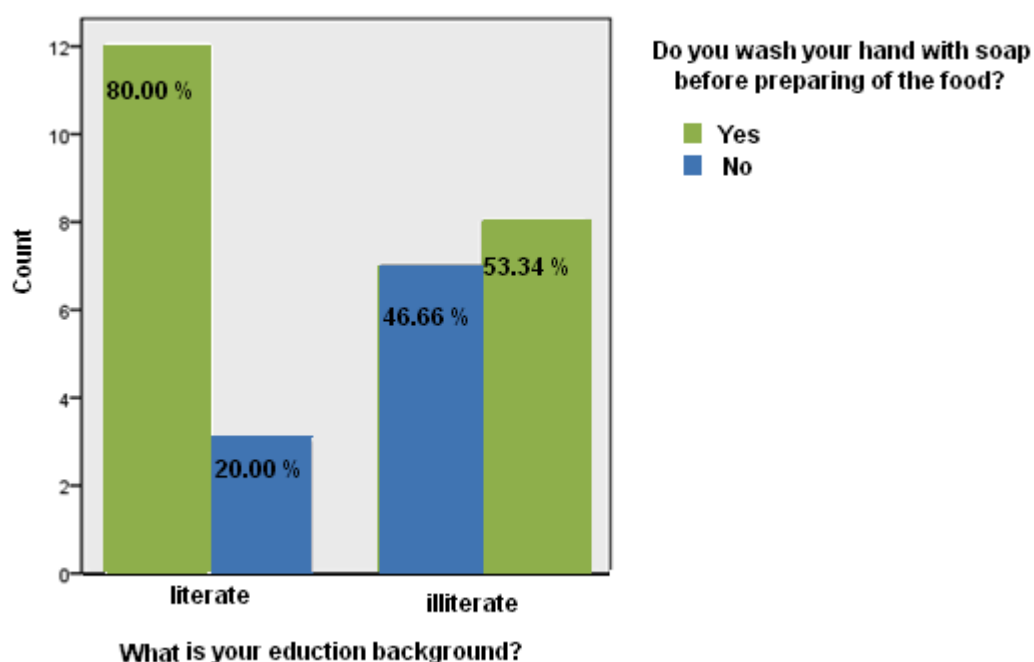
All of the consumers (literate & illiterate) are washing their hands before preparing food in the kitchen, and 88 percent use potable water sources from the tap, while only 12 percent use well water. (Figure 19)

Figure 19 Consumer use water source



The Figure 20 shows only twenty percent of the literate consumers are not using soap to wash their hands before preparing the food, while more than fifty percent of the illiterate consumers are not using soap to wash their hands before preparing of the food.

Figure 20 Hand washing with soap between literate and illiterate consumers



Only four of the illiterate consumers returned the cooked meats or other foodstuffs in the previous dish (plate) that came into contact with raw meat. (Table 12)

Table 12 Returning back cooked food in the dish contacted with raw meat

#	Question	Yes	No
1	Do you return cooked meats or other foodstuffs in the previous dish (plate) that contacted raw meat?	4 illiterate	26 literate and illiterate

4.4 Government (Food Safety Board) results

In Herat there is a Board of Food Safety comprised from different government bodies which are Herat Agriculture Directorate, Environmental Health Directorate and Market Arrangement Directorate of Municipality. The job certificates for commercial broiler farms are awarded by the Herat Agriculture Directorate, while the job certificates for poultry meat wholesalers and retailers are awarded by the Herat Market Arrangement Directorate of Municipality. It is regulated by the laws that slaughterhouses, wholesaler cooling storage facilities and retailers' shops and storage must construct under the design of the food safety members from the municipality.

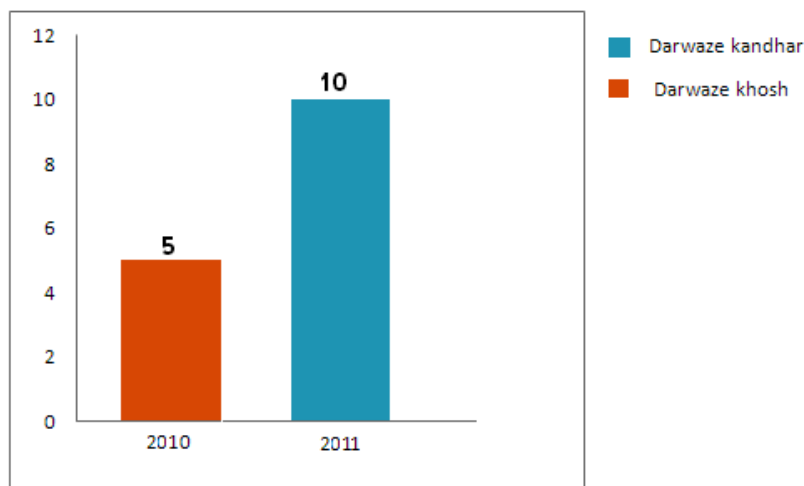
The Food Safety Board mentioned that the food safety risks associated with broiler production chain in Herat is the microbiological risk factors such as contamination of meats with *Salmonella*, *Campylobacter* and *E. coli*. The poor hygienic slaughtering, processes and post slaughtering procedures, in addition to improper distribution through wholesalers and retailers are defined as steps in the chain causing contamination of poultry meats with all mentioned pathogens that impact humans' health. In addition, we also concern about the feed imported without any examination for food safety issues and reliability of the labeling on feed that coming through Pakistan is not assure the ingredients in the feed and some suppliers are mixing the feed with extra materials that reduce the value of the feed. However, the Food Safety Board also indicated that concerning about the prevalence of the Highly Pathogenic Avian Influenza (HPAI) is threatening the public health as well as with the food safety problems in Herat because mostly small poultry houses are built in suburban areas of Herat city among the residential houses, and inappropriate farmers' bio-security actions predispose risk of HPAI outbreak in Herat.

The Food Safety Board's policy is to reduce and minimise these microbiological risks associated from poultry meat consumption to assure consumers receive safe meats. Moreover, the government wants to enhance public awareness about poultry meat safety through locally available media such as radio, TV, newspapers, etc.

However, The Food Safety Board mentioned the retailing point is an important stage for them rather than other steps, and they invest further activities in this step. In case of improper sanitation and poor hygiene conditions, the Food Safety Board gives recommendations as well as warnings for the first time offenses, and if it finds repeated offenses they close their shops for 72 hours as a punishment. On the third offence, the merchant's job certificate will be cancelled and they do not give them permission to continue this business in the future.

Figure 21 shows the number of the retailers' shops closed down for one week as penalties by the Arrangement Directorate of Municipality in 2010 and 2011 in two locations (10 in Darwaze Kandhar out of 22 and 5 Darwaze khosh out of 30) in Herat city. The majority of reasons for closing down these retailers' shops were selling chicken meat with other foodstuffs (fruits, vegetables), slaughtering live birds in front the shops, poor sanitation and hygiene of the shop, storage and workers.

Figure 21 Number of retailers' shops closed down in 2010 and 2011 by Municipality



Source: Municipality record keeping book

The actors of the broiler chain in Herat have to complete the following procedures in order to be certified by the government:

- Poultry farms must be constructed far away from residential houses – at least 20 kilometers outside of the city (the major point in construction mentioned about slaughterhouses, wholesalers' and retailers' buildings were floors and surfaces that could easily be cleaned and reduced microbiological risks).
- Poultry must be slaughtered in the slaughterhouses under the hygienic conditions with government inspections.
- Poultry houses, slaughterhouses, cooling storage facilities, wholesaler and retailers' shops are required to build their facilities under the design of the Food Safety Board.
- All the facility owners are required to apply hygiene practices in each step of the chain.
- The facility owners and workers across the poultry chain must have medical health certificates.

The factors influencing government (Food Safety Board) activities are:

- Low number of government personal employed
- Influence of some hierarchic government authorities and local warlords
- Broad food safety policy
- Inadequate contribution of some government bodies e.g. employees of Herat customs, police, etc.
- Discordance among the Food Safety Board members
- Inaccessibility of Food Safety Board to update knowledge regarding poultry meat safety practices
- Insecurity in the area
- Length of time for returning laboratory result of samples that have been sent to Kabul
- Privatization of the broiler commercial farms

4.5 Pre – harvest observation results

4.5.1 Observation of the broiler farm

#	Criteria	Requirements	Farm	Result
1	Feed	1. Rodents shouldn't have access to the feed 2. Wild birds & insects shouldn't have access to the feeding area. 3. Feed storage does not have dampness. 4. Feed supplied from a certified company. 5. There is no risk of cross contamination of feed with unhygienic materials.	A	Poor
			B	Good
			C	Fair
			D	Fair
			E	Good
2	Water	1. Water disinfected properly. 2. Animals and pests (rodents, cats, insects, and wild birds) shouldn't have access to the water source. 3. Water is changed every 12 hours. 4. Watering system to minimise the possibility of contamination with pathogens in low levels.	A	Fair
			B	Good
			C	Fair
			D	Fair
			E	Fair
3	Building	1. Constructed in a way that minimises access to rodents, birds, and other pests 2. Provides adequate space for chickens. 3. Lighting and ventilation is sufficient. 4. Surfaces are suitable for cleaning. 5. Footbath exists in entrance door of poultry houses.	A	Poor
			B	Good
			C	Fair
			D	Fair
			E	Fair
4	Facilities and equipment	1. Facilities and equipment are suitable in size, design, precision, and accuracy for their intended use. 2. All equipment is designed, constructed, and maintained to facilitate inspection and use of cleanout procedures.	A	Fair
			B	Fair
			C	Fair
			D	Good
			E	Fair
5	Personal hygiene	1. Farmers wear clean clothes and shoes. 2. Farmers wash their hands with soap before entering the poultry house and feeding the chickens. 3. Farmers take a shower at least once per week.	A	Fair
			B	Good
			C	Good
			D	Fair
			E	Fair

Depends on severity, importance of the required element and missing one or two or all of elements three point scale measurements (poor, fair, good) are used for justification of the observation.

Figure 22 Observation of the broiler farm



1) Feed source of th farm



2) Water supplying systme for broiler farm from the well



3) Flaming of the farm with gas after each cycle of production for disease control



4) Shows used for entering to poultry house



5) Good storage of the broiler feed



6) One day old chicks produced in Herat



7) Broiler farm



8) Crates for transportation of birds



9) Birds ready for transportation to the slaughterhouse



10) Feed storage of the farm



11) Broiler farmer



12) Researcher in one of the broiler farm in the Enjil district of Herat

Source: Compiled from observation

4.6 Harvesting observation results

4.6.1 Observation of the poultry slaughterhouse

#	Criteria	Requirements	Safid Par Taraki	Tiyorani Ayoubi
1	Chicken inspection	1. Birds should be inspected for diseases by an expert before slaughtering. ¹²	Fair	Fair
2	Time of slaughtering	1. Slaughtering at night and early in the morning reduces the risk of microbiological contamination.	Good	Good
3	Bleeding time	1. Two minutes bleeding time is necessary for de-feathering.	Good	Good
4	Building conditions	1. Buildings should be constructed in ways that minimize access by rodents, birds, and other pests. 2. Provide adequate space for workers. 4. Surfaces are suitable for cleaning.	Good	Good
5	Facilities and equipment	1. Facilities and equipment are suitable in size, design, precision, and accuracy for their intended uses and possibility of contamination is very low.	Fair	Fair
6	Water	Water should be disinfected for carcasses as well as for washing the surfaces and personal use.	Fair	Fair
7	Slaughterhouse workers	1. Workers are using protected clothes (gloves, mask, and shoes) during the slaughtering and washing hands with soapy water before slaughtering. 2. Workers are not eating, drinking or chewing gum during the slaughtering.	Fair	Fair
8	Surfaces	1. All the surfaces must be clean with enough water and disinfected before and after slaughtering.	Fair	Good
9	Waste management	1. Waste should be managed in such ways to minimise risks of cross contamination in a minimum level.	Poor	Fair

Depends on implementation, weak implementation or non-implementation of the above requirements in slaughterhouse three point scale measurements (poor. fair. good) are used for justification of the observation.

¹² Inspection done by an experienced worker with the external symptoms, however the veterinarian were present there but he was not inspecting the birds

Figure 23 Observation of the slaughterhouse



1) Worker without protective clothes at the recieval of birds



2) One worker is using mask during the hanging of the birds and the other one is not using the mask



3) Good transportation of birds in the different parts in slaughterhouse



4) Workers are using local scarf and are not wearing the mask



5) Carcass fall down to the ground during slaughtering



6) Workers are using the local caps during the slaughtering



6) Improper evisceration



7) Workers working without the gloves contacted with carcass



8) Workers are not covering the hairs



9) Properly tasks responsibility



10) Chilling of the carcass with ice



11) Rusted tube is using for chilling of the carcass

Source: Compiled from observation

4.7 Post – harvest observation results

4.7. 1 Observation of the poultry meat wholesalers

#	Criteria	Requirements	A	B	C	D
1	Meat selling status	Meat should be handled with gloves and stored in a refrigerator or freezer (depends on frozen or non-frozen meat).	Fair	Fair	Fair	Good
2	Shop condition	Shops should be equipped with refrigeration and cleaning facilities, all the shop surfaces must be easy to clean.	Good	Good	Fair	Good
3	Personal hygiene of seller	Sellers should observe following principals: -Wearing clean clothes and gloves during chicken meat handling and adequate hair restraints. - Fingernails are short and clean - Hands should be washed properly, frequently, and at appropriate times.	Fair	Fair	Fair	Good
4	Equipment	Equipment in contact with meat should be cleaned properly and disinfect.	Fair	Good	Fair	Good

Four wholesaler (A, B, C and D) observed and depends on weak implementation or non-implementation of the above requirements in wholesalers' shops three point scale measurements (poor. fair. good) are used for justification of the observation.

4.9.5 Observation of retailers

With regards to criteria and requirements for the retailers' observation; meat selling status observed 33 percent poor, 47 fair and 20 percent good. Shop conditions observed 30 percent poor, 57 percent fair and 13 percent good. Personal hygiene observed 40 percent poor, 27 percent fair and 33 percent good. Equipment observed 33 percent poor, 53 percent fair and 13 percent good. (Figure 24)

Figure 24 Retailers observation result

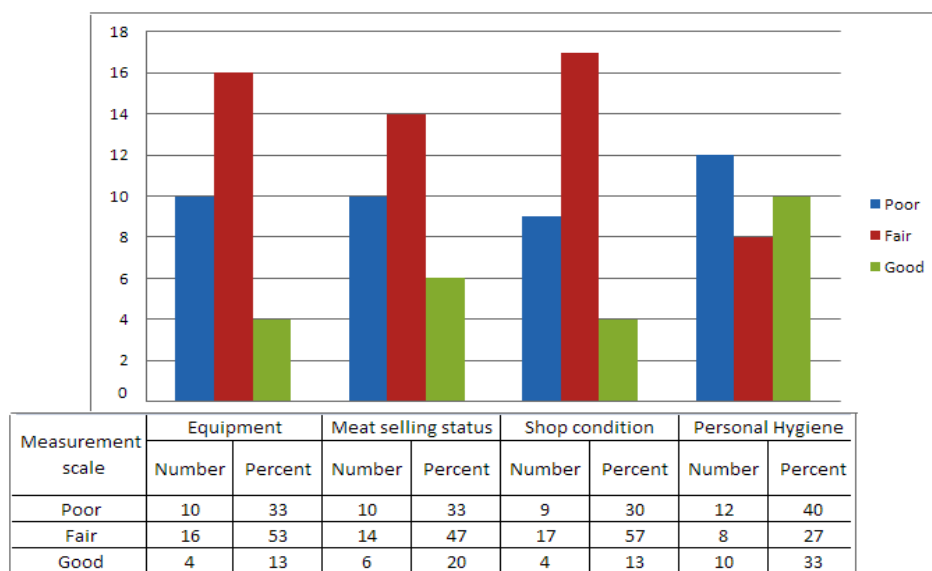


Figure 25 Observation of the wholesalers and retailers



1) Wholesaler is selling the meat to the one of the retailers



2) Tiyoran Ayoubi wholesaler shop



3) Safid Par Taraki wholesaler shop



4) Cooling storage of one of the wholesaler



5) Automatic cooling storage of one of the wholesaler



6) Loader with cooling facilities used for poultry meat transportation



7) A good hygienic retailer



8) Good meat selling status of one retailer



9) Good meat selling status of one of the supermarket



10) Poor meat selling status



11) Poor meat selling status



12) Poor meat selling status

Source: Compiled from observation

4.8 Overall Observation results

Actors		Poor = +	Fair = ++	Good = +++	Result
Farm	A	+++	++++		7
	B		++	+++++	14
	C		+++++	+++	11
	D		+++++	+++	11
	E		+++++	+++	11
Slaughterhouse	Safid Par Taraki	+	+++++	+++++	20
	Tiyorani Ayoubi		+++++	+++++ +++++	23
Wholesaler	A		+++++	+++	9
	B		++++	+++++	10
	C		+++++		8
	D			+++++	12
Retailer	30 retailers ¹³	+++++ +++++ +++++ +++++ +++++ +	+++++ +++++ +++++ +++++ +++++ +++++	+++++ +++++ +++++	120

¹³ The retailers' observation counted for 30 persons according the number of poor, fair and good measurement scale in the figure 24

4.9 Risk Assessment

Risk assessment tool was used to address the potential hazards may occur at three stages (Pre – harvest, Harvesting and Post – harvest) of the broiler vertical chain in Herat. The different Colour with roman letter was used to show the level of the risk of these hazards in order to conclude which once are the potential hazards. However, the moderate risk and high risk considered as the potential hazards threatening Herat poultry meat consumers based on case studies, surveys and interview results especially on observation and researcher experience.

Table 13 Pre – harvest risk assessment

Stage	Common hazards & Sources or Causes	Risk Assessment		
		S	F	S*F
Pre – harvest	Biological 1: <i>Salmonella</i> bacteria such as <i>S.enteritidis</i> , <i>S.typhimurium</i> , <i>S.virchow</i> and <i>Campylobacters</i> like <i>C.jejuni</i> and <i>C.coli</i> . Source or Causes: One day old chicks and fertilized eggs imported from Pakistan or Iran	3	2	IV
	Biological 2: Pathogenic bacteria such as <i>Salmonella spp</i> and <i>E.coli</i> Source or Causes: Supplying water from the well for the birds without disinfection	2	2	IV
	Biological 3: Pathogenic bacteria such as <i>Salmonella spp</i> and <i>Campylobacter spp</i> Source or Causes: High prevalence of diarrhea among the flocks without the clinical signs	2	2	IV
	Biological 4: Pathogenic bacteria and <i>Mycotoxins</i> such as <i>Aflatoxins</i> , <i>Orcharatoxins</i> , <i>Trichothecenes</i> , <i>Zearalenone</i> and <i>Fumonisin</i> Source or Causes: Due to access of pests such as rodents to feed storage and improper storage of the feed	2	1	II
	Chemical 1: Pesticides and drug residues Source or Causes: Feed imported from Pakistan or Iran from without any traceability about level of pesticides residue in it. Administration of the antibiotics by farmers	3	3	IV

Table 14 Harvesting risk assessment

Stage	Common hazards & Sources or Causes	Risk Assessment		
		S	F	S*F
Harvesting	Biological 1: Pathogenic bacteria Source or Causes: Slaughtering of the poultry in open space at the retailers shop or at home under poor hygiene conditions	3	2	IV
	Biological 2: Pathogenic bacteria such as <i>Salmonella spp</i> and <i>Campylobacter spp</i> and etc. Source or Causes: None inspection of the birds before slaughtering at the receival point of slaughterhouse by an expert for disease concerns	3	2	IV
	Biological 3: Pathogenic bacteria such as <i>Salmonella spp</i> and <i>Campylobacter spp</i> and etc. Source or Causes: Improper evisceration of the carcass by hands at the slaughterhouse	3	2	IV
	Biological 4: Pathogenic bacteria such as <i>Salmonella spp</i> and <i>E.coli</i> Source or Causes: Using water from the well at the slaughterhouse	2	2	IV
	Biological 5: Pathogenic bacteria Causes: Carcass chilling with ice in rusted tube at the slaughterhouse	3	3	IV
	Biological 6: Pathogenic bacteria Source or Causes: Inadequate management of slaughtering procedure with poor hygienic practices at the slaughterhouse	3	3	IV

Table 15 Post – harvest risk assessment

Stage	Common hazards & Sources or Causes	Risk Assessment		
		S	F	S*F
Post – harvest	Biological 1: Pathogenic bacteria such as <i>Salmonella spp</i> and <i>Campylobacter spp</i> and etc. Source or Causes: None wearing protective clothes by workers during the handling of meat to the wholesalers and selling of poultry meat by retailers especially who that sells poultry meat with the eggs and live birds	3	3	IV
	Biological 2: Pathogenic bacteria such as <i>Salmonella spp</i> and <i>Campylobacter spp</i> and etc. Source or Causes: Transportation of the poultry meat in hot weather without cooling facilities by tricycle and car with the retailers	3	3	IV
	Biological 3: Pathogenic bacteria Source or Causes: Poor hygiene practices at home due to not adhering of the consumers to wash their hands with soap before preparing of the food	3	2	IV
	Chemical 4: Fertilizer Source or Causes: Transportation of the poultry meat with the tricycle which is normally used for transportation of the fertilizer.	2	1	II

	1	2	3	
1	I	II	III	Frequency
2	II	III	IV	
3	III	IV	IV	
	Severity			

I = No risk	II = Low risk	III = Moderate risk	IV = High risk
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Stages in the vertical chain	#	Type of hazards	Risk level	
Pre – harvest potential hazards	1	Biological 1	IV	High risk
	2	Biological 2	IV	High risk
	3	Biological 3	IV	High risk
	4	Biological 4	II	Low risk
	5	Chemical 1	IV	High risk
Harvesting potential hazards	1	Biological 1	IV	High risk
	2	Biological 2	IV	High risk
	3	Biological 3	IV	High risk
	4	Biological 4	IV	High risk
	5	Biological 5	IV	High risk
	6	Biological 6	IV	High risk
Post – harvest potential hazards	1	Biological 1	IV	High risk
	2	Biological 2	IV	High risk
	3	Biological 3	IV	High risk
	4	Chemical 1	II	Low risk

Based on the risk assessment concluded that 4 potential hazards exist in the pre – harvest stage at the poultry farm, 6 potential hazards in the harvesting stage at the slaughterhouse and 3 potential hazards at the post – harvest stage from wholesaling, retailing and consuming stage in this study. In addition, the risk of foodborne diseases due to biological hazard number 4 at the farm level in pre – harvest stage and chemical hazard at the post-harvest stage is low.

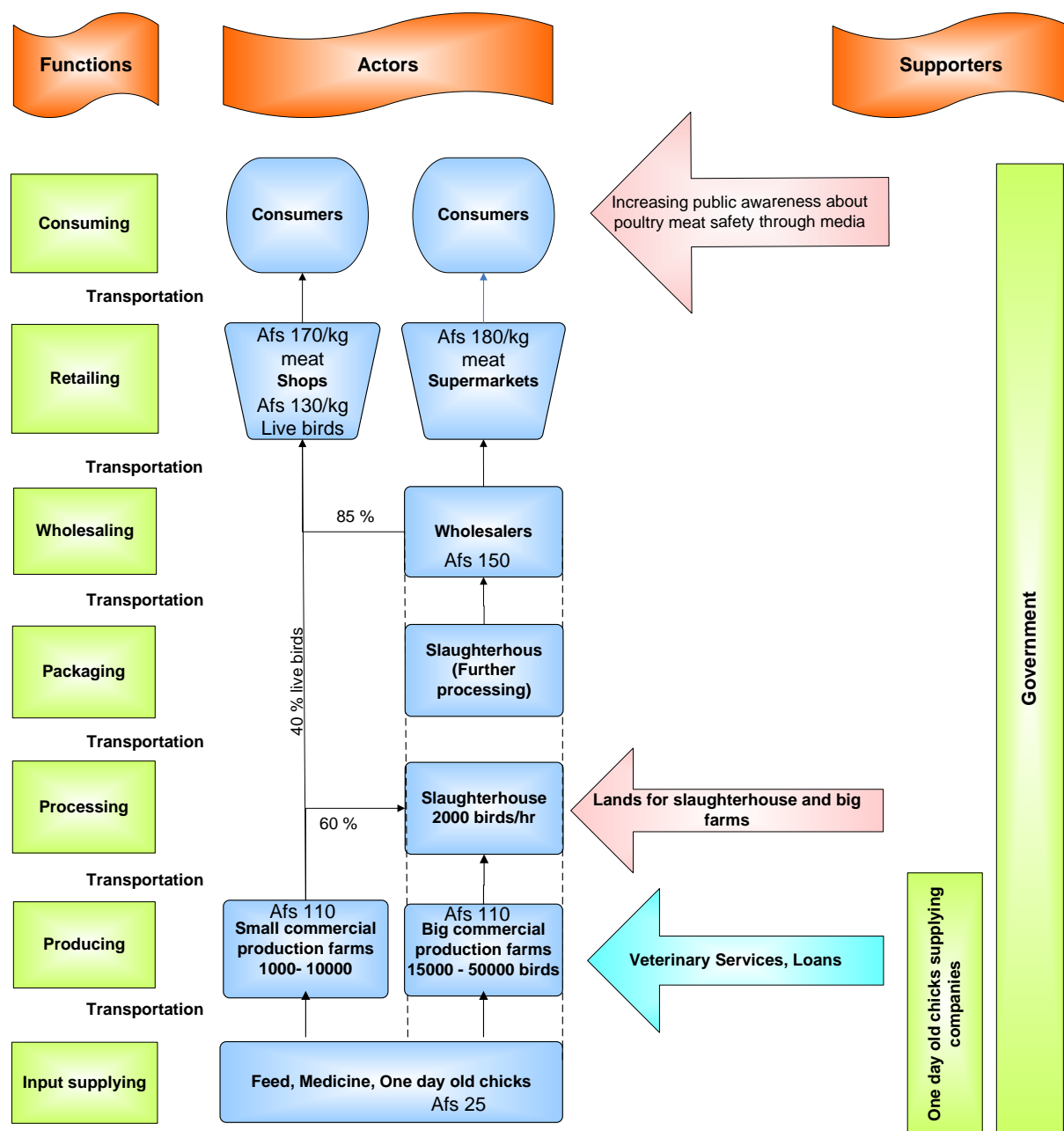
4.10 Structure of Herat broiler chain, role of actors and supports of the chain

As is reflected in Figure 26, Herat broiler vertical chain consists of the following actors and supporters:

1. **Input suppliers:** are stakeholders who have a role of actor and supporter in Herat broiler chain, they import feed, vaccines, veterinary medicine for poultry and produce one day old chicks¹⁴ or they import one day old chicks from Pakistan or Iran.
2. **The stakeholders:** are input suppliers, producers (broiler farmers), processors (slaughterhouse owners), wholesalers, retailers and consumers. Feed and one day old chick companies and government are supporters of the Herat broiler chain.
3. **Producers:** Big commercial farmers as well as small commercial farmers keep the broiler chickens in suburbs of Herat city. Big farmers are rearing 15000 - 50000 birds and small farmers are rearing 1000 – 10000 birds in each cycle of production. Big farmers deliver their poultry meat after processing to their own wholesale shops in Herat city. Small farmers sell their birds directly as live bird to the retailers in the market or to the slaughterhouse.
4. **Processing:** There are 2 slaughterhouses in Herat broiler chain which is owned by big farmers and processing Herat poultry meat products. These slaughterhouses are located 20 – 30 kilometers out of the city in suburbs of the city in Enjil District. In every week, at least 6000 numbers of birds are slaughtered by each slaughterhouse.
5. **Packaging:** is one component of the slaughterhouse and poultry meat. After slaughtering, the meat is chilled and packaged as a whole or as different cuts, and delivered by the cooling loaders to the wholesalers' shops in the city.
6. **Wholesalers:** in Herat, wholesalers of the poultry meat are the big farmers who have their own shops in the city and sell the products to the retailers' shops in the city.
7. **Retailers:** Mostly retailers of poultry meat located in the city and they sell poultry meat of the Herat products, live birds and frozen imported poultry meat in Herat.
8. **Consumers:** They are the last actors in Herat broiler chain and buy the poultry meat and live birds from retailers' shops.
9. **Supports:** Feed and one day old suppliers are the Herat broiler chain supporters which provide veterinary services for farmers. Government as a supporter provides cheap land out of the city for farmers to establish the farm and slaughterhouses, make rules and regulation for the different chain actors, monitor performance of the actors, check and examine the imported frozen poultry meat, give medical health certificate for retailers and pass public health message in regards to poultry meat safety through in order to enhance public awareness about poultry meat safety.

¹⁴ Eggs for production of one day old chicks in Herat import from Pakistan

Figure 26 Herat broiler chain



Source: Compiled from field research

CHAPTER 5 DISCUSSION

5.1 Pre – harvest discussion

5.1.1 Background information of the farmers

The result shows that middle aged farmers who have a primary, secondary or college level of education are more likely to be involved in broiler production in Herat, which could be attributed to their level of education and experience to invest in such commercial broiler production as a new livestock enterprise. The study result has been addressed that uneducated farmers who have never been to school have small sized flocks (1000 – 5000) and (1–2) cycles of production per year while the educated farmers have large sized flocks with more than three cycles of production per year. (Table 9 Farmers' background in Chapter Three)

Furthermore, involvement of educated farmers is a positive and significant trend towards the improvement of food safety at the farm level. The implication is that educated and experienced farmers have the capacity to learn and willingness to adopt food safety improvements at the farm level. However, for successful HACCP implementation, particularly in small and medium sized enterprises, awareness, level of education and training are the factors needed to overcome the barriers. (Report of Meat Regulatory and Inspection Review)

The study results revealed that the sources of one-day old chicks to Herat broilers commercial farms are from Iran or Pakistan. Even, the fertilized eggs for one - day old chicks for Herats' hatcheries import from Iran or Pakistan that shows the dependency of Herat broiler production on neighboring countries. However, import of one day old chicks inevitably happens but it should consider that in import of the chicks from unknown source transparency is significant for food safety issues because it indirectly threatens consumers' health. In a microbiological assessment on day-old chicks supplied to Maiduguri, North-Eastern Nigeria revealed *E. coli* and *Staphylococcus spp* as the common bacteria encountered from the navels and cloacal swabs of the chicks. (Y.A. Geidam, U.I. Ibrahim, M.M. Bukar, H.I. Gambo and O. Ojo 2007)

Although HPAI is not considered a direct cause for foodborne diseases, it is indirectly a threat to the actors' health along the supply chain. However, it is considered as an important issue concerning humans' health by the food safety board in Herat due to the location of poultry farms, in residential areas and the backyard poultry that kept by women in every village of Herat. So, if one-day old chicks are supplied from a contaminated source with HPAI, the study suggests that there is a high possibility of a prevalence of HPAI. Furthermore, the prevalence of H5N1 HPAI reported in 2006 in a sample of chickens in Afghanistan (in 4 provinces Kabul, Logar, Nangarhar and Kapisa which are close to Pakistan) with the same serotype has also been detected in Pakistan. (FAO, 2006)

5.1.2 Pre- harvest practices

The importance of pre-harvest practices towards reducing microbiological risk factors posed from farm level to poultry meat is biosecurity¹⁵ at the poultry farm. Supplying safe feed and water for the poultry are the significant components of biosecurity at the farm level.

The case studies and observations show that in the case of availability of safe feed for poultry, uncertainty exists because a majority of the farmers bought feed from one day old chick suppliers that imported either from Iran or Pakistan without any examination for the level of pesticide residue. Additionally, the labeling is not assuring the traceability of the feed and if it is free from pesticide residue. It may be due to the fact that there is not any modern

¹⁵ Biosecurity is a set of practices designed to prevent spread of disease at the poultry farm.

laboratory to examine the feed or that there are inadequate government efforts for strict rules on importing of feed. Thus, without any examination of the feed or tracking it, it is difficult to judge feed which are imported from Iran or Pakistan if it is free from the pesticide residues.

Despite the fact that chlorination of water is banned in European countries for animal and humans, it is a common practice in developing countries. However, the study results suggest that four of the farmers for disease prevention among the birds by water used to chlorinate the water, which shows the awareness of the farmers about the role of contaminated water in transmission of pathogens to poultry, but not as a result concerning food safety. However, apart from the chlorine residue in water, chlorination at the processing level has positive impact on reducing food borne diseases due to infections may release by bacteria such as *E. coli* and *Cholera* but chlorination of water in at the farm level must be aware about the amount of chlorine for water treatment; the maximum chlorine could be supply to the water is 1 milligram per liter (mg/l), if it is higher than 1 milligram per liter it is a risk due to high residue level of chlorine in poultry meat for consumers. (Cooperative Extension Service, Drinking Water Quality for Poultry, 2007)

Although the case study result showed a majority of the farmers have basic hygienic practices in place at the poultry farm for biosecurity purposes, (Table 9 in Chapter Three) the study result has shown that farmers are suffering from a high prevalence of diarrhea and bronchitis at the poultry farm (Figure 13 in Chapter Three). This may be due to the improper or inadequate hygienic practices like giving the dead birds to wild animals, improperly storing feed or omitting footbaths at the entering point of poultry house, as observed by the researcher during the field data collection. Further, the prevalence of diarrhea at the broiler farm indicated by farmers as well as by food safety board, is a contributing risk towards foodborne diseases through poultry meat consumption because *Salmonella spp* is the most common reason of diarrhea at the poultry farm. Many of the birds do not show the clinical signs of being infection before slaughtering, thus it is suggested that it can be a source for outbreak of salmonella food poisoning in Herat, and chemical risks due to drug residue administered to the sick birds by the farmer without the veterinarian prescription can contribute for the issue as well as.

It is good to notice that farmers prevent visitors in the poultry house, which is not only related to the awareness of farmers about the biosecurity at the farm level, but it is also due to the belief of a majority of the farmers of the “evil eye” of the visitors that may affect their growth of birds or cause a disease outbreak among the flock. It seems to be a good trend towards prevention of disease due to visitors in the poultry house. Another good practice towards food safety improvement at the farm level is the contract between the farmers and workers that they hire. They often hire experienced people who have been working many years in a poultry house during refugee life, and they are not allowed to break the contract until one cycle of the production is finished. This is because the farmers are concerned that introducing a new worker between the cycles of production can increase the chances for transmission of the disease by new workers to the poultry flock.

5.3 Harvesting discussions

Hygienic slaughtering and dressing of the poultry is very important, not only in terms of the food safety of meat but also concerning the health of the workers at the slaughterhouse. Slaughtering of poultry at the retailer's shop is banned by the government but still some of the farmers that prefer to sell live birds directly to the market may be due to charge a fee for the slaughtering service or customers demand for live birds. Thus it leads retailers or consumers to slaughter poultry at the shop or at the home in unhygienic conditions that may cause food borne diseases for them.

However, establishment of standard poultry slaughterhouses in Herat seems to be a positive trend towards food safety improvement in the harvesting stage along the broiler vertical chain and it will reduce the number of foodborne diseases in Herat as well as the economic cost for treatment of foodborne disease. The slaughtering of poultry in open spaces accounts for the majority of the foodborne disease due to unhygienic conditions. The Tehran mayor in an interview with Hamshari news in 2010 stated that the cost of food poisoning due to consumption of chickens killed in open space in Iran is estimated 400 million Rials yearly.¹⁶

The two slaughterhouses responded they have some food safety practices such as cleaning and disinfecting of the slaughterhouse, inspection of the live birds before and during slaughtering by experienced worker, using basic protective clothes, observing basic personal hygiene, chilling the carcass after slaughtering and transporting with cooling loader but the result of research observations shows that these practices are not in line with the requirements of Good Manufacturing Practices (GMPs) for poultry slaughterhouses. GMPs require 13 control points for harvesting stage (processing in slaughterhouse) at poultry slaughterhouse (Annex: Table 4 GMPs poultry slaughterhouse). The observation result highlights some control points as steps that are important issues towards poultry meat safety and thereby optimization for prevention of foodborne disease in Herat. The receiving of live birds, evisceration, carcass cleaning, carcass chilling and the general hygiene respectively are the control points in this study.

Receiving of live birds requires that poultry should be inspected by an expert for disease concerns. The observation result showed that none of the birds were inspected for disease concerns while the veterinarian was present at the Ayoubi slaughterhouse. It may be due to the personal attitude of the inspector who does not want to perform according to his responsibility.¹⁷ However, according to the HACCP quality system, this step is considered as a part of the critical control points (CCPs) in prevention of the disease at the slaughterhouse.

Evisceration of the poultry done in an improper manner by hands and offal is not inspected. However, the standard criteria compliance is needed; it can be suggested here that this practice leads to a high likelihood of cross contamination of all subsequent meat carcasses because of the less attention by workers to perform well. This might be due to a low level of knowledge of the workers even if he has worked in the same field for many years.

Washing of the carcasses after the evisceration step follows in both slaughterhouses, but this water is not guaranteed to be clean because the source of the water is from the well. Moreover, the chlorinated water cannot remove *Salmonella* from the skin of carcass. It shows that washing of the carcass in both slaughterhouses cannot prove the declining of the *Salmonella* bacteria from carcass (Zohari, 2005)

¹⁶ It was something surprised the author that was not expected, also it should be mentioned 400 million Rial is equal to \$ 370000 (The exact time is forgotten)

¹⁷ He informally mentioned to the researcher that he is not satisfy with the government performance evaluation mark, that is why he is disappointed and is not interested to work properly according to his responsibility.

Chilling the carcass after slaughtering has a positive impact toward prevention of the bacterial multiplication. Both slaughterhouses consider this issue by chilling the carcass with ice in the water. It extremely surprised the researcher that after heating the carcass in boiling water, it was then again returned to the water which is absolutely not safe for chilling, outgrowth of pathogenic bacteria in the meat because the source of the ice is not clear, and the tube which is used for chilling was rusted and is not recommended for use. This could pose potential food safety risks to the poultry meat at the end of the slaughtering procedure, which is normally expected to be safe at this step. In addition, this may be possibly due to unavailability or inaccessibility of the slaughterhouse owners to better facilities for carcass chilling because both of the slaughterhouse owners are aware of food safety issues and have a good educational background (secondary and college level).

In terms of general hygiene, the observation that slaughterhouse workers, although wearing protective clothes, have some components of the clothing that are missing such as gloves and masks. That leads to an increase in the possibility of pathogen transmission through humans to the poultry meat and thereby threatens the health of consumers. Less attention during the slaughtering procedure is observed especially with contact of the carcass with floor of the slaughterhouse (Figure 23). This failure is attributed to the inadequate management of the slaughterhouse owners along the line of slaughtering and training of the workers; however, the low level of knowledge of the workers may contribute to causes of this incident. Adoption of good hygienic practices based on the HACCP quality system with continuous monitoring of slaughterhouse manager and government helps to reduce the above negative points observed by researcher.

5.4 Post - harvest discussions

The post-harvest practices along the broiler vertical chain refer to wholesalers, retailers and consumers practices. However, the result shows for meat safety purposes that wholesalers and retailers have admitted to using cooling facilities such as cold storage and refrigerators with an appropriate time and temperature. (Refer to table 12 and Footnote 15 in Chapter 3)

Personal hygiene and proper handling of the poultry meat has a broad impact on the safety of the meat for consumers. Not wearing gloves and protective clothes by workers during the handling of poultry meat by wholesalers and retailers, complicates the aim to assure consumers' meat is safe for them, especially with the retailers who sell poultry meat as well as live birds due to the huge amount of bacteria on surface of the live bird. This kind of poultry meat is capable of posing a high risk of pathogens for consumers due to buying contaminated meat from these retailers.

Regulating the use of gloves in retailing points without observing proper hygiene cannot prove that the meat is safe and secure for the consumers, due to the fact that gloves can be a source of contamination. If it is the case, retailers must follow certain rules for using gloves such as cleaning hands properly before putting on gloves, changing and disposing the used gloves regularly and if gloves are used for certain duties such as cleaning, handling raw food, waste or money, they must always be disposed of before starting another activity, which seems to be far away in Afghanistan's situation.

Also, closing down these retailers' shops by the food safety board is not a good option. Possible ways to overcome and minimise the risk from this source could be separating the live birds retailers from the poultry meat retailers and centering them in a special place in Herat city that keeps the chain working and as well as provides for the needs of consumers who prefer to buy live birds. Further, providing trainings for retailers and continuously doing surveillance and monitoring by the government and increasing the public awareness about proper hygiene during the slaughtering at home is required to fulfill this objective. This option has its own risk such as foodborne disease due to contact with live birds or risk of HPAI prevalence.

The study revealed that all of the wholesalers are transporting the poultry meat by refrigerated car while 60 percent of retailers are transporting poultry meat with tricycle and 17 percent with car without the cooling facilities. It may not be a problem during a cold winter but with consideration to the Herat climate especially in summer season of Herat, the temperature is between 33 and 40 °C. This is a big risk towards consumers' health because optimum temperature for bacteria colonisation, such as *Salmonella spp* and *Campylobacter spp*, is associated between 35 to 42 °C and they can grow very fast in such kinds of situations. Moreover, the problem could be doubled when the retailers are using the same tricycle which is usually used to deliver fertilizer in Darwaze Khosh in Herat because if a failure occurs in proper handling, such as tearing of the cartons, poultry meat may come in contact with the fertilizer that may be remaining on the surface of the tricycle.

The survey results among the literate and illiterate consumers shows the level of not adhering to using soap for washing hands before preparing of the food is respectively 20 and 46 percent. Thus, education is seen as a key factor in improving food safety practices in the home. However, in terms of returning the food and other foodstuffs on the previous plate contacted with raw poultry meat, all the literate women responded **No** and from illiterate women only four women responded **Yes** showing that even among the illiterate women, maybe due to experience, have practice in avoiding contamination of the food or other foodstuffs with raw meat.

Moreover access of over eighty-six percent of the consumer to healthy potable water in Herat city and its suburban is a positive point in prevention of pathogens may transmitted to the food due to inaccessibility of clean water and thereby foodborne diseases among the consumers.

Nevertheless, the consumers' practices cannot grantee that food safety at home by consumers because there are more rules and procedure must be follow at home to minimise food safety risks such as separation of the cooked food (ready to eat) from uncooked foods, well cooking of the foods and proper cleaning practices e.g. washing hands with soap before and after preparation of the food, proper cleaning of the kitchen, cutting boards and utensils with a mild bleach.

The risk of microbiological pathogens from the production until retailing would be managed, as there are still cases of the foodborne disease in Herat hospital due to poultry meat consumption, it suggests that consumers are not able to fully manage the risk of the pathogens and there is always chance for foodborne disease prevalence due to poor hygienic practices by consumers

5.5 Food safety board discussion

Existence of the food safety board from the different government bodies which make regulations for different chain actors in Herat attributed the Herat authorities' willingness for improving food safety and concerns regarding consumers' health.

Although the food safety board indicates the HPAI as the major concern among poultry sector threats to the public health, it is not associated yet in Herat. The data available in Herat hospital shows the foodborne disease is due to consumption of unsafe foods cooked at home or at the market by the restaurants. Moreover, the food safety board expressed their concerns regarding the feed which are coming from Pakistan and is not trustable. It may be an option to encourage the traders to invest for establishing a feed supply manufacturing company for the poultry farms in Herat because the raw inputs for poultry feed is available in Afghanistan.

However, other practices by food safety board regarding safe meat production and distribution along the broiler chain in Herat contributed to the development of food safety like monitoring of the poultry retailers' shop, personal hygiene, slaughterhouse monitoring, and distribution of job certificates for poultry meat actors from the farm to the retailers, but their efforts are mainly concentrated at the retailing point while the food safety standards are required attention from the farm to end consumers. Closing down of the retailers' shops due to lack of food safety practices by the food safety board can push retailers to better performance temporarily, while providing training for the retailers would be a better option as discussed before to enhance food safety.

The interview with the government food safety board revealed that there are some factors influencing their activities that possibly give limitation towards food safety implementation, especially influencing some hierarchical authorities in Herat. For instance one of the food safety board members in an interview stated:

"When there is a problem regarding poultry safety, we want to perform according to the food safety policies but unfortunately some of the government officials influence and flout the procedures. The best example is company (A) that we realised that its meat was not meeting the requirements of food safety. Although we did not allow the company to distribute the meat in Herat city, we received many orders from top level officials in the ministry to clear the meat for distribution in Afghanistan."

Thus, it means existence of a food board safety cannot be a measure as an indicator for improvement of food safety. It needs sufficient staff training and support of the government and as well as from the other chain actors to achieve the goal of food safety.

CHAPTER 6 CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

This study assessed the practices of each actor in contribution to the food safety improvement in the Herat broiler sub sector from an inclusive vertical chain perspective. Moreover, it figures out a number of the microbiological and chemical risk factors as the potential hazards in the Herat broiler sub sector.

With regards to the food safety issues, the study revealed the following practices in contribution to the food safety issues in the Herat broiler sub sector which includes;

1. Pre – harvest practices namely; (1) keeping poultry farm and birds protect from pests, (2) disinfection and cleaning of the poultry house and equipment in each cycle of production, (3) transportation of live birds in standard crate (4) disinfection of the vehicles' wheels at the entry site of the farm (5) prohibition of visitors from the poultry house, (6) chlorination of the water at the farm, (7) protection of feeds from pests, (8) vaccination and treatment of the sick birds, (9) and basic personal hygiene e.g. washing hands before feeding of the poultry and entering to the poultry house

2. Harvesting practices namely; (1) cleaning and disinfecting of the slaughterhouse, (2) inspection of the live birds before and during slaughtering by the experienced worker, (3) using basic protective clothes, (4) observing personal hygiene, (5) chilling the carcass after slaughtering and transporting with cooling loader to the wholesalers' distribution point.

3. Post – harvest practices namely; (1) using cold storage and refrigerators with an appropriate time and temperature by poultry meat wholesalers and retailers (2) cleaning of the poultry meat storage by poultry meat wholesalers in every months or 10 days (3) washing hands by all of the consumers (literate & illiterate) and using soap by over fifty percent of the literate consumers before preparing of the food (4) protection of other foodstuffs from contact with raw poultry meat by majority of the consumers (5) using the tap potable water by wholesalers, retailers and consumers.

Apart from those practices in contribution to the food safety issues, a number of microbiological factors e.g. bacteria *Salmonella* and *Campylobacter spp*, fungi toxins e.g. *Mycotoxins*, chemical factors e.g. pesticides residues and drugs residues in poultry meat identified as the potential hazards in the Herat broiler sub sector.

The major factors or sources contributed to expose of these potential hazards includes;

(1) Import of one day old chicks, fertilized eggs and feed from unknown sources from Pakistan or Iran, supplying water from the well, improper feed storage, giving the dead birds to wild animals, high prevalence of the diarrhea, missing of the foot baths in the poultry farms in the pre – harvest stage in the Herat broiler sub sector.

(2) Poor slaughtering management in slaughterhouse in combination with poor processing procedures in the receiving of live birds, evisceration, washing of the carcass and chilling steps in the harvesting stage in the slaughterhouse. In addition, open space slaughtering by some of the retailers and as well as consumers in the home.

(3) Poor transportation of the poultry meat by tricycle without the cooling facilities in hot weather by over sixty percent of the retailers, poor poultry meat selling status and live birds selling with the poultry meat by some of the retailers and low interest of the uneducated consumers to personal hygiene especially not adhering to wash hands with soap before preparation of the food in the home in the post – harvest stage in the Herat broiler sub sector.

Apart from the paper purpose, the study was a continuous learning procedure especially the field data collection was interest of the researcher because to find the key data source people, planning, communication with different actors to pass his question and get the correct data was a big challenge. However, this was an opportunity to examine the researcher abilities in the field to learn how a research project should be organised and what kind of external and internal factors may influence the failure or success of a research project. Therefore, it will help the researcher to visualise these points in his future activities in the position of an agriculture lecture in National Agriculture Institute Centre in Afghanistan.

6.2 Recommendations

Overall the food safety issue in the Herat broiler sub sector is ongoing. Despite, still there are potential hazards that threats the consumers' health, it must be noticed from the conceptual point of view, the perception regarding the food safety issue is exist within all the actors along the broiler vertical chain but it needs more efforts to reach in a standard level and minimum possibility of foodborne disease outbreak. Thus, the following recommendations are suggested in order to ensure the poultry meat is safe and is not threatening the consumers' health.

It is recommended that specific attention should concentrate on handling and distribution of the poultry products by wholesaler and retailers. However, the current continuous monitoring of the retailers' shops is recommended. In addition, through the food safety board efforts and negotiations with poultry meat retailers' representative tricycles with cooling facilities have to be providing for poultry products transportation from wholesalers to the retailers' shop.

The research suggests that to centralise all the live birds' retailers in a special place in different region of the Herat city by the Market Management of the Municipality and regulates poultry meat retailers to sell only poultry meat. However, a basic training on cleaning, sanitation have to be conducted for the retailers as well as. Increasing the public awareness about handling and correctly cooking poultry meat through the media especially TV and Radio is recommended too.

The research recommends that the Herat Agriculture Directorate through Livestock Department ensures that suppliers of the Herat one day old chick have the health certificate of a day old chicks and their parent stocks and the feed suppliers provide the documentation of the feed source ingredients and the manufacturing company. Furthermore, in cooperation with Kabul laboratory examines the ingredients of the feed sample in every three or six months. However, establishing the parent stocks poultry farms, hatcheries and poultry feed manufacturing company recommended in the long term by encouraging of the enthusiasm farmers in poultry business through government and support of the government.

The research suggests effective trainings need to be provide for the farmers on topics such as (1) provisions for safe water supply, (2) dead bird disposing, (3) importance of the footbath in minimising and prevention of pathogens to the poultry house, (4) proper feed storage of the poultry, (5) and importance of the protective clothes in poultry house in combination with the basic hygienic practices at the farm level. In this respect, linking of the farmers together as well as with the Veterinary Field Unit (VFU) through providing trainings give the opportunity to the farmers share their experiences regarding farm practices and access to the veterinary services in low cost in their villages. As a consequence of the inability to produce live birds free of pathogens at this moment, decontamination treatments of the birds must be provided for the future plans in minimising and controlling of the risk pathogens.

Also, the research recommends for that basic trainings have to be provided in terms of personal hygiene and responsibility of each worker. The slaughterhouse manager in consultation with the food safety board develops and implements local quality system based on HACCP principles.

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ANNEX

1. Questionnaire for broiler farmer

Part A: General Background information

#	Characteristics	A	B	C	D
1	Farmer education back ground	Never been to school	Primary	Secondary	College
2	# of chicken per cycle of production	1000 - 5000	5100 - 10000	10100 - 15000	15100 - 50000
3	Production cycle per year	1 – 2	3 – 4	4 – 5	5 – 6
4	Source of chicks supply to his farm	Eggs produce by farmer and chicks derived from himself	Eggs import from Iran or Pakistan and chicks produce by himself	One day old chicks bought by farmer from market (imported from Iran or Pakistan)	One day old chicks bought by farmer from market (self-production in Herat)

1. Farmer Education Back Ground 1) A 2) B 3) C 4) D
 2. # of birds per cycle of production 1) A 2) B 3) C 4) D
 3. Production cycle per year 1) A 2) B 3) C 4) D
 4. Source of chicks supply to the farm 1) A 2) B 3) C 4) D

Part B: Open and close questions

1. How do you store feed in your farm? Show which of the followings are present in storage of feed

- 1.1 - Store place is dampness 1) Yes 2) No
 1.2 - Store place is protected from rodents 1) Yes 2) No
 1.3 -Store place is protected from wild birds 1) Yes 2) No

2. What is the source of water for the farm?

- 1) Tap 2) Well

3. Do you supply clean water source for chicken?

- 1) Yes 2) No

If yes: 1. how do you ensure water is clean and safe?

2. Do the clean water available all the time for the chicken?

- 1) Yes 2) No

4. Have you been experienced disease problem regarding to chicken health?

- 1) Yes 2) No

If yes, what type of diseases associated yet in your farm?

5. Do you vaccine the chickens?

- 1) Yes 2) No

If yes, what types of disease do you vaccinate the chicken?

6. Do you give any supplementary like vitamin or antibiotic for the chicken?

1) Yes 2) No

If yes; How often and how much?

7. Do you have any problems of pests inside the poultry house?

1) Yes 2) No

If yes, 1. Rodents 2. Flies 3. Wild birds 4. Other pests

8. Do you disinfect the poultry house?

1) Yes 2) No

If yes, 1- How often do you do?

2- When do you disinfect?

9. Do you change the litter of the chicken?

1) Yes 2) No

If yes, how often do you change?

10. How do you keep clean machinery and equipment of the farm?

11. Do you have any rule for visitors regarding hygiene?

1) Yes 2) No

If yes, please explain

12. How often do you remove the chickens' manure?

13. How do you transport the chicken to slaughterhouse or market as live bird?

14. Do you disinfect the vehicle's wheels before enter to your farm?

1) Yes 2) No

15. How do you observe the personal hygiene inside the farm?

A: Do you wash hands before entering to the farm with soap or handling of chickens?

1) Yes 2) No How often?

B: Do the soap and clean water always available for cleaning and hand washing?

1) Yes 2) No

16. How often do you clean the farm buildings, toilets, offices, stores and break rooms?

17. Do you have documentation and record keeping about sanitation and hygiene in your farm?

1) Yes 2) No

18. Do you receive any training about hygiene practices from the government?

1) Yes 2) No

19. Do you have mortality of poultry?

1) Yes 2) No

If yes. What is the percentage?

What do you do with dead birds?

2. Checklist for slaughterhouse owner

Part A: General Background Information

Slaughterhouse Name:

Location:

of literate personnel.....

Owner Name:

Certified by government:

of illiterate personnel.....

Characteristics	A	B	C	D
Owner education back ground	Never been to school	Primary	Secondary	College
Capacity of slaughtering per hour	100 -1000	1100 - 2000	2100 - 3000	3100 - 4000
# of chicken slaughter per week	1000 - 5000	5100 - 10000	10100 - 15000	15100 - 50000

1. Owner education back ground 1) A 2) B 3) C 4) D
3. Capacity of slaughtering per hour 1) A 2) B 3) C 4) D
4. # of chicken slaughter per week 1) A 2) B 3) C 4) D

Part B: Open and close questions

- How do you receipt live bird into the slaughterhouse?
- Do the chicken inspect before slaughtering by a veterinarian or an expertise in poultry?
1) Yes 2) No
- Do you clean and disinfect all the surfaces and facilities before and after slaughtering?
1) Yes 2) No
- Where is your water source from?
- How do you assure you water source is clean?
- Do you use any materials to safe your water for consumption in slaughterhouse?
1) Yes 2) No if yes, how do you do that?
- How does the chicken de-feather after slaughtering?
1) Hand 2) Machine
- What practices do you have after venting and evisceration in order to prevent dirt from surface coming into contact with chicken meat?
- Is there a veterinarian or a sanitary expert to inspect internal organs and carcass for disease concerns?
1) Yes 2) No
- Do the carcasses chill before the secondary process (portioning)?

1) Yes 2) No

If yes, how do you chill them?

11. What is the storage place temperature?

12. Do you package the meat?

1) Yes 2) No

13. How do you keep packaging facilities in a clean condition?

14. Do you have store place for meat after packaging?

15. How many days/hours meat store after packaging in slaughterhouse?

16. How do you keep clean store place condition and control temperature?

17. Do you provide protected cloths for workers during slaughtering procedure?

1) Yes 2) No

18. Do the workers wash their hands with soap after toilet and before enter to slaughtering unit?

1) Yes 2) No

19. Have you been provide the basic hygiene training for you workers?

1) Yes 2) No

20. Do the visitors allow entering the slaughterhouse?

1) Yes 2) No if yes, Do you have any criteria for them to follow like changing clothes, hand washing, foot path and etc?

1) Yes 2) No

21. Do the workers or visitors allow eating, drinking or smoking inside the slaughtering unit?

1) Yes 2) No

22. Is the slaughterhouse constructed well to minimize or prevent access of rodents, birds, cats and other pests?

1) Yes 2) No

23. Do the equipment and facilities are suitable to avoid cross contamination of meat from dirt?

24. Does the slaughterhouse wall, ceilings, floors constructed well to easily be cleanable?

1) Yes 2) No

25. How the meat deliver from the slaughterhouse to the other actors (wholesalers or retailers?

3. Checklist for Wholesaler

1. What is your education background?

A) Never been to school B) Primary C) Secondary D) Collage

2. Are you aware of safe handling of chicken meat?

1) Yes 2) No

3. How do you prevent cross contamination of meat with unhygienic materials?

4. How do you receipt meat from the slaughterhouse?

5. What is the temperature during handling and storage of the meat?

6. Have you been faced meat spoilage problem?

1) Yes 2) No if yes, How do you overcome the problem?

7. How many days do you keep meat in your storage?

8. How is the shape (physical infrastructure) of your storage?

9. Does it well equipped with cleaning facilities? 1) Yes 2) No

10. Does it have sufficient space for your volume of meat? 1) Yes 2) No

11. How do you store meat away from heating source inside the storage like machines?

12. How often do you clean the storage?

13. What is the water source for cleaning of the storage?

14. Do you wear protective clothes during the handling of the product?

1) Yes 2) No

15. How do you prove your handling operation assure food safety?

4. Questionnaires for retailers:

Name:

Location:

1. What is your age?

2. What is your education background?

A) Never been to school B) Primary C) Secondary D) Collage

3. How much meat do you sell in average per day?

4. How much live bird do you sell in average per day?

5. Do you have refrigerator or freezer for keeping meat in your shop?

1) Yes 2) No

6. How do you receipt meat from wholesaler to your shop?

A) by bicycle B) by motorcycle C) by normal car D) by refrigerated car

7. Do you wear gloves during handling and selling of meat to your customers?

1) Yes 2) No

8. Do you have certification from government for selling of meat?

1) Yes 2) No

9. How many times per month government monitor your shop for sanitation and required facilities purpose?

A) 1 – 2 times B) 3- 4 times C) above 5 times D) never

10. Do you have health certificate from the government?

1) Yes 2) No

5. Questionnaires for consumers:

Name:

Location:

Age:

Level of education:

1. Do you wash your hand before preparing of the food?

1) Yes 2) No

If yes, Do you use soap or any other liquid detergent for washing your hands too?

1) Yes 2) No

2. What is your water source?

A) Tap B) Well C) river source

3. Do you use soap or any other liquid detergent to wash your hands after toilet, changing baby's soiled diaper or touching of livestock?

1) Yes 2) No

4. Do you return cooked meat or other foodstuffs in the previous dish (plate) that contacted with raw meat?

1) Yes 2) No

If yes, How many times do you do it? Please select one of the below four options

1) Always 2) Sometimes 3) Often 4) Rarely

6. Checklist for Government (Food safety board)

1. What is the common safety risks associated along broiler vertical chain with concerning consumers' health?

2. Which stages of the broiler vertical chain food safety risks have been associated with?

3. How do you want to minimise these risks?

4. What are the procedures for certifying the actors dealing with poultry meat along the chain? Are there any rules and regulations or criteria that have to be completed?

5. To what extent the current food safety practices are assure to prevent foodborne disease among consumers?

6. What may be the factors affect your activities regarding food safety with poultry sub sector?

7. What is your future strategy about food safety issue regarding consumers' health to assure they will have a safe product for consumption?

7. Observation table for farm

Table 1

#	Criteria	Requirements	Justification method	
1	Feed	1. Rodents shouldn't have access to the feed 2. Wild birds & insects shouldn't have access to the feeding area. 3. Feed storage does not have dampness. 4. Feed supplied from a certified company. 5. There is no risk of cross contamination of feed with unhygienic materials.	Poor	Number 1, 2 and 3 is missed
			Fair	Number 4 is missed
			Good	5 criteria is in line with the requirements
2	Water	1. Water disinfected properly. 2. Animals and pests (rodents, cats, insects, and wild birds) shouldn't have access to the water source. 3. Water is changed every 12 hours. 4. Watering system to minimise the possibility of contamination with pathogens in low levels.	Poor	Number 1, 2 and 4 is missed
			Fair	Number 4 is missed
			Good	4 criteria is in line with the requirements
3	Building	1. Constructed in a way that minimises access to rodents, birds, and other pests 2. Provides adequate space for chickens. 3. Lighting and ventilation is sufficient. 4. Surfaces are suitable for cleaning. 5. Footbath exists in entrance door of poultry houses.	Poor	Number 1, 3, and 4 is missed
			Fair	Number 1 2 and 4 is missed
			Good	5 criteria is in line with the requirements
4	Facilities and equipment	1. Facilities and equipment are suitable in size, design, precision, and accuracy for their intended use. 2. All equipment is designed, constructed, and maintained to facilitate inspection and use of cleanout procedures.	Poor	Number 1 is missed
			Fair	Number 2 is missed
			Good	2 criteria is in line with the requirements
5	Personal hygiene	1. Farmers wear clean clothes and shoes. 2. Farmers wash their hands with soap before entering the poultry house and feeding the chickens. 3. Farmers take a shower at least once per week.	Poor	Number 1 and 2 is missed
			Fair	Number 3 is missed
			Good	3 criteria is in line with the requirements

Depends on missing one or two or all of requirement criteria three measurement scale (poor. fair. good) are used for justification of the observation.

8. Observation table for Slaughterhouse

Table 2

#	Criteria	Requirements	Justification method	
1	Chicken inspection	1. Birds should be inspected for diseases by an expert before slaughtering.	Poor	Birds are not inspected
			Fair	Birds inspect by the experienced worker
			Good	Meet the requirement
2	Time of slaughtering	1. Slaughtering at night and early in the morning reduces the risk of microbiological contamination.	Poor	Slaughtering and transportation of the birds are at the middle of the day
			Fair	Slaughtering is the beginning of the day
			Good	Meet the requirement
3	Bleeding time	1. Two minutes bleeding time is necessary for de-feathering.	Poor	Bleeding – time is less than 1 minute
			Fair	Bleeding time is in range 1 - 2 minutes
			Good	Meet the requirement
4	Building conditions	1. Buildings should be constructed in ways that minimize access by rodents, birds, and other pests. 2. Provide adequate space for workers. 4. Surfaces are suitable for cleaning.	Poor	Number 1, 2 and 3 is not meeting the requirement
			Fair	Surfaces are not properly suitable for cleaning.
			Good	Meet the requirement
5	Facilities and equipment	1. Facilities and equipment are suitable in size, design, precision, and accuracy for their intended uses and possibility of contamination is very low.	Poor	possibility of contamination is very high and facilities are not designed for intended use
			Fair	Facilities are designed well but due to improper use of the worker may pose risk of the contamination
			Good	Meet the requirement
6	Water	Water should be disinfected for carcasses as well as for washing the surfaces and personal use.	Poor	Water is not disinfected
			Fair	Water is disinfected but not all the times
			Good	Meet the requirement
7	Slaughterhouse workers	1. Workers are using protected clothes (gloves, mask, and shoes)	Poor	Both number 1 and 2 are missed

		during the slaughtering and washing hands with soapy water before slaughtering. 2. Workers are not eating, drinking or chewing gum during the slaughtering.	Fair	Workers protective clothes are not suitable and workers adhere to do not eat, drink and smoke during the slaughtering procedure
			Good	Meet the requirement
8	Surfaces	1. All the surfaces must be clean with enough water and disinfected before and after slaughtering.	Poor	Surfaces clean but not with disinfected water or some parts missed or the water is not enough to clean in a good manner the surfaces
			Fair	Surfaces clean well but not with disinfected water
			Good	Meet the requirement
9	Waste management	1. Waste should be managed in such ways to minimise risks of cross contamination in a minimum level.	Poor	Waste management is weak and the risk for cross contamination is high
			Fair	The risk of cross contamination is exist but not seriously in high level
			Good	Meet the requirement

Depends on implementation, weak implementation or non-implementation of the above requirements in slaughterhouse three measurement scale (poor. fair. good) are used for justification of the observation.

8. Observation table for wholesalers and retailers

Table 3

#	Criteria	Requirements	Justification method	
1	Meat selling status	Meat should handle with gloves and store in refrigerator or freezer (depends on frozen or non-frozen meat), Meat is not selling with live birds and other foodstuffs	Poor	Meat is not handle with gloves, sometimes re-freezes or is keeping out of the refrigerator for selling and the shop is selling live birds too.
			Fair	Meat is not handle with gloves but is keeping in refrigerator or freezer. The shop is not selling the live bird as well as.
			Good	Meet the requirement
2	Shop condition	Shops should equipped with refrigerator and cleaning facilities, all the shop surfaces must be easy cleanable	Poor	Shop is not equipped with refrigerator or either is equipped but it is off for 1 – 3 hours because of the electricity fee. The surfaces are not suitable to be cleaned well.
			Fair	The surfaces are not suitable to be cleaned well but equipped with the cooling facilities
			Good	Meet the requirement
3	Personal hygiene of seller	Seller should observe following principals - Wearing clean clothes, gloves during chicken meat handling and adequate hair restraints. - Fingernails are short and clean - Hands should wash properly, frequently, and at appropriate times.	Poor	Personal hygiene is not meeting the requirement
			Fair	Seller is wearing clean clothes but not gloves and washing his hands with from a clean source like tap.
			Good	Meet the requirement
4	Equipment	Equipment in contact with meat should clean properly and disinfect.	Poor	Equipment in contact with meat is not cleaned and also contacted with other pathogenic source like live birds
			Fair	Equipment cleans but not in way to minimise the risks in very low level.
			Good	Meet the requirement

Depends on weak implementation or non-implementation of the above requirements in retailer shops or wholesalers shop three type of measurement (poor. fair. good) are used for justification of the observation.

Table 4 GMPs poultry slaughterhouse

#	Control Points	Requirements	Inspections
1	Transportation of live poultry	<ol style="list-style-type: none"> 1. Vehicle shall be designed to be strong and appropriate for poultry species with adequate spaces for poultry crate. 2. Movement of poultry shall be approved by Department of Livestock Development. 3. Sick poultry shall not be transported with the healthy ones. 4. Poultry shall arrive at abattoir at least 30 min before slaughtering 	Visual inspection and review related documents
2	Receiving of live poultry	<ol style="list-style-type: none"> 1. Ante-mortem inspection is required. 2. Sick or suspected poultry suffering from diseases are isolated and kept in separated area and sacrificed them in emergency area after slaughtering the normal poultry. 3. Clean and disinfect vehicles and container after unloading poultry. 	Visual and record inspection
3	Poultry slaughtering	<ol style="list-style-type: none"> 1. Humane slaughtering 2. Bleeding knife shall be cleaned every time before use. 3. Poultry shall not come into contact with the floor during slaughtering. 4. Time allowed for complete bleeding shall be at least two minutes. 5. Slaughtered poultry shall be washed and cleaned. 6. Bleeding equipment, tools and floor shall be cleaned after the bleeding processes. 	Visual inspection
4	Scalding and defeathering	<ol style="list-style-type: none"> 1. Scalding water temperature shall be at least 58 °C and high enough for defeathering. 2. The water temperature and period of immersion shall be related to the size and species of poultry. 3. Slaughtered poultry shall be completely defeathered. 4. If wax or adhesive substances are used in defeathering processes, the substances shall be qualified for use with food. 	Visual inspection and review related documents
5	Head removal and shank cutting	<ol style="list-style-type: none"> 1. Head removal and shank cutting (can be omitted where necessary) 	Visual inspection
6	Evisceration	<ol style="list-style-type: none"> 1. Offal shall be completely removed by appropriate equipment. 2. Carcass shall not be contaminated by contents of offal. Offal and carcass shall be placed together for inspection. 3. Post-mortem inspection is required. 	Visual inspection and review related documents
7	Carcass cleaning	Poultry carcass shall be washed by water after bleeding, defeathering and eviscerating.	Visual inspection

8	Carcass or poultry meat chilling	1. Within one hour after chilling or during storage for distribution, the core temperature of carcass or poultry meat shall not be exceeding 7 °C.	Temperature monitoring and review related documents
		2. Temperature of carcass or poultry meat and room temperature shall be recorded. 3. Chilling room shall be free of condensation	
9	Carcass cutting	1. Equipment, tools and utensils shall be cleaned properly. 2. Cutting up area shall be clearly separated from other production area and strictly controlled of entering.	Visual inspection
10	Packaging	1. Packages shall be durable and soundly safe for food products. 2. Label shall be legible on each package. 3. Packaging area shall be clearly separated from other production area.	Visual inspection
11	Operating procedures in poultry abattoir	1. Operating procedures in poultry abattoir shall be appropriately stepwise and preventing microorganisms cross contamination	Visual inspection
12	General hygiene	Hygienic practices in production are not defined here.	Visual and relevant document inspections
13	Waste water treatment	1 Waste water treatment system shall be in place in compliance with relevant laws.	Visual inspection