



MAURITIUS RESEARCH COUNCIL

MAPPING THE SUPPLY CHAIN OF BROILER CHICKEN IN MAURITIUS, TO ASSESS THE EFFECTS OF EXTERNAL THREATS

Final Report

March 2013

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List of Abbreviations

AI	Avian Influenza
AREU	Agricultural & Research Extension Unit
BSE	Bovine Spongiform Encephalopathy
DBM	Development Bank of Mauritius
DVS	Division of Veterinary Services
e.g.	For example
FAO	Food and Agriculture Organisation
Kg	kilogram
LFF	Livestock Feed Factory
MCA	Mauritius College of the Air
MoAF&C	Ministry of Agriculture and Fisheries
MoAF&H	Ministry of Agriculture, Fisheries and Human Resources
MAF	Ministry of Agro-industry & Fisheries
MUR	Mauritian Rupee
PBC	Poultry Breeding Centre
SADC	Southern African Development Community
SC	Supply Chain
SCM	Supply Chain Management
SCP	Supply chain Performance
T	Tonnes
US	United States
WTO	World Trade Organisation
EPA	Environment Protection Act
PER	Preliminary Environment Report
HACCP	Hazard Analysis and Critical Control Points
MOH	Ministry of Health
MSB	Mauritius Standards Bureau

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Executive Summary

- A study was carried out to map out the broiler chicken supply chain to define and describe the roles and importance of the main actors in the sector, and to analyse the effect of external threats on the supply chain as well as the strategies adopted by the identified actors with respect to those threats.
- The development of the poultry sector has been a major success story in Mauritius. Initially, the Government spearheaded the development of the sector and with the setting up of larger farms by the private sector; the poultry sector has undergone a major shift in structure and operations. The technical and managerial capacity in all aspects of poultry production has increased over the years and this core expertise is recognised.
- Today Mauritius is self sufficient in poultry and poultry products and the local production stood at 47,200 tonnes of chicken meat with an average consumption of 36 kg/head, in 2012. There is a general acknowledgement that chicken is increasingly becoming the meat of choice locally.
- The market has transitioned from a predominantly frozen market in the early 1908's to a principally chilled market nowadays. There is a growing trend towards increasing value addition in the form of processed chicken to cater for reading to cook/convenience food market.
- There are 4 types of poultry production systems: backyard, low biosecurity small-scale commercial, high biosecurity medium-scale commercial and industrial and integrated farms. The backyard system is now almost inexistent. The medium sized operators are an important group and some of them are contract growers for the 2 large industrial farms. These farms are large, vertically integrated units (keep breeding stock, operate

hatcheries and commercial broiler farms), and use latest technologies for fattening chicken. The two large producers account for around 65% of the production, the medium and small ones representing 25% of the market and the backyard producing 15% of the total production.

- The high growth rate has also been supported by using genetically improved breeds which are fast growers, have low mortality rates and are excellent feed conversion together with the adoption of health measures and biosecurity plans.
- The reasons behind the rise of the poultry industry are many and includes factors such as relative low cost of chicken meat as compared to other meats, rising disposal incomes, improved standard of living, change in food habits, no religious barriers against its consumption, and a flourishing tourist industry.
- The survey effected at producers' level showed that 52.9% of them were involved with their business on a full-time basis. Such producers were bound to adopt coping strategies to deal with threats to subsequently sustain their livelihoods.
- 10% of producers that participated in the survey had formal contractual agreements with large and/or industrial producers to produce broiler chicken using specific inputs and at specific prices. 70% of responding producers reported that they generally marketed their production through traders and that selling prices were generally verbally agreed-upon.
- 80% of producers were aware of avian flu and 77% reported that they would seek help from the Ministry of Agro-Industry and Food Security in case of an outbreak.
- All the 70 responding producers mentioned that the price of broiler feed was too expensive and heavily impacted on their cost of production. The majority of them (78.6%) claimed that feed accounted for between 70-75% of their production costs. 71% of the producers claimed that they would be forced to give up broiler production in case

price of broiler feed continues to rise. The remaining 29% of producers reported that they would rather increase the price of the products and transfer the increased costs to their buyers. It is interesting to note that those producers who claimed that they would transmit the increase in cost of feed to their buyers were generally directly marketing their products to consumers. Increasing cost of feed was ranked as the main threat to broiler chicken production by producers.

- 47.4% of chicken traders procured chicken from industrial producers like Innodis and Avipro. 31.6% of respondents claimed that they sourced their broiler chicken from medium producers and the remaining ones either procured themselves from small producers or from their own production
- Traders (55 out of 57) who claimed that they were sourcing their broiler from producers, affirmed that they had a contractual agreement with producers, but the majority of them (50 out of 55) mentioned that this agreement was informal in nature. Only two traders reported that they formalized their agreement in the form of a written contract with weight, price specifications, mode of delivery and mode of payment.
- Traders (55 out of 57) who claimed that they were sourcing their broiler from producers, affirmed that they had a contractual agreement with producers, but the majority of them (50 out of 55) mentioned that this agreement was informal in nature. Only two traders reported that they formalized their agreement in the form of a written contract with weight, price specifications, mode of delivery and mode of payment. Furthermore, 73% believed that they would have to give up broiler production where as the remaining 27% claimed that they would continue with their broiler business once the ban would be lifted.
- In case of chicken imports, 23% of the respondents believed that they would have to shift from selling fresh chicken to selling frozen chicken. 10.3% believed that the

demand of fresh chicken would decrease given that the price of the imported products would be lower.

- Based on the findings of the survey, the marketing of broilers from small and medium producers was mainly through wet markets that is through traders, poultry meat retailers, chicken dressers and own marketing. The most prominent channel in that market has been found to be:

Producer → Trader → Meat retailer → Consumer

- Data collected from the producer survey also showed the existence of a more structured and organised marketing channel, with the involvement of industrial producers supplying own brand retail outlets, processing plants, hyper/super markets, hotels and ultimately consumers. This channel could generally be represented as:

Industrial producer → Own brand retail outlets → Consumer

Industrial producer → Processing plants → Consumer

- The market for chicken can be segmented into retail segment, restaurants and hotels and institutional clients. 2 key industrial players have set up their own retail chains (e.g PointFrais & Chantefrais) to market their products under chilled and ready to cook poultry products.

- Findings have shown that there are different types of business linkages that exist along the broiler supply chain locally and such linkages are usually coordinated through contracts. Such linkages and their coordination depend on the types of productions processes. In the case of backyard and small producers, they generally had verbal contracts with traders and prices were usually verbally agreed upon. On the other hand the governance structure differed significantly for medium and large producers that were producing for industrial producers. The latter write formal contracts and offer them to producers, with recommended inputs and usage. Such contractual agreements ironed out the likely heterogeneity that could exist in the production systems of

medium and large producers and also to reduce systematic uncertainty that exist in the marketing channel that involved medium and large producers.

- Key threats faced as perceived by the main actors in the broiler chicken industry include high price volatility of feeds, vulnerability to disease outbreaks, volatile prices of raw material.
- The study has shown that actors adopt different coping strategies depending on their position in the supply chain. Those more at risk are essentially in the difference production systems and most specifically the industrial and vertically integrated producer due to high assets fixity. Against one of the main threats which is the increasing price of the main raw ingredients used for feed manufacturing. The findings have confirmed the central role that the feed plays in broiler production locally. The chicken feed industry is of strategic importance to the poultry industry as feed can account for up to 75% of production costs. The dependency of the feed industry on imported maize and soybean makes it exposed to various risks, the main one being input-commodity price volatility and its subsequent impact on production costs. The impact of such changes are felt even more severely by non-industrial producers locally as they are dependent on the two feed manufacturing plants which are integrated with industrial chicken producers. Some of the coping strategies for producers include developing better feed formulations at the level of feed millers to decrease the amount of feed to be given to the birds; reducing the flock size for small and medium commercial producers amongst others.
- In spite of identified threats, there is a bright future for the broiler chicken industry as it appears to be resilient to external pressures and the prospect for consumption growth and export.

Chapter 1 Introduction

1.1 Background

Mauritius has witnessed rapid economic growth since the early 1980s to achieve a GDP/capita of US\$ 6742 in 2012 (World Bank, 2012). This growth has concomitantly lead to an increase in disposable income for the average Mauritian, resulting in fundamental changes in food consumption patterns, characterised by an increase in total calorie intake and accompanied with a shift in the composition of the diet towards more meat, eggs, dairy products (Neeliah and Shankar, 2008). Among all livestock products, broiler chicken has been most successful in meeting the eating habits of Mauritians. This sustained demand for broiler¹ meat has been met through local production, complemented with imports from the mid eighties to the mid nineties. This increased local demand has led to the sustained development in indigenous production, resulting in self-sufficiency in 1995.

Correspondingly the Mauritian broiler industry has witnessed an evolution from a traditional backyard production in the late 1950s to an essentially vertically integrated industrial production today. There are many factors responsible for this trend and these are: an increase in income per capita, economic, scientific and technological progress, price competitiveness with respect to meat substitutes, policies aimed at increasing production, better consumer acceptance with respect to other types of meat namely pork and beef, dietary concerns which favour substitution of red meat, and efforts of industries to add value, create and respond to consumer demand for innovative and high quality products.

Although the importance of broiler chicken in the Mauritian diet is a well acknowledged fact, . the reasons and drivers that have led to this state are not well referenced. It is recognised that the broiler chicken industry is one of the most successful agro-industrial ones, but given that it operates in a highly dynamic environment, it is not totally sheltered from external threats. Four main threats identified are: disease outbreaks, trade liberalisation, food scares, and related

¹The term broiler in the text hereafter refers to broiler chicken.

food quality and safety issues. These threats can disrupt the broiler chicken supply chain, jeopardise the economic sustainability of the broiler sector and hence affect the consumption habits of Mauritians. Therefore, appropriate policies must be devised and implemented to anticipate and address the likely effects of these threats; and enhance competitiveness and market participation by all operators.

Formulating and implementing policies for a particular sector requires an in-depth understanding of that sector. Locally there is a dearth of information on the structure, performance and governance of the broiler chicken supply chain as no systematic study has been carried out to characterise the broiler chicken supply chain to date.

So this research project aims at addressing the information asymmetry stated above by shedding light on the roles and functions of all the actors in the local broiler sub-sector, analysing the structure and functioning of the broiler supply chain; and identifying external threats in view to recommend appropriate measures to ensure the economic sustainability of the broiler sector.

1.2 Objectives of the study

The main objective of the study is to characterise the broiler chicken supply chain and assess the structure and governance to better review the likely of potential external threats. Moreover, the study aims at reducing the information gap that exists in the broiler chicken supply chain. Below are the specific objectives, research questions and respective methodologies.

Objective 1

Objective	To map the broiler chicken supply chain in terms of its structure, and governance
Research questions	1. Why is it useful to map the broiler chicken supply chain in terms of its structure and governance? 2. What is the need of reducing information gap in that sector?
Hypothesis	1. A comprehensive map of the broiler chicken supply chain, in terms of its structure and governance, reduces the information gaps that exist in this supply chain. 2. A comprehensive map of the broiler chicken supply chain helps in identifying the roles and functions of the different actors in the supply chain.
Methodology	1. Literature search and collection of secondary data at national and international level 2. Design of questionnaires for collection of primary data in the broiler chicken supply chain based on indicators of the structure and performance of a supply chain.

Objective 2

Objective	To assess the likely effect of external threats on the broiler chicken supply chain
Research questions	1. What is the need of assessing the effect of the external threats?
Hypothesis	1. An assessment of the effect of external threats provides an indication of the coping strategies used by actors in the chain with respect to those threats.
Methodology	1. Design of questionnaire to capture the coping strategies of actors with respect to external threats.

Objective 3

Objective	To provide recommendations of appropriate measures based on identified coping strategies, which relevant stakeholders can take to ensure the sustainability of the sector.
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1.3 Structure of the report

The report is divided into five chapters as follows:

The first chapter is an introduction to the research project and presents the objectives as well as the research questions and hypotheses put forward.

The second chapter is a comprehensive description of the Mauritian broiler chicken industry from its origins to present days. It also provides a detailed account of the support systems for poultry production as well as an account of the legal environment that surrounds broiler chicken production in Mauritius. The chapter presents as well the main drivers behind the evolution of the broiler industry while emphasising on the threats to the industry.

The third chapter is a review of literature on the concept of supply chain in general, and on agri-food supply chains in particular and more specifically on the application of these concepts in the broiler supply chain.

The fourth chapter is concerned with the methodology of the research project.

The fifth and last chapter presents the results, discussion and conclusions of the study.

Chapter 2: A review of the Mauritian broiler chicken industry

2.1 Historical background

The development of the poultry sector in Mauritius started in the early 1940's. Over the last forty years, the Mauritian poultry sector has witnessed a drastic change from a backyard production to a vertically integrated industrial production. This development has occurred at an impressive rate as compared to other livestock sectors (Figure 1.0).

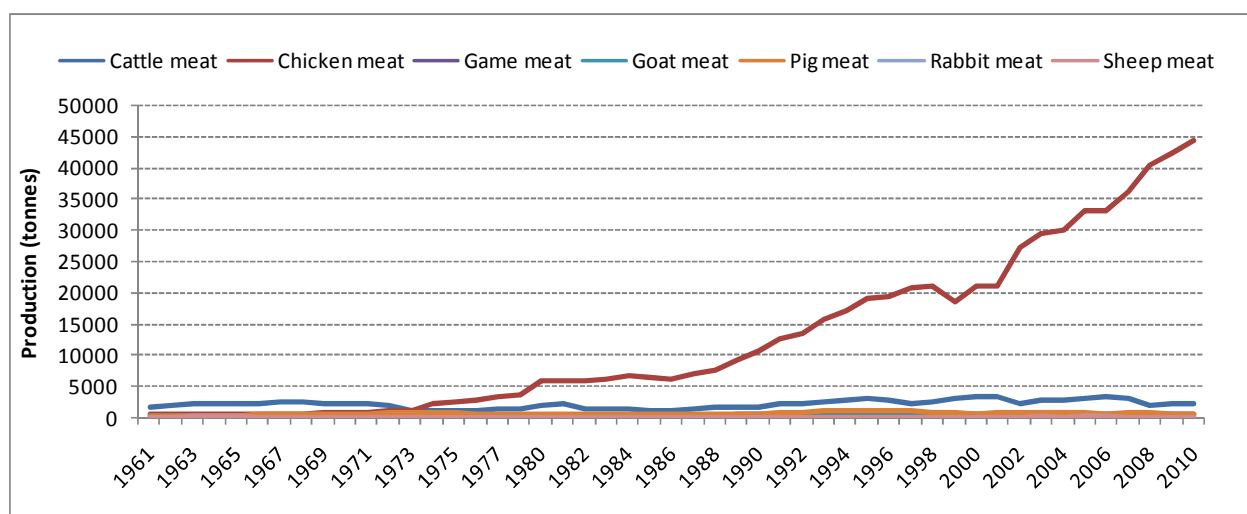


Figure 2.0: Meat production in Mauritius. (Source: FAO, 2012)

In 1961 local production of chicken meat was 394 tonnes and in 2011 it amounted to 46,200 tonnes, (Statistics Mauritius, 2012) accounting for a 117 fold increase. In 1961 broiler production accounted for 14.4% of total meat production, while local cattle meat production accounted for 61.1%. Over the next 50 years there has been a gradual and sustained displacement in the composition of local meat production, shifting from cattle to chicken meat production. In 2011 chicken production accounted for 91.9% of total meat production, whereas cattle meat production made up 4.8% of local production (Figure 2.0).

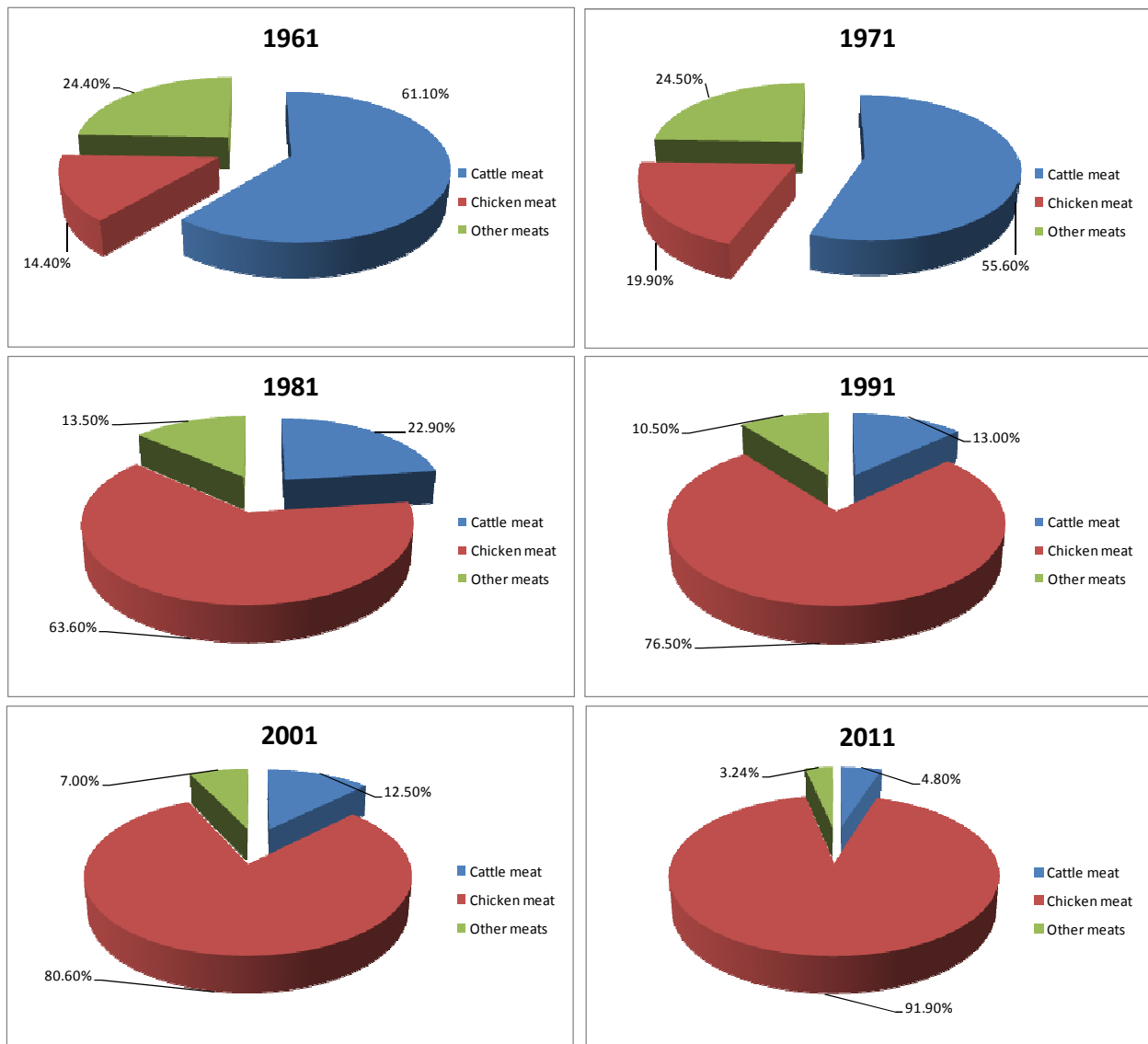


Figure 2.1: Evolution of the contribution of chicken meat in local meat production from 1961 to 2011.

2.2 The evolution of chicken production over the last 50 years

This section documents the evolution of chicken production over the last 5 decades.

2.2.1 Period 1940 to 1960

The period of 1940 to 1960 saw the establishment of two institutions, the Poultry Breeding Centre (PBC) and the Livestock Feed Factory (LFF), and both played an important role in the development of the broiler chicken sector in Mauritius.

In 1943, the Government Maize Mill was erected to store and dry locally grown maize and also to produce “maize rice” for human consumption during the wartime rice shortage (Limfat, 1962). During the initial period, from 1950 to 1953, the factory produced a single all purpose feed known as “Special Maize Mixture”. This feed was mainly bought by small pig keepers and small quantities were used to feed cattle and poultry (Limfat, 1962). In 1958, the Government Maize Mill was renamed as Livestock Feed Factory and continued the manufacture of special mixtures for poultry, cattle, pigs and horses (Revue Agricole Sucrière de L’île Maurice, 1960).

Concerning the local poultry sector, in 1943 and 1944, some hens and cocks were imported from South Africa for breeding purposes (MoAF&C, 1943). There are very few published information concerning the importation and production of poultry in the year 1940 to 1960. But from the set-up of the PBC, record keeping and publication was more accessible.

The PBC was created in 1959 by Dr. J. D. Shuja at Réduit (Revue Agricole Sucrière de L’île Maurice, 1961) with the main objective to import parental stock from Australia and to produce day-old chicks locally that will be sold at an affordable price to local farmers (Naidoo *et al.*, 1995). Progeny testing was carried out to select the best breed out of the pedigree White Leghorn and Rhode Island Reds imported from United Kingdom and Australia. During that year, some 4500 chicks were hatched for progeny testing purposes (Revue Agricole Sucrière de L’île Maurice, 1960).

As from 1940 to 1960, very few information concerning diseases were published. One of the main disease outbreaks reported was during the end of the 1950's, when several cases of Aspergillose were identified mainly at Beau-Bassin and Pamplémousses (Webb & Lionnet, 1959). Consequently, various experiments were carried out to determine the cause of that disease.

From 1940 to 1960, several papers were published and experiments were carried out to boost the poultry sector in Mauritius.

2.2.2 Period 1961 to 1980

On the 21st of January 1961, the veterinary services, responsible for backyard broiler production organised a “Journée avicole” at Réduit. Among the guests, the Minister of Agriculture & Natural Resources and several poultry breeders were present (Revue Agricole Sucrière de L’île Maurice, 1961).

In March 1961, the PBC started supplying 6000 hatching eggs and 45 000 table eggs on the market. Moreover, over 3000 pounds of poultry meat was produced and put on the local market (MoAF&C, 1961). Besides the PBC carried experiments on nutrition, aiming at improving poultry production under local conditions (Revue Agricole Sucrière de L’île Maurice, 1961). The first sale of day-old chicks from tested stocks took place on 10th May 1961, in the presence of the Minister of Agriculture and Natural resources. 2859 day-old chicks and 4499 four-weeks old chicks were sold to breeders. From 1961 to 1963, day old chick production increased from 7358 to 25362 units.

On the 20th of June 1961, from the initiative of Mrs. Clan Angus and Mr Serge Lionnet, a meeting was organized at the seat of British council at Rose-Hill in the presence of a representative of the Ministry of Agriculture (Revue Agricole Sucrière de L’île Maurice, 1961). The aim was to create a “Mauritius poultry club” to promote the poultry sector in Mauritius.

However, there is very few information concerning the functions and activities of the “Mauritius poultry club”. The year 1961 marked several important events which served to boost the local broiler chicken industry.

Later on, an “Agricultural show” was organized by the livestock sector in 1965. The booklet “Poultry keeping in Mauritius” was published and was in great demand at that time.

In 1966, the first private company, the Food and Allied Industries Limited (FAIL) was set up with the idea to supply local chicken and to boost up the poultry production system in Mauritius. The company was principally owned by Michel De Speville with a weekly production of 400 broilers.

Initially, the PBC was supplying day old chicks to the industrial producer but with time FAIL started producing its own chicks (Ramasawmy, 1996).

During the same year, Mr R Joomye joined the emerging broiler chicken industry and created the Joomye Industries Company Ltd (JICOL), but unfortunately the company was closed after a few years.

In 1973, another poultry farm was established by Happy World Foods Limited under the name of Mauritius Farms Ltd. The name of the Company was changed to Happy World Foods Limited on 22 December 1994. The main activities of the Group and the Company are production, poultry farming, distribution and marketing of food and grocery products, sanitary pads and hygiene products (Innodis, 2007). Later known as the Innodis Ltd, this company introduced two different brands of broiler meat namely: Carmen and Prodigal. .

Since the beginning, the main problem in the industrial production of broiler was, and still is, poultry feed. In 1976, 85% of the feed used for the production of poultry were imported. The FAIL set up its own animal feed mill, the Livestock Feed Limited (LFL), in 1977. This feed mill

company produces not only poultry feed for its own farms and for sale to the public but manufactures other types of animal feeds as well (Saraye, 1995).

In 1978, the chicken meat industry was maintaining its upward trend. Production recorded for the period of December 1978 was 3616.4 tonnes as compared to 3252.7 tonnes in 1977. The yearly per capita consumption thus increased from 2.94 kg in 1976 to 3.93 kg in 1978 (MCA, 1979).

2.2.3 Period 1981 to 2000

In 1983, the first Kentucky Fried Chicken (KFC) outlet, a franchise of the FAIL, was launched in Mauritius and built a solid reputation for quality product and quick service. The chicken supplied to KFC is essentially from FAIL (FAIL, 2007).

Unfortunately for the broiler industry, in 1984, the outbreak of the Newcastle disease, particularly affecting hens, turkeys, geese and ducks caused the death of chicks resulting about in MUR 20 million loss for the country (MOAF&H, 1987).

At a point in time, the two private companies FAIL and Mauritius Farm Ltd (Innodis) were the major broiler producers with a production capacity of 7 million birds per year. Towards the end of 1990, Mr Edwin Kwok took over the poultry farm of Mr Joomye (Owner of ex-JICOL) to establish another private company, Mont-Ida poultry farm. As a result, the overall production increased from 7 million to 7.9 million birds, almost a 12% increase (MoAF&C, 1990).

On the other hand, with the expansion of broiler chicken production on an industrial scale, and the diversification of their product lines into further processed and choice cut meat, the livelihood of the traditional small scale backyard poultry producers was put in jeopardy. However, the fresh poultry from traditional production still retains a niche market as the poultry meat is given a special value by local consumers.

In 1992, another industrial poultry industry, Poulet Arc en Ciel was set up headed by Mr Varma Aubeeluck, introducing another chicken brand named “La bonne volaille”.

The year 1994 marked the establishment of another animal feed manufacturing company named as “Meaders Feed”. The factory started with a monthly production of 5500-6000 tonnes of animal feed. 90% of the total animal feed produced was for the poultry sector (Laviolette, 2005). Meaders Feed Ltd has several clients such as Innodis, CERES (now known as Inicia Ltee), Poulet Arc en Ciel , Mont Ida poultry farm and about 500 small poultry breeders including the association of “petit aviculteurs de Maurice” (Business Magazine, 2005).

From 1990 to 1997, the total broiler production had almost doubled from 10 300 tonnes to 20 000 tonnes respectively. On the other hand, there was almost no importation of poultry meat as from 1995; this is certainly due to the high tariff on imported poultry products. Another reason could be adequate local production and imports limited to only processed chicken products. The period 1980 to 2000 marked the set up of several private companies associated with the broiler chicken industry, which has helped to double the total broiler production.

From 1940 to 2000, the broiler chicken industry has changed considerably from a backyard/traditional production to an industrial broiler production. Several institutions including public and private bodies have been introduced to enhance broiler chicken production in Mauritius.

In 2000, four industrial companies, namely FAIL, Innodis, Poulet Arc en Ciel and Mont Ida, operating on an industrial scale produced the majority of the total chicken consumed in Mauritius. The single structured broiler chicken production system namely the traditional/backyard system has evolved to 4 different systems of broiler chicken productionnamely the traditional/backyard system, the small-scale commercial system, the medium scale commercial system and the industrial system.

On the 1st of September 2000, the Southern African Development Community (SADC) Trade Protocol was officially launched. The main objective was to favour intra-regional trade and to establish a fully integrated free Trade Area through the gradual elimination of all tariff and non-tariff barriers on various products including poultry products. The implementation period is over 12 years based on the principle of reciprocity (MCA, 2001). However, with increased globalisation of the poultry sector, several challenges are expected.

2.2.4 Main events in the Mauritian broiler chicken industry from 1958 to 2000

The main events that have shaped the Mauritian broiler chicken industry from 1958 to 2000 can be summarised in Table 2.0.

Table 2.0: Main events in the Mauritian broiler chicken industry from year 1958 to 2000

Year	Main events
1958	Set up of LFF to supply poultry feed
1959	Outbreak of Aspergillose
1959	Set up of the PBC to supply day old chicks at a reasonable price to local farmers
1961	Organisation of a “Journée avicole”
1961	Creation of a “Mauritius poultry club”
1965	Organisation of an “Agricultural show”
1966	Set up of FAIL
1977	Set up of LFL
1980	Set up of “Mauritius Farm” (Innodis)
1983	KFC launched
1984	Outbreak of Newcastle disease
1990	Set up of Mont Ida Poultry farm
1992	Set up of Poulet Arc en Ciel
1994	Setup of Meaders feed Ltd
2000	SADC protocol launched

2.3 Current status of the broiler chicken sector

Mauritius has been self-sufficient in poultry meat for more than two decades and has successfully met the increasing demand for this commodity. The sections below give details on the current structure and production of the broiler chicken industry in Mauritius.

2.3.1 Production data

According to AREU, in 2011, there were around 741 broiler chicken farmers of which 6 are commercial ones. The number of birds reared in 2011 was estimated at 25 million units. Production of chicken meat reached 46,200 tonnes in 2011 with a consumption of about 35.7 kg of chicken meat/capita (Statistics Mauritius, 2012). A study by Jugessur and Seenevassen Pillay in 2001 indicated that about 85% of the total broiler meat consumed in Mauritius came from industrial producers, 10% from small commercial producers and 5% from backyard family poultry farms.

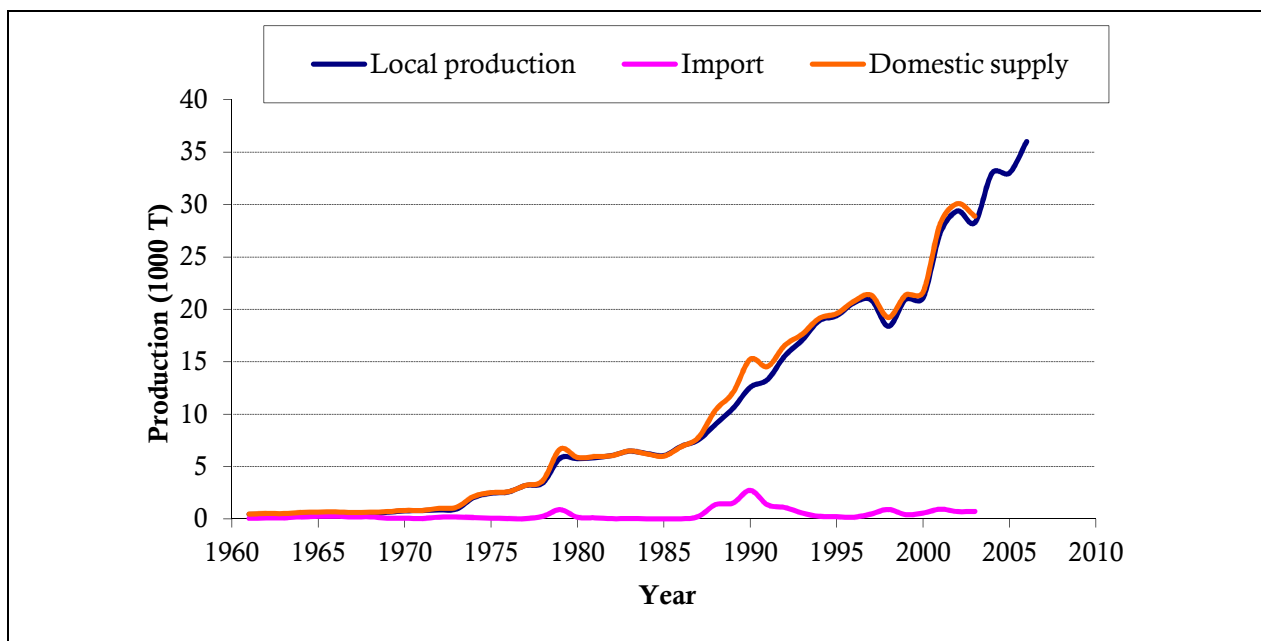


Figure 2.2: Poultry production in Mauritius (Source: CSO, 2007)

2.3.2 Production system

According to FAO (2004), poultry production systems can be broadly categorised into 'sectors' according to their level of biosecurity and the marketing system.

- Sector 1 represents the industrial integrated system with high level biosecurity and birds/products marketed commercially (e.g. farms that are part of an integrated broiler production enterprise with clearly defined and implemented standard operating procedures for biosecurity).
- Sector 2 represents commercial poultry production system with moderate to high biosecurity and birds/products usually marketed commercially (e.g. farms with birds kept indoors continuously; strictly preventing contact with other poultry or wildlife).
- Sector 3 represents commercial poultry production system with low to minimal biosecurity and birds/products usually entering live bird markets (e.g. a caged layer farm with birds in open sheds; a farm with poultry spending time outside the shed; a farm producing chickens and waterfowl).
- Sector 4 represents village or backyard production with minimal biosecurity and birds/products consumed locally.

The categorisation of the local broiler production systems is based on flock size only, and a classification has been devised by the Agricultural Research and Extension Unit (AREU) (M. Pillay, pers. Comm., 2006). Hence the main broiler production systems in Mauritius are classified as follows:

- Traditional/Backyard semi-commercial production (characterised by less than 50 units)
- Small-scale commercial production (characterised by a minimum of 50 units of broiler chicken up to 500 units)
- Medium-scale commercial production (characterised by a minimum of 500 units of broiler chicken up to 10 000 units)
- Industrial production (characterised by more than 10 000 units of broiler chicken)

2.3.2.1 Traditional/Backyard semi-commercial production

In the late 1950s, local chicken broiler meat production was carried out essentially as a backyard activity. This is a low input production system where birds are left to 'scavenge' on kitchen refuse. Poultry products are either consumed by the household or sold live or freshly-slaughtered to neighbouring households. Today backyard production is not considered to be of economic importance, but it does involve around 1000 part-time producers (Jugessur and Seeneevassen Pillay, 2002), and also contribute towards household food security. Over the years with incentives given by the Government in terms of subsidies on feed, day-old chicks and vaccines, the traditional backyard production has given way to an increasingly commercial production.

2.3.2.2 Small-scale commercial production

This type of production is characterised by a minimum of 50 broilers up to a maximum of 500 units (M. Seeneevassen Pillay, pers. Comm., 2006). It is mainly carried out in the same residential area of the producer and is essentially a part-time activity, having evolved from the traditional sector.

2.3.2.3 Medium-scale commercial production

This type of production is characterized by a minimum of 500 broilers up to a maximum of 10000 units (M Seeneevassen Pillay, pers. Comm., 2006)

2.3.2.4 Industrial production

There are four main industrial broiler producers in Mauritius namely Food and Allied Industries Ltd, Innodis Ltd, Poulet Arc en Ciel and Mont Ida Poultry Farm. In addition to having mechanised and automated most of their production system, these companies are vertically integrated in terms of parent stock farms, production of day-old chicks, broiler grow-out farms (self and contract farming), feed manufacturing plants, processing plants for transformation into value-added products, as well as marketing and distribution companies.

Food and Allied Industries Limited (FAIL)

FAIL launched in 1966, employed more than 750 people in 2006 with an annual production of about 11 000 tonnes of chicken meat and 140 000 broiler chicken per week. This company imports 3000 – 4000 chicks per year from France and also sells day-old chicks to small producers (Business Magazine, 2006).

FAIL is divided into 4 parts: Reproduction unit: hatching of eggs, brooding areas for chicks, fattening unit and a slaughter house

This company is equipped with a modern abattoir and can treat 6000 chicken/hr. FAIL has more than 20 farms and several subsidiaries such as LFL, Chantefrais (created in 2002), KFC, Panagora and many others. Panagora and Blyth Limited (IBL) are responsible for the distribution of broiler chicken products.

According to FAIL, fresh chicken “Poulet frais” represent about 60% of total poultry production. Fail is present in Madagascar since 10 years (set up in 1996) and produces 75 000 – 80 000 chicks per week which are sold to small ‘Malgache’ breeders (Business Magazine, 2006).

Innodis Ltd

Launched in 1973, Innodis Ltd has been in the production and supply of broiler chicken for almost 40 years. The main objective of the company was to make Mauritius self-sufficient in chicken and as a result it started with an annual production of 2000 to 3000 tonnes. Presently, Innodis Ltd is vertically integrated with its own parent stock, laying unit, hatching unit, broiler production farm, slaughterhouse, processing and marketing units. The slaughterhouse has a capacity of treating 3000 chickens per hour and has an annual production of 9500 tonnes of dressed chicken. Innodis Ltd produces and markets two brands of dressed chicken meat namely “Prodigal” and “Carmen”. The business unit is ISO 9002 and Hazard Analysis and Critical Control Points (HACCP) certified. Innodis Ltd has approximately a 40% share in the local broiler chicken production.

Mont Ida Poultry Ltd

Toward the end of 1990, Mont Ida Poultry Farm was established from JICOL. The farm is today a fully integrated farm with its own breeding and hatchery unit. In 2012, about 3.6 million kg of live chicken were produced (E. Kwok, pers. Comm., 2013).

Poulet Arc En Ciel Ltd

Established by Mr V. Aubeeluck, Poulet Arc En Ciel Ltd was set up in 1992 and is presently a subsidiary of Innodis. This company has an annual production of 2500 tonnes per year (around 1.45 million birds per year) and contributes 7 to 8% of the local broiler chicken production. It is vertically integrated with reproduction units, brooding areas, fattening unit, slaughter-house and marketing section. It supplies chicken products in the local market with the brand names of “La bonne Volaille” and “Farm Fare”. The company has a quality management system that satisfies the Mauritius Standard Bureau (MSB) and has a future project for HACCP certification.

Le Poulet Fermier Ltee

Situated in the district of Black River, “Le Poulet Fermier Ltee” has been in the production of free range chicken for more than 10 years. This company is principally owned by the “Jhuboo Group of Companies”. Initially, it started with 200 free range birds in 1998 with parent stocks imported from France and the main objective was to supply free range chicken meat in Mauritius.

Compared to other broiler chicken production system, “Le Poulet Fermier Ltd” deals with slow growing broilers that are kept for around 70 to 80 days. Part of the growing cycle of this special breed of broiler is traditionally done in open air.

Initially, in 1998, the company was fully integrated but when broiler production increased, an agreement was signed with Innodis for slaughtering, processing and distribution of Le Poulet Fermier brand. Le Poulet Fermier Ltd has a production of about 175 000 units annually (around 300 tonnes annually) and the broiler products are marketed by Innodis which represents about

0.8% of the local broiler chicken market. Le Poulet Fermier brand has a niche market and is available as both chilled and frozen across the island.

2.3.3 Marketing

With the evolution of the broiler industry, the marketing of chicken has also evolved from simple to quite complex. The marketing of chicken has been mainly influenced by the increase in chicken production and storage facilities. Different producers have different marketing schemes. Chicken meat produced by Food and Allied Industries Limited under the brand name of “Chantecler”, is marketed by Panagora Marketing Limited. Other industrial broiler producers such as Innodis Ltd, Poulet Arc en Ciel Ltd and Mont Ida Poultry Ltd have their own marketing facilities for their chicken products. Commercial small and medium scale producers and backyard producers do their own marketing but sometimes they depend on broiler chicken traders to market their products. The marketing channel shows the different pathways adopted by broiler chicken producers.

2.3.4 Consumption

As highlighted in figure 1.1 the poultry production accounted for 92% of total local meat production. This growth in production has been driven by a systematic increase in demand and consumption of broiler chicken (figure 1.3). This point is perfectly illustrated in figure 1.3. In 1985 the consumption per head was 6.34 Kg and in 2011 it was 35.7 kg. This represents an increase of 463% over a period of 27 years, amounting to an average annual growth rate of 17.1%. The growth rate in consumption over the last 10 years has steadied and has averaged 5.35%.

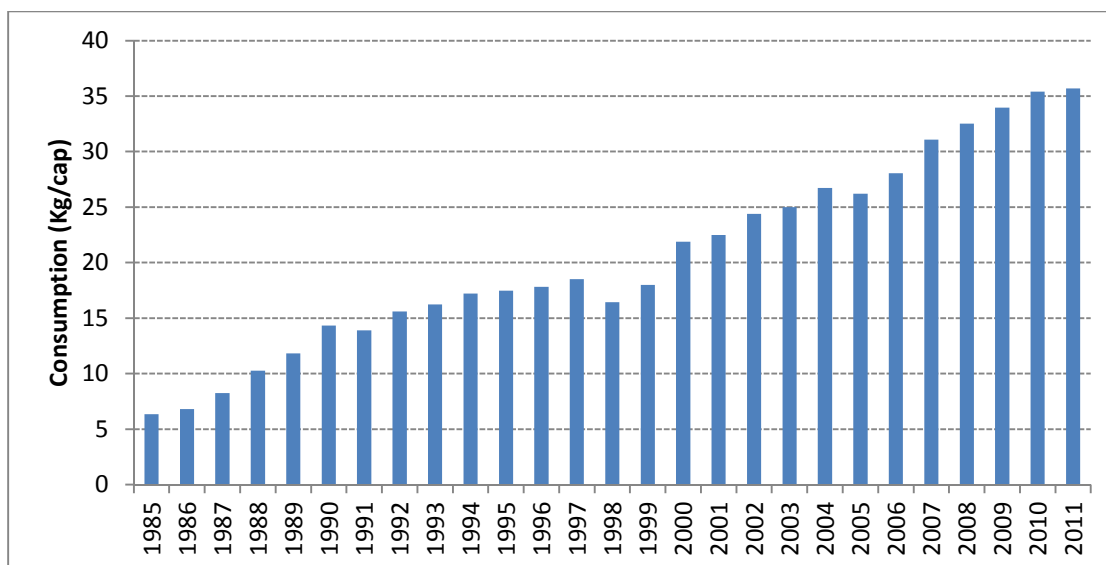


Figure 2.3: Consumption trends for broiler chicken in Mauritius

2.4 Support systems for poultry production

There are several actors working in the broiler chicken supply chain who provide support to the chain through the supplies of raw materials and other inputs necessary for the production of broiler chicken. In addition, other actors play an important role in the institutional support to the sector as well as providing research and extension services.

2.4.1 Inputs and inputs suppliers

Inputs such as broiler chicks, broiler feed, drugs, broiler equipment and litter are used in commercial broiler production. Most of the inputs are available locally but some raw materials used in feed manufacture are imported.

Table 2.1: Suppliers of broiler chicken inputs

Broiler chicken inputs	Suppliers
Broiler feed	Meaders, LFL, LFF
Broiler chick	La maison du petit aviculteur, Poultry Breeding Centre, CERES (now known as Inicia Ltee), Maurivet, Poulet Arc en Ciel
Drugs	CERES (now known as Inicia Ltee), Mauripharm, Pharmacie Vetopharma Ltd, Maurivet
Broiler equipment	Teleport Ltd, Maurivet, Velvindron

2.4.1.1 Broiler feed

Feed cost represents about 70% of the total broiler production cost. Local broiler producers make use of mostly three types of broiler feed: Broiler starter, broiler grower and broiler finisher. Other types of feed such as broiler starter elite, broiler grower elite, broiler finisher elite and chicken mass are also available locally.

Table 2.2: Price of feed from the three local feed suppliers in 2013

Poultry feed suppliers	Meaders	LFL	LFF*
Poultry feed	Price (MUR/50 Kg)		
Broiler Starter (Select)~	1090	1089	385
Broiler Grower (Select)	1057	1063	325
Broiler Finisher (Select)	1010	1013	365
Broiler Post Finisher (Select)	994	998	
Broiler Starter (Elite)	1135	-	-
Broiler Grower (Elite)	1105	-	-
Broiler Finisher (Elite)	1055		-
Broiler Post Finisher (Elite)	1035		-
Chicken mass	-		-

* ceased operations in 2009

~ The term Select and Elite applies only to Meaders

2.4.1.2 Broiler chicks

Usually chicks are produced locally but the parent stocks are imported from different countries depending on the breed of broilers. The private sector produces about 2 million chicks each month and sells at a higher price while the PBC produces about 42,000 chicks (Table 1.3)

Table 2.3: Suppliers of chicks and the corresponding price of chicks in 2008

Broiler chicks suppliers	Price of day old chick (MUR/unit)	Breeds
PBC	20.00	Ross 308
Maison du Petit Aviculteur	24.00	Hubbard
CERES (now known as INICIA LTEE	25.00	Cobb 500

Poulet Arc en Ciel and Maurivet also supply day old chicks but data from these suppliers were unavailable.

2.4.1.3 Broiler medication

In Mauritius, private companies like CERES (now known as Inicia ltee), Mauripharm, Pharmacie Vetopharma Ltd, Maurivet and others are responsible for the supply of drugs for broiler production. Mainly drugs like vitamins, antibiotics, vermifuges and vaccines are used. For small-scale production, the Division of Veterinary Services (DVS) provides vaccines at an affordable price.

2.4.1.4 Broiler equipment

Companies like Teleport Ltd, Maurivet, Velvindron and others are responsible for the supply of broiler equipment. Broiler equipment includes feeders, drinkers, brooders and plumbing materials that are made up of either plastic or metals. Both imported and local equipment can be handled either automatically or manually. Mostly commercial and semi-commercial broiler producers use broiler equipment as their production system is mechanised and automated.

2.4.2 Support institutions

Institutions like Agricultural Research and Extension Unit (AREU), Poultry Breeding Centre, Veterinary Services, and DBM support the Mauritian broiler industry by providing services and facilities to broiler producers.

2.4.2.1 Agricultural Research and Extension Unit (AREU)

AREU provides extension services, promotes cost effective production techniques, gives advice and training in husbandry practices to broiler producers around the island. AREU is also responsible in conducting research in the livestock sector.

According to AREU, major threats such as avian influenza, high price of feeds, high cost of production and the risks associated with the disposal of spent litter can affect the broiler industry locally. In order to limit the consequences of these threats, AREU creates awareness amongst actors in the industry, provides training and advice on biosecurity, waste disposal, efficient production system and cost of production.

Additionally, AREU gives training to farmers and entrepreneurs, arranges group meetings with broiler producers, and conducts regular farm visits so as to help broiler producers to run their business more efficiently. AREU also published a manual on egg and meat production in 1996.

2.4.2.2 Development Bank of Mauritius (DBM)

The role of DBM is to help small broiler producers financially by providing short term, medium and long-term loan. DBM provides a lower interest rate compared to other banks in Mauritius. Different loan schemes are available for agro-processors and livestock breeders, depending on the total cost of projects, repayment periods and amount of loan to be taken.

2.4.2.3 Animal Production Division (APD) & Poultry Breeding Centre (PBC)

The main objective of the PBC is to supply day-old broiler and layer chicks to local farmers at an affordable price (Table 3.0). The PBC presently maintains a flock of 8 000 parent stocks with an

annual production of 600 000 saleable chicks. As at April 2011, only broiler chicks are being produced and around 42,000 units are sold on a monthly basis.

According to officers in charge at PBC, major threats affecting the broiler chicken industry are mainly bio-security, increase in price of broiler feed and avian flu. In case of an avian flu outbreak, the PBC will have to inform the Veterinary Services. The latter will set up a crisis committee and take measures according to established protocol concerning the disease.

2.4.3 Support services

There are several institutions which are directly or indirectly involved in the broiler production and processing activities to provide a sustainable broiler industry in Mauritius. The following sub-section provides some details about relevant legal and institutional organisations involved in the local poultry industry.

2.4.3.1 Ministry of Agro Industry & Fisheries (MAF)

The MAF is responsible for the creation of new business avenues in the agricultural sector. The existing guideline is the Animal Diseases Act (1925), which deals with mainly import procedures and animal diseases. The DVS also devised a Contingency Plan for AI.

2.4.3.2 Ministry of Environment & National Development Unit

This Ministry ensures the protection and management of environmental assets and promotes sustainable development of the poultry industry. Several legislations exist such as the regulations under Environmental Protection Act (2002), Environmental Guidelines on poultry rearing (2006) and Guideline on the preparation of Preliminary Environmental Report for poultry projects (2005).

2.4.3.3 Local Authorities

The mandate of the Local Authorities is to control economic activities within their authority. The regulation is under the Local Government Act, 2003.

2.4.3.4 Ministry of Local Government

This institution controls the poultry industry by ensuring an efficient and sustainable management of solid wastes under the Local Government Act, 2003.

2.4.3.5 Ministry of Health and Quality of Life

This ministry ensures that broiler farming activities are practised in a sanitarily acceptable way under the public Health Act, 1982.

2.4.3.6 Ministry of Housing & Land

It ensures planned development of the Mauritian territory by developing policies and optimising scarce land resources.

2.4.3.7 Water Resources Unit

This department is responsible for the assessment, management and conservation of water resources and it also grants water discharge permits.

2.4.3.8 Water Management Authority

It grants permits for the discharge of wastewater into sewers under the regulation of Wastewater Management Authority Act, 2000.

2.4.3.9 Ministry of Industry, Small & Medium Enterprises, Commerce & Cooperatives

It provides facilities to small enterprises to start a business under the Business Facilitation Act 2006.

2.4.3.10 Other institutions or organisations

Other institutions that are directly or indirectly involved in the poultry activities in Mauritius are:

- The University of Mauritius
- World Poultry Science Association
- Poultry Producers Association

2.4.4 Existing legislations concerning the poultry industry

Legislations such as the Environment Protection Act (EPA) 2002, Public Health Act 1982 and Business Facilitation Act 2006 have a direct regulation on the broiler industry.

2.4.4.1 EPA 2002

The rearing of poultry above 5000 birds , slaughtering of birds not less than 5000 per month, food processing industries (excluding small and medium enterprises) and manufacturing of animal feed are listed as activities requiring a Preliminary Environmental Report (PER) as per the Environment Protection Regulations 2006. The concerned authority for PER approval is the Ministry of Environment & National Development Unit.

2.4.4.2 Public Health Act, 1982(Poultry breeding regulations 2004)

Under the Public Health Act 1982, Poultry Breeding Regulations were formulated in 2004 with respect to poultry rearing activities.

The regulations included the following:

- Application and renewal of permits
- Proper location of poultry farms
- Good husbandry practices
- Structural and sanitary requirements
- Use of poultry manure for agricultural purposes
- Closing down of pen

The Sanitary Authority under the Public Health Act 1982, makes provision to serve a notice on the person responsible of a nuisance to urge the latter to stop the nuisance within a specified lapse of time. In case the nuisance is maintained, then the court may further order the author to reduce the nuisance within a prescribed delay.

2.4.4.3 Business Facilitation Act 2006

The Business Facilitation Act 2006 act allows businesses to start operations on the basis of self-adherence to comprehensive and clear guidelines and the authorities to check for compliances by exercising ex post control.

2.5 Drivers behind the evolution of broiler industry

2.5.1 Increase in income per capita.

One of explanatory factors underpinning the rapid surge in the consumption of broiler chicken in Mauritius has been the significant growth in standards of living. Mauritius has witnessed rapid economic growth since the early 1980s to achieve a GDP/capita of US\$ 7591 in 2010 (figure 2.4).

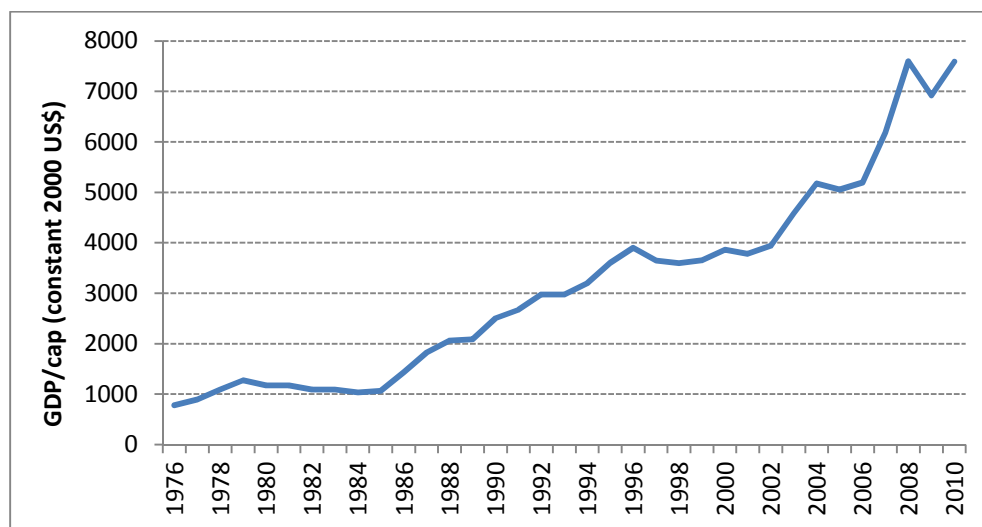


Figure 2.4: Evolution in GDP/cap for Mauritius (constant 2000 US\$)

This growth has concomitantly lead to an increase in disposable income for the average Mauritian, resulting in fundamental changes in food consumption patterns, characterised by an increase in total calorie intake and accompanied with a shift in the composition of the diet towards more meat, eggs, dairy products as well as more fats and oils. As previously illustrated chicken meat has been the main constituent of meat consumption locally.

2.5.2 Increase in price of chicken and its substitutes

Since the last decade, price of chicken meat has increased considerably due to increased cost of production. But, if compared to other meats such as beef and pork, chicken meat remains cheaper (Figure 2.5), and is therefore more competitive in terms of price. Mauritians are generally price sensitive. Indeed, price is considered to be a major determinant of food consumption. Immediately after the rise in price of chicken meat, there may be a decrease in consumption of chicken meat. However, this decrease in demand of chicken does not last for a long period of time. Shortly, the demand for chicken regains its previous trend since chicken substitutes are much more expensive. Consequently, the local demand for chicken meat is higher compared to other meats. In order to meet this demand, supply of chicken meat in the local market has increased.

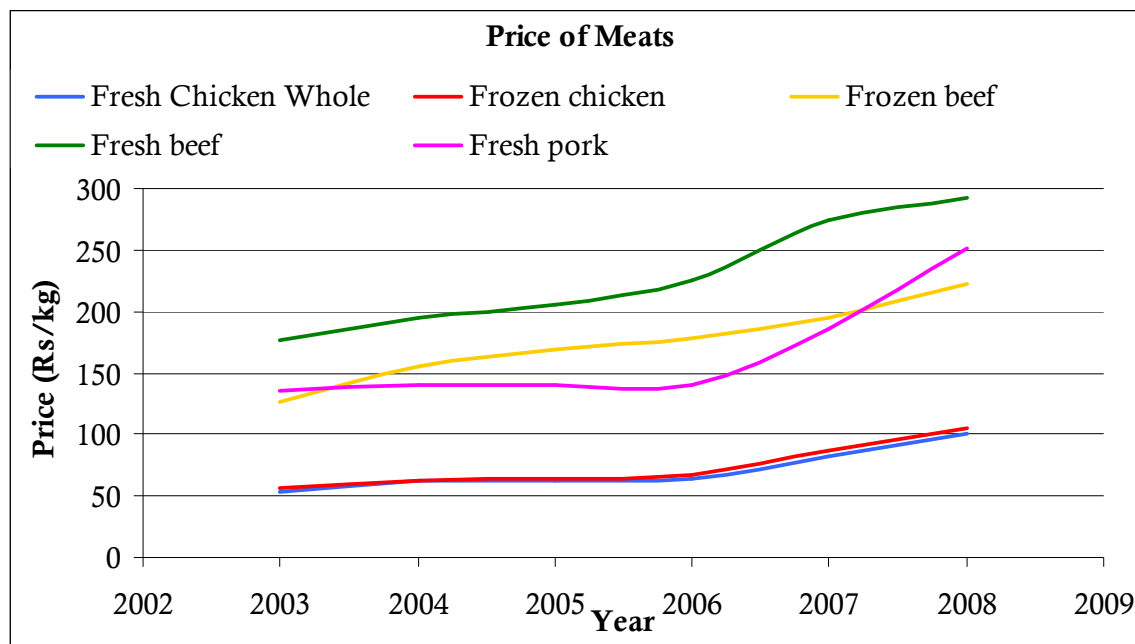


Figure 2.5: Price (Rs/Kg) of different meats from 2002 to 2009

2.5.3 Religious dietary restrictions

Food is an important part of religious observance and spiritual ritual for many faiths including Christianity, Judaism, Islam, Hinduism and Buddhism. Religious traditions and beliefs have

shaped the diets and food patterns of believers. Religious dietary guidelines influence a follower's food choices and behaviours. Compliance with these guidelines creates an identity and a sense of belonging for an individual. Some religions prohibit the consumption of certain foods. For instance, Muslims are not allowed to eat pork whereas Hindus are not allowed to eat beef. Chicken meat, being free from any religious restrictions, has a greater market share in countries where other meats are religiously prohibited. The same situation prevails in Mauritius where Hindus and Muslims represent 51.8% and 16.6% of the population respectively (CSO, 2007).

2.5.4 Availability and accessibility of chicken in Mauritius

2.5.4.1 Production cycle

As compared to other livestock, broiler chicken has a shorter life cycle. Normally, commercial broilers reach maturity in 6 to 7 weeks, which make chicken meat easily available and highly accessible throughout the year. This activity has gained the interest of more than 270 broiler chicken producers in Mauritius (AREU, 2007) since money invested is rapidly recovered. Consequently, broiler production is considered to be a lucrative business.

2.5.4.2 Availability of chicken in Markets, Supermarkets, Retail shops and Meat shops

Around 50 years back, there were very few retail shops in Mauritius and the sale of chicken meat in these shops was almost inexistent. Later, the introduction of supermarkets, hypermarkets and food outlets led to an increased accessibility of chicken meat. As a result, sales and consumption of chicken also increased. Additionally, opening of meat shops, both “Chantefrais” and “Non-Chantefrais” outlets, made fresh chicken meat more accessible to Mauritian consumers. Nowadays, chicken meat is available in almost every village and consumers no longer have to travel long distances to buy chicken meat. As at the year 2007, there were more than 272 fresh chicken outlets in Mauritius (MOH & Quality of Life, 2007).

2.5.4.3 Chicken products

In the past, only fresh chicken was available for consumption in Mauritius. However, new technology, processing techniques and preservation methods led to the introduction of several chicken cuts and chicken products namely, frozen whole carcass, frozen cuts, chilled meat, chilled cuts, marinated cuts, de-boned chicken meat, organic broiler chicken meat, chicken sausages, chicken burgers and chicken nuggets. The emergence of supermarkets, hypermarkets and chicken outlets in Mauritius greatly helped in making chicken meat and its products more accessible to Mauritian consumers. The wide variety of chicken products has made chicken more popular. Chicken products form an integral part of the Mauritian diet.

2.5.5 Change in food habit and lifestyle

Industrialisation and technological advancement have increased the standard of living of billions of people in both developed and developing countries. As a result, food habits and lifestyles have also undergone some changes. With an increase in disposable income, fish, meat, poultry and their products have become more affordable and they are no longer considered as luxury food commodities. Changes in food habits gave rise to diseases of affluence such as heart disease. Consumers nowadays are aware that diet is intricately related to health and bad eating habits may lead to health problems.

Rise in non-communicable diseases, scientific advancement and the media have made consumers become more health-conscious. Indeed, rising awareness of the dangers of eating food that contains high levels of cholesterol, or animal fat, has resulted in a decline in the consumption of red meat (Richardson, 1994). Red meat, which used to be the most popular choice for dinner, is no longer an American favorite, instead, chicken, turkey and fish have become more popular (International Thomson Asia ELT, 2009). Moreover, Richardson (1994) found evidence for a trend away from the red meats of beef and lamb towards the increasingly popular white meats like chicken. Additionally, according to a recent study in Australia, a high intake of red meat (ten times per week or more) may increase the risk of Age-related Macular Degeneration (AMD) which is the leading cause of blindness among older people (Chong *et al.*,

2009). It can be concluded that the health risks associated with red meats have played in favour of chicken meat. Everyone is striving for a better quality of life and therefore people are more willing to adopt new healthier lifestyles by shifting to healthy foods.

2.5.6 Public and private incentives

Both private and public sectors have helped to boost the broiler chicken industry in Mauritius. .

2.5.7 Food Quality Assurance (FQA)

Nowadays food production is more dependent on quality than on quantity or price of food products, that is, markets are quality-oriented rather than quantity-oriented. This shift from quantity to quality in food production, led to the emergence of FQA.

FQA is the implementation of quality checks and procedures at every production step, to immediately correct any failure or mistake that may reduce the quality of the final food products (Blaha, 2000). The field of food quality assurance has evolved substantially over the past decade, and certain key developments such as Quality Systems (e.g., ISO 9000) and HACCP have become widely accepted. Thus, FQA ensures high quality products, eliminates losses incurred by low quality products and increases competitiveness.

Although meat inspection and food hygiene are sufficient to guarantee meat safety, consumers are still concerned about the health risks associated with meat. It has been observed that consumers do not differentiate between commodities or diseases so that media reports on BSE do not only have an adverse impact on beef, but on meat in general (Blaha, 2000). Therefore, the implementation of a FQA system in the broiler chicken industry would help to restore the decreasing confidence of consumers in food safety.

Another advantage of a FQA system is that it can be used as a marketing tool both nationally and internationally. FQA systems can be used to overcome trade barriers which restrict trade

based on food safety issues. Hence, adoption of a FQA system may boost up the broiler chicken industry.

2.6 Threats to the broiler supply chain

Global production of broiler chicken meat has been growing since the 1960s, faster than that of any other meat. This growth is expected to continue because poultry meat is cheaper, more versatile, and provides more health benefits than other meats (Chang, 2007). However, it faces threats such as the Avian Influenza (AI), cheap imports of chicken products, trade liberalisation, rising price of feed and consumer concerns related to food safety.

2.6.1 Avian influenza

Highly pathogenic AI outbreaks can have disastrous effects on the whole broiler industry, resulting in substantial losses. In 2006, the Agricultural and Rural Development (ARD) Department of the World Bank classified these losses as direct, consequential or indirect.

2.6.1.1 Direct losses

The direct losses arise from the death of birds, reduction in the production of eggs as well as disposal and disinfection costs. Once introduced to a chicken flock, AI outbreaks lead to high mortality, therefore direct and immediate impacts of AI outbreaks in poultry flocks result from the loss of the current value of birds, which die or are culled (ARD, 2006). Large numbers of poultry have died from AI or been culled to control the disease since it spread widely from 2004 onwards. In Thailand, for example, 63.8 million birds were culled from the onset of AI outbreaks from 2004 to 2006 (Otte *et al.*, 2008). Total number of birds that died from AI may well have been higher, since information on the poultry losses in traditional backyard systems in rural areas often remains unreported.

2.6.1.2 Consequential losses

These losses refer to farm costs or lost farm income due to the AI outbreak. Consequential losses result from foregone income from poultry raising during the ensuing interruption of production (ARD, 2006). After an outbreak of AI, poultry production is usually interrupted for several weeks and financial losses result from the disruption of poultry and egg sales and continuing fixed costs (Otte *et al.*, 2008). Moreover, countries engaged in poultry trade may resort to emergency vaccination. Meat from vaccinated poultry may be ineligible for export and thus the meat has to be redirected to lower priced domestic or regional markets (Otte *et al.*, 2008). Additionally, the farms have to be restocked after the outbreak. Hence, interruption of business and restocking add to the expenses linked to AI.

2.6.1.3 Indirect losses

These losses are incurred outside the farm and may not directly affect farmers or poultry producers. Rather, indirect losses have greater impact on the other people involved in the broiler supply chain such as feed manufacturers, poultry retailers and consumers.

Firstly, AI may lead to a significant drop in the demand for poultry feed since large numbers of birds are killed in an AI outbreak. In Vietnam, for example, one major feed producer reported a 90% drop in demand, whereas another reported a 60–70% drop (Agrifood Consulting International (ACI), 2006). Yalcin (2006) reported that in Turkey, during the AI outbreak period, sales values of vaccines, drugs, vitamins and feed additives to the poultry industry dropped by 25, 44, 55 and 30%, respectively, whereas sales value of disinfectants increased by 20%. Decreased trade volumes represent foregone income, thereby resulting in losses.

AI outbreaks may also negatively impact the broiler supply chain at the level of slaughtering. For instance, Ibrahim *et al.* (2007) reported that in Egypt, about 250 slaughterhouses stopped operating completely at some stage of the AI crisis. In Turkey, slaughterhouse output dropped by 12% during and by another 21% after the AI outbreak before gradually recovering (Otte, 2008).

The consequences of AI outbreaks can also have drastic effects on restaurants and food outlets. For example, after the Vietnamese government banned the sale of chicken, Thai-owned Kentucky Fried Chicken franchised stores in Vietnam had to close shop for weeks before reopening and changing the menu to serve fish instead of chicken (Kazmin, 2004).

As the highly pathogenic AI H5N1 virus has shown to be able to infect humans, AI outbreaks in poultry have, at least in the period immediately following their notification, led to a drop in demand for poultry meat and eggs (Otte *et al.*, 2008). For example, as a reaction to the spread of AI in early 2006, nearly 20% of the respondents of a consumer survey conducted in the European Union (EU) stated that they had reduced consumption of poultry meat by an average of 18% and the sales of poultry and eggs fell by 70% and 20% in Italy and France, respectively (Agra CEAS, 2007). In Ghana, after the first outbreaks of AI in 2007, almost 50% of the respondents changed eating habits and 75% of public and animal health workers stopped eating poultry meat (Otte *et al.*, 2008). The drop in demand caused by consumer anxiety about the risk of contracting AI virus can lead to a severe fall in the price of poultry and its products.

Some actors in the poultry market who are perceived as supplying safe poultry products can, at least temporarily, benefit from widespread consumer concerns. For example, in December 2005, prices of chicken in Vietnamese supermarkets were 25–35% higher than pre-outbreak prices, at a time when poultry prices in traditional markets were still below pre-outbreak levels (ACI, 2006). A drop in supply of and demand for poultry meat generally leads to a concomitant increase in demand for the substitutes of poultry such as pork, beef, fish and soya. In Cambodia and in Vietnam for example, prices of non-poultry meat rose by 30% as a result of the first AI epidemic wave in 2004 (ACI, 2006).

According to Otte *et al.* (2008) Thailand and Vietnam are probably the two severely infected countries that have put the largest efforts into the elimination of AI and in which, as a consequence, the disease has induced the largest structural changes. In those two countries, large poultry companies that contracted poultry production to individual farmers prior to AI

have moved away from contract farming to full vertical integration in order to increase control over all stages of production. The AI crisis also accelerated the shift of poultry exports from unprocessed frozen to pre-cooked meats. Most of these changes are unlikely to be reversed.

Till now, there has been no AI outbreak in Mauritius. Still, according to the Division of Veterinary Services (2006), the potential risk of AI outbreaks cannot be completely ignored. The Mauritian broiler industry would be immensely jeopardised if ever AI outbreaks occur in Mauritius. AI outbreak in Mauritius may have a direct negative effect on local poultry production, exports, poultry feed industries, retail outlets, employment, public health as well as the tourist sector (Division of Veterinary Services, 2006). Thus, all necessary measures have to be taken in order to minimise the risk of such outbreaks. In this context, the OIE has developed guidelines for the progressive control of HPAI around the world and Mauritius is in constant touch with OIE as regards to latest developments. Mauritius has therefore adopted a strategy in line with OIE recommendations for the prevention and control of the disease. A National Committee comprising of different Ministries and major stakeholders both from the private and public sectors has developed an Avian Influenza Contingency Plan with the following objectives; to articulate on the procedures to be followed in case of a suspected and/or confirmed outbreak of Avian Influenza, to ensure that there is necessary personnel to assist the Division of Veterinary Services with administration and procurement of necessary material and equipment and to constantly update and inform the population in order to avoid nationwide panic and compensation in the event of mass destruction of affected poultry (Ministry of Agro Industry and Food Security, 2012).

2.6.2 Rising price of feed (maize)

Poultry feed consists mostly of maize, in fact it makes up approximately 70% of poultry feed and therefore maize represents a large share in the cost of production (Integrated Regional Information Networks, 2009). Ellis (2008) reported that in fact, feed accounts for approximately 65% of the production costs. Recent rises in feed prices have increased the production cost in

poultry farms (Yegani, 2008). Maize prices have increased by 35% from end of 2007 to mid 2008 (Ellis, 2008).

In Mauritius maize is grown in both pure stand cropping and in intercropping with sugarcane. Maize is used both for human consumption and poultry feed. However, since 1986, area under maize production has declined due to cheaper imports (SADC MAPP, 2007). In the late 1990's, the local cost of maize production, was at MRU 5 per Kg, whereas the price of imported maize from South Africa and Argentina was only MRU 2.5 per Kg (Salmon, 2002). Therefore, it was more economical to import grain maize than producing maize locally. As a consequence, in 1963 grain maize production stopped completely in Mauritius (Rummun and Govinden, 1997). The subsequent increase in maize production is mainly due to the production of sweet corn and green cobs (Figure 2.6).

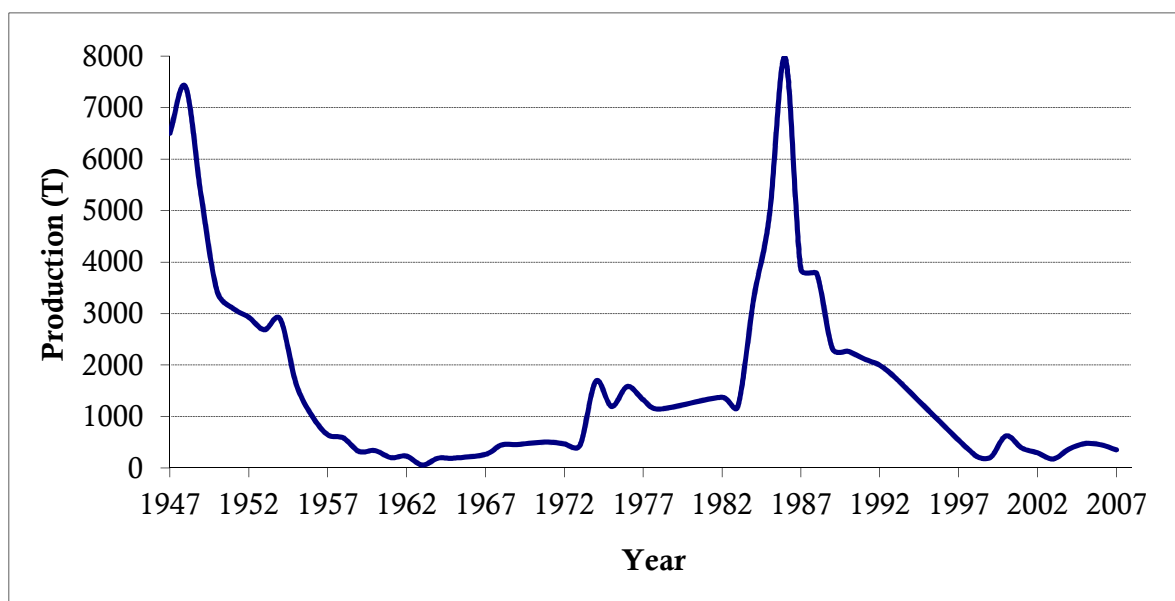


Figure 2.6: Production of maize² in Mauritius from 1947 to 2007
Compiled from SADC MAPP (2007) & Ng Kee Kwong (2008)

The maize produced locally is mainly used for human consumption. Maize used for feed manufacture is solely imported and since 2001 Mauritius has been importing maize from

² Maize includes grain maize, sweet corn and green cobs.

Argentina only (Neeliah *et al.*, 2006). Approximately 75 000 tonnes of maize (mostly yellow) are imported annually from Argentina and the average CIF (Cost, Insurance and Freight) price increased from MRU 5,200 per tonne to MRU 8 500 per tonne in 2007 (SADC MAPP, 2007). From Figure 2.7 it can be seen that the most remarkable increases in price of maize occurred in June and July 2008.

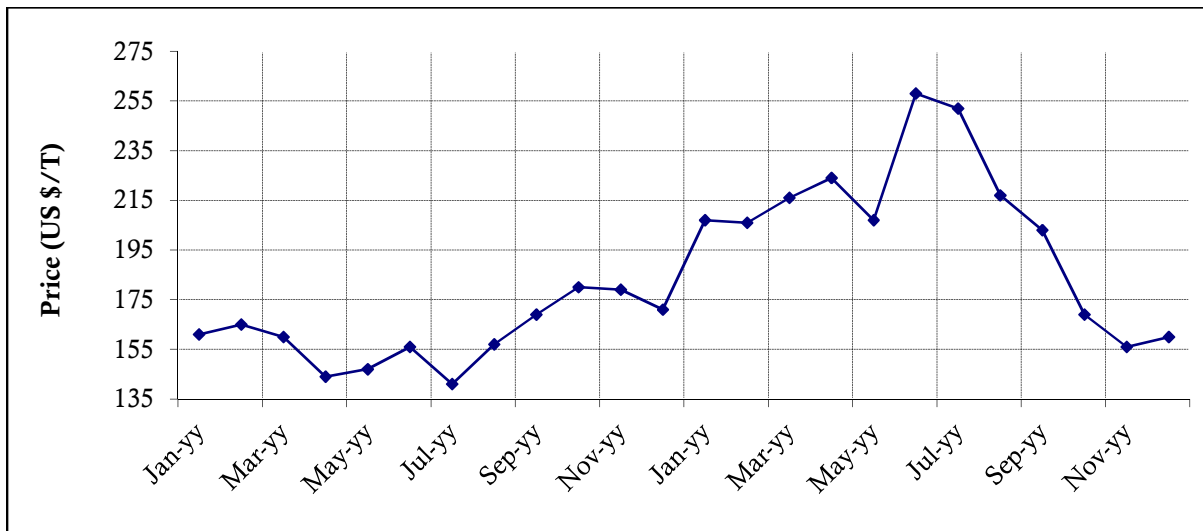


Figure 2.7: Estimated average monthly price of maize in Argentina
Compiled from Food and Agriculture Organisation (2008)

The rise in price of maize can be explained by the fact that the demand for maize exceeded its supply. According to Cutts and Hassan (2003), the scarcity of maize can be attributed to drought and the increasing use of maize for the production of biofuels. Moreover, the government of Argentina has been restricting food exports in order to minimise the effects of high food prices and to ensure that the local population have enough food for a healthy and productive life (Braun, 2008).

Rising feed prices automatically increases the cost of production. Das (2008) reported that 20% of poultry farms had closed down due to the rise in cost of production. Rising production costs can result in a decrease in the quantity of products produced as well as an increase in consumer prices. Consumers will have to bear the consequence of sky-rocketing feed prices by paying

high prices for broiler products, whereby consumers may be more inclined to shift to other substitutes.

According to Hinrichs and Steinfeld (2008), the rising price of feed can be attributed to the scarcity of maize as 55 million tonnes of maize were used in the United States of America for the production of biofuels. Still, farmers could take advantage of this situation by using biofuel co-products as feed. This would diversify the diets of broilers and ensure the availability of adequate protein. However, this possibility remains to be explored.

2.6.3 Regional trade liberalisation

Food imports and trade liberalisation are interlinked. Trade reform has the power to change the conditions of access to markets. Thus, it may have far-reaching effects on competition between imported and domestically manufactured products as tariffs are reduced. Production falls in the major importing region with the removal of trade barriers such as tariffs (Peterson and Orden, 2004). For example, in Senegal, tariff reductions on chicken, in the context of a regional trade agreement, led to higher imports over the years 2000 to 2003 (Sharma *et al*, 2005). The growth in imports was rapid since tariff reductions were implemented in a context of appreciating exchange rates, thus accentuating the price difference between imported and domestic product, and poultry imports rose four-fold to account for nearly one-quarter of domestic consumption (FAO, 2006). Similarly, in Tanzania, a lowering of tariffs led to a four-fold import rise from 1996 to 2005 (FAO, 2006; Sharma *et al*, 2005).

In Tanzania, changing consumer requirements for processed poultry products and inadequacies in the domestic processing industry have fuelled poultry imports (Sharma *et al*, 2005). This, combined with large exporters' ability to freeze the product and sell at different prices to different markets, decrease the competitiveness of local broiler operations that produce higher priced whole chickens. Additionally, given the price differential between cuts and whole birds, a small reduction in international prices of low priced chicken cuts could have a disproportionate impact on broiler industries in developing countries (FAO, 2006).

2.6.4 Import of cheap quality chicken products

Rising food imports and its negative effects on domestic markets are a major concern for many countries. High food imports disrupt local markets and may have a negative impact on prices, production and food security. For instance, in Ghana the domestic poultry supply reduced from 95% in 1992 to 11% in 2002 (Kudzodzi, 2006). Senegalese imports of poultry have grown dramatically over the past decade, rising from 506 tonnes in 1996 to 16 600 tonnes in 2002 (Sharma *et al.*, 2005). For small scale producers as well as actors involved in poultry slaughtering, the high influx of poultry imports can put an end to their business or jobs. The product characteristics of imported chicken, usually frozen low priced broiler make it difficult for local broiler operations, producing fresh and highly perishable whole chickens which have a higher cost of production, to compete (FAO, 2006).

The FAO (2006) further estimates that since 1983, developing countries have witnessed 669 cases of poultry import surges. The incidence of these surges increased over the 1984-2003 period with the highest annual incidence occurring over the 1999-2003 period, averaging 41 cases per year.

2.6.5 Food safety

Food safety is defined as the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (Codex Alimentarius, 2003). Food safety is a worldwide issue affecting hundreds of millions of people who suffer from diseases caused by contaminated food. Food safety is, in fact, one of the most widespread health problems and it has the power to drastically reduce economic productivity (Daniell, 2001). Indeed for consumers, safety is the most important ingredient of their food (White Paper on food safety, 2000). It is not difficult to understand these concerns given the large number of reports on food safety issues from around the globe: Sudan dye in chilli pepper (UK); melamine and cyanuric acid to augment crude protein levels in feed (USA, Canada); industrial coolant in toothpaste (Panama); and contaminated vitamin A (Belgium) to name but a few recent cases (Partridge,

2006). Additionally, Flake and Patterson (1999) reported that food safety concerns and increased coverage of meat contamination reduces meat consumption. Food safety issues and consumer concerns associated to chicken meat arises mainly due to problems of hygiene and feed additives.

Hygiene

The term 'hygiene' refers to all the conditions and measures necessary to ensure safety and suitability of food at all stages of the food chain (Codex Alimentarius, 2003). Good hygienic practices reduce the risk of microbiological hazard, which is a major concern for consumers. This is reinforced by the fact that 77% of European consumers considered contamination by bacteria and germs as a serious hazard (Jackson *et al.*, 1996). The chicken meat industry recognises that proper handling at all steps in the food industry (at the farm, by processors, transporters and retailers and in commercial kitchens) can significantly reduce the amount of bacteria on chicken meat and any risk to consumers (ACMF, 2006).

Food hygiene is crucial as it paves the way towards ensuring food safety, thus reducing foodborne diseases. Consumers expect to be provided with safe food. Food issues related to unhygienic practices shake the confidence of consumers. Thus, consumers will be unwilling to purchase food from food businesses previously involved in health related food issues. Food businesses may have to pay huge compensations as a result of legal action taken by consumers suffering from foodborne diseases. Food produced by unhygienic practices may be unsafe or unsuitable for sales, leading to food wastage and reduced productivity. The costs of foodborne diseases are incurred not only by individuals who become ill, but also by their employers, their families, health care agencies and food businesses involved (Jouve *et al.*, 1999). Hence, at the end of the day, every stakeholder in the food chain may have to bear the consequences of unhygienic food practices.

Food additives

Jackson *et al.* (1996) claimed that additives are the second greatest consumer concern, the first one being microbiological hazards. A 2006 report from the European Health Focus organization highlighted that 57% of consumers were “extremely or very concerned”, about antibiotics and hormones in meat and poultry (Partridge, 2006). Concurrently, another research showed that 78% of consumers were concerned about hormones given to broilers and 84% of consumers believed that additives were harmful to human health (Aguilar, 2007).

Studies done so far do not provide concrete evidence to state that hormone residues in meat or dairy products cause any human health effects. The amount of steroid hormone that is eaten through meat of a treated animal is negligible compared to what the human body produces each day (Gandhi and Snedeker, 2000). More research must be undertaken in order to compare the risk of breast cancer risk in women who eat meat from hormone-treated animals and in those who eat meat from untreated animals. Partridge (2006) explains that notwithstanding the truth of the matter, consumer perceptions will always prevail as in the classical example of hormones in chicken, which exist only in the minds of some consumers. The perception that growth-promoting antibiotics are deleterious to human health is reflected in the restrictions placed on the use of these feed additives by the Scandinavian nations (Shane, 2006). Furthermore, consumer confidence in the safety of additives appears to have declined; in 1991 40% of consumers claimed confidence in the safety of additives in food, while in 2006 this proportion decreased to 18% (Report Buyer, 2005). Consumer confidence, trust and beliefs can be a threat to any food industry and additives seem to be a very sensitive issue as far as consumers are concerned

2.6.6 Consumer concerns related to animal products produced from genetically modified (GM) inputs

Farmers are increasingly turning towards GM poultry feed (especially GM maize and GM soya) since it offers a competitive advantage compared to more costly non-GM feeds (Foley, 2008). As per Neeliah *et al.* (2006), Mauritius imports grain maize required for feed manufacture solely from Argentina which is the second largest GM producer and exporter. Indeed, the majority of

crops (99% of soya and 65% of maize) in Argentina are GM (Food Standards Agency, 2003). Hence, it is highly probable that Mauritius is importing GM maize from Argentina.

So far, the European Food Safety Authority, which provides scientific advice to the European Commission and member states on food and feed safety, has failed to address genuine concerns over the safety of GM organisms (Friends of the Earth, 2004). However, consumers have expressed major concerns relating to the safety of products from animals on GM diets. For instance, 77% of European consumers stated they would prefer to eat and buy dairy, meat and fish products derived from animals fed on a non-GM diet (Friends of the Earth, 2006). Such reactions can negatively impact on the sales of chicken products derived from broilers on GM diets.

However, human foods derived from GM-fed animals do not have to be labelled (Friends of the Earth, 2006), therefore consumers have no way of knowing whether the animal produce they are eating comes from animals on GM diets and so consumers may consume such food without being aware of it. In this case, the consumers are not given the choice of avoiding foods coming from animals on GM diets. If consumers are not receptive towards GM feed, consumer reactions may present a threat to the chicken broiler industry.

This chapter, based on available secondary information, has enabled us to provide a comprehensive overview of the broiler chicken industry in Mauritius. We have seen that this industry is well structured with actors having well defined roles and responsibilities. As per the objectives of the research project, using the theory underlying the concept of supply chains, we expect to draw a more detailed map of the broiler chicken sector in terms of its structure, performance and governance. In order to do so, we rely on the mechanisms defined in the literature on agri-food supply chains which we present in the following chapter.

Chapter 3: A Literature review of supply chains

3.1 Concept of supply chain, chains and network

3.1.1 Theoretical underpinnings of supply chains

Prior to the 1980s, actors along a supply chain were optimising their individual outputs rather than integrating their goals and objectives with other stakeholders in the supply chain. This individualistic management style resulted into sub-optimisation as it has several weaknesses. As highlighted by Stevens (1989) a disruption destabilises the whole chain, resulting in poor performance. So since the early 1990s firms have been thinking in terms of competing as part of a supply chain rather than a single firm against other individual firms (Christopher, 1992).

Evolution of some parameters for a Personal Computer supply chain is shown in table 3.0.

Table 3.0: Example of a migratory model summarizing the transition in a PC supply chain operation

S.C evolution phase	I	II	III	IV
S.C time marker	Early 1980's	Late 1980's	Early 1990's	Late 1990's
S.C Philosophy	Product driven	Market oriented	Market driven	Customer driven
S.C type	Lean functional silos	Lean S.C	Leagile S.C	Customised leagile S.C
Market winner	Quality	Cost	Availability	Lead time
Market qualifiers	1. Cost 2. Availability 3. Lead Time	1. Availability 2. Lead time 3. Quality	1. Lead time 2. Quality 3. Cost	1. Quality 2. Cost 3. Availability
Performance metric	1. Stock turns 2. Production cost	1. Throughput time 2. Physical cost	1. Market share 2. Total cost	1. Customer satisfaction 2. Value added

Source: Mason-Jones *et al.*, (2000)

A supply chain is therefore defined as a network of suppliers, manufacturers, warehouses, distributors, and retailers who, through coordinated plans and activities, develop products and services by converting raw materials to finished goods inventory. In the process, they share materials, financials, and information flows between them (Chandra and Grabis, 2007). A supply chain is thus a system that embeds other sub-systems representing product, process and organizational structures of enterprises. Agostinho and Teixeira (2003) add to the definition by stressing on the importance of the interaction of a supply chain with its environment. A crucial question is whether the supply chain should be product- or customer-focused. Chandra and Grabis (2007) argue that the type of supply chain should be a mix of both. This important realisation therefore determines what type of supply chains to enter.

3.1.2 Types of supply chain

3.1.2.1 Lean supply chain

A lean supply chain aims towards continuous improvement to eliminate waste or non-value steps along the chain. It is supported by the reduction of setup times to allow for the economic production of small quantities; thus achieving cost reduction, flexibility and internal responsiveness. The lean supply chain cannot mass-customise and cannot easily adapt to future market requirements (Vonderembse et al., 2006). This type of supply chain is essentially based on the lean principles, which have as basis the reengineering of business processes to remove all non-value added activities and waste within the system. The derived benefits are a high capacity utilisation rate, shorter lead times, and minimisation of total supply chain costs.

3.1.2.2 Agile supply chain

The agile supply chain is more flexible. It has the capacity to rapidly respond to continually fragmenting global markets by being dynamic and context specific, aggressively changing, and growth-oriented. According to Vonderembse *et al.* (2006), this type of supply chain is driven by customer designed products and services. It is based on the principles of agility, which nurtures a production environment where products and services are adaptable to future changes in

demand with particular attention to volume, variety, and lead times. In this environment, a high level of synchronisation is desired with the result that members of the supply chain also implement agility principles in their business operations.

Difference between lean and agile supply chain

Both lean and agile supply chain demand high level of product quality but have several differences in terms of attributes (Table 3.1).

Table 3.1: Comparison of lean and agile supply

Attributes	Lean supply	Agile supply
Typical products	Commodities	Fashion goods
Market place demand	Predictable	Volatile
Product variety	Low	High
Product life cycle	Long	Short
Customer drivers	Cost	Availability
Profit margin	Low	High
Dominant costs	Physical costs	Marketability costs
Stockout penalties	Long term contractual	Immediate & Volatile
Purchasing policy	Buy goods	Assign capacity
Information enrichment	Highly desirable	Obligatory
Forecasting mechanism	Algorithmic	Consultative

Source: Mason-Jones *et al.* (2000)

3.1.3 Structure of the supply chain

As stated by Nielsen *et al.* (2002), “the supply chain structure is the network of companies or organisations that manufacture and deliver products or services from the source to the customers”. It involves the integration of the organisation governing the network of supply

chain members and the links between members through which the enterprise is governed (Lambert *et al.*, 1998).

A supply chain is usually divided into tiers. These are units with the same general functionality. But as highlighted by Chandra and Grabis (2007) the concept of tier should be treated with care, however, as differentiation between tiers is often fuzzy and units can belong to multiple tiers. Still, tiers help structure the supply chain and can consequently facilitate identification of their common features. Figure 3.0 presents the structure of a classical supply chain with four tiers.

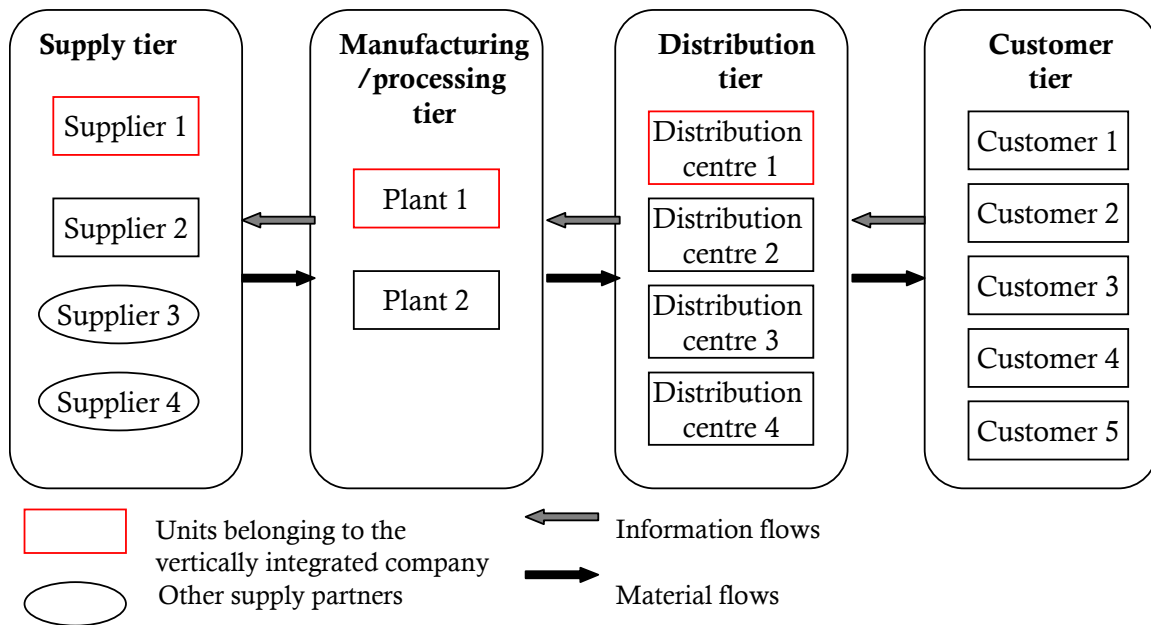


Figure 3.0: A generic supply chain structure
Source: Adapted from Chandra and Grabis (2007)

The customer tier is the most downstream one. It is where the demand for supply chain products originates. The distribution tier receives customer requirements and is responsible for delivering required products and services. It involves units such as warehouses and distribution logistics. According to Chandra and Grabis (2007) this tier can alternatively be classified as wholesalers, retailers and brokers. The processing or manufacturing tier receives demand information and orders from the distribution tier and in return provides products to the distribution tier. The supply tier provides materials to the manufacturing or processing tier based on information received. This tier can be further divided into raw material suppliers, secondary suppliers and direct suppliers. Christopher (1992) summarises the structure of the supply chain as a network of organisations that are involved through upstream and downstream linkages in the different processes and activities that produce value in the form of products and services. An important element is to configure the supply chain that is to specify the number of tiers in the supply chain, the number and types of units in each tier and also identifying specific constraints for the tier as a whole.

A supply chain comprises a number of members vertically spread across the different tiers. Each of the tiers consists of at least one business unit and each unit can pursue its own independent strategies to manage its functions and strive to achieve specific goals and objectives. Each organisation tries to maximise its performance in dealing with supply chain drivers through a combination of outsourcing, partnering and in-house expertise. According to Hugos (2003) it is common for successful companies to attempt to own much of their supply chain through vertical integration. This is the degree to which a firm owns its upstream suppliers and downstream consumers. This is usually typified by one firm engaged in different aspects of production and the main aim is to gain maximum efficiency through economies of scale. This is illustrated by the red-lined units in figure 3.0. However, Hugos (2003) argues that in contemporary fast-moving and highly competitive markets, a company usually focuses on what it considers to be its core competencies in supply chain management (SCM) and outsource the rest.

3.1.4 Supply chain management (SCM)

SCM consists of activities undertaken to influence the behaviour of the supply chain to meet certain predetermined objectives. It is more systematically defined as the process of planning, implementing and controlling the operations of the supply chain as efficiently as possible. It therefore coordinates forms of organisation from production to the final consumer. The theory has arisen from the recognition that transactions do not occur without costs. According to Wilson (1996), SCM has found business relevance as it focuses on countering the competitive disadvantage of working confrontationally. Actors along the chain have realised that working together can improve the abilities of each actor to supply what the market demands, achieve economies of scale and improve marketing support. Better SCM results into lower transaction costs.

Managerial issues crop up along a supply chain. These issues include but are not restricted to: distribution network configuration, inventory management, supply contracts, distribution strategies, supply chain integration and strategic partnering, outsourcing and procurement

strategies, information technology and decision support systems, customer value and challenges for information sharing in the supply chain (Simchi-Levi et al., 2003). They should be addressed for a supply chain to function effectively and efficiently.

Intervention can be classified into three levels namely strategic, tactical and operational. The timeline and type of decision, presented in Table 3.2 are quite generic and can be modified to fit specific types of supply chains. Therefore to successfully compete, organisations are embracing supply chain management to deal with the above issues and respective decision-making along the entire value chain.

Table 3.2: Types of decisions made at the three different levels

Decision making level	Timeline	Type of decision made
Strategic	3 to 10 years	Investment on plant and capacities Creation of a logistic network
Tactical	3 months to 2 years	Inventory policies to use Procurement policies to be implemented Transportation strategies to be adopted
Operational	Day-to-day	Scheduling of resources Routing of raw materials and finished products Solicitation of bids and quotations

Source: (Chandra and Grabis, 2007).

Nolan (1999) presents five factors that help in the effective implementation of a SCM system and aid managers reap full benefits of the SCM approach. These include achievable implementation phases, senior level involvement, collaboration, business process and organisational design and effective performance measures. Therefore SCM brings a system approach to understanding and managing a supply chain.

3.1.5 Performance

Supply chain performance (SCP) is an overall performance measure that depends on the performance at each tier in the supply chain. Van der Vorst (2000) defines SCP as the degree to which a supply chain fulfils end user requirements concerning the relevant performance indicators at any point in time and at what supply chain cost. Neely *et al.* (1994) highlight the importance of measurement in SCP and characterise it as the process of quantifying the efficiency and effectiveness of an action using performance indicators.

Measurement of performance at the level of the SC is important as it impacts on decision-making through the evaluation of past behaviour against benchmarks. Ittner and Larcker (2003) observe that performance measurement can also be used to help in directing the allocation of resources, assess and communicate progress towards strategic objectives and evaluate managerial performance. According to Hannus (1991), cited by Korpela *et al* (2002), a supply chain measurement should reflect the objectives of main interest groups such as customers, owners and personnel. A natural measure of performance is the productivity ratio (ratio of outputs to inputs) where the larger is the value of the ratio; the better is the performance (Coelli *et al.*, 2005).

Several authors have distinguished dimensions of SCP in various supply chains and within these dimensions they have identified several performance indicators. Measuring performance in an agri-food SC is relatively difficult because of the nature and characteristics of agricultural products (Aramyan *et al.*, 2007).

Van der Vorst (2000) defines performance indicators as measures which can be used to evaluate the performance of products, services and production processes. Table 3.3 shows some performance indicators for food supply chains on three levels.

Table 3.3: Performance indicators on three levels

Levels	Performance indicators
Supply chain	Product availability, quality, responsiveness, delivery reliability, total supply chain cost
Organisation	Inventory level, throughput time, responsiveness, delivery reliability, total organisational cost
Process	Responsiveness, throughput time, process yield, process cost

Source: Van der Vorst (2000)

Based on literatures, Aramyan *et al.* (2007) has designed a conceptual framework for measuring performance in agri-food supply chain and grouped the performance indicators into four main categories: efficiency (measures the utilisation of resources), flexibility (indicates the degree to which the supply chain can respond to a change in environment), responsiveness (aims at providing the output in a short lead time) and food quality (refers to the product and process quality).

Table 3.4: Conceptual framework for measuring performance in agri-food SC

Performance			
Efficiency	Flexibility	Responsiveness	Food quality
<ul style="list-style-type: none"> ▪ Cost ▪ Profit ▪ Return on investment ▪ Inventory 	<ul style="list-style-type: none"> ▪ Customer satisfaction ▪ Volume flexibility ▪ Delivery flexibility ▪ No. of back orders & lost sales 	<ul style="list-style-type: none"> ▪ Fill rate ▪ Product lateness ▪ Customer response time ▪ Lead time ▪ Shipping errors ▪ Customer complaints 	<ul style="list-style-type: none"> ▪ Product quality <ul style="list-style-type: none"> - Sensory properties & Self-life - Product safety & health - Product reliability & convenience ▪ Process quality <ul style="list-style-type: none"> - Production system - Environmental aspect - Marketing

Source: Aramyan, 2007

A usable and well-defined supply chain measurement system therefore increases the chance for success by aligning processes across multiple firms or tiers, targeting the most profitable markets and obtaining a competitive advantage through differentiated services and lower costs (Lambert and Pohlen, 2001). Practically, a performance measurement system informs decision makers whether they are achieving their objectives, about consumer satisfaction and identifies areas of improvement (Aramyan *et al.*, 2007).

SCP is an overall performance measure that depends on the performance of each tier in the supply chain. Van der Vorst (2000) defines SCP as the degree to which a supply chain fulfils end user requirements concerning the relevant performance indicators at any point in time and at what supply chain cost. Neely *et al.* (1994) highlight the importance of measurement in SCP and characterise it as the process of quantifying the efficiency and effectiveness of an action using performance indicators. Measurement of performance at the level of the supply chain is important as it impacts on decision-making through the evaluation of past behaviour against benchmarks. Ittner and Larcker (2003) observe that performance measurement can also be used to help in directing the allocation of resources, assess and communicate progress towards strategic objectives and evaluate managerial performance. A usable and well-defined supply chain measurement system therefore increases the chance for success by aligning processes across multiple firms or tiers, targeting the most profitable markets and obtaining a competitive advantage through differentiated services and lower costs (Lambert and Pohlen, 2001). Practically a performance measurement system must enable managers identify areas where SCP can be improved.

3.2 Agri-food supply chain

An agri-food supply chain is defined as a supply chain where an agricultural product goes through different stages of production and distribution before reaching the final consumer and information simultaneously flowing in the opposite direction. Characteristics that differentiate agri-food supply chains from other types of supply chains are production and distribution of

vegetable and animal-based products. Van der vorst (2000) distinguishes two main types of supply chain:

- SC for fresh agricultural products (e.g. fresh vegetables, flowers, fruits,..) comprising growers, auctions, wholesalers, importers, exporters, retailers and speciality shops. The main processes are handling, storing, packing, transportation and trading.
- SC for processed food products (e.g. canned foods, snacks, processed foods, etc.). Here agricultural products are used as raw materials to produce higher-value consumer products. Another characteristic of this supply chain is that there are conservation and conditioning processes that extend shelf life of agricultural products.

There are several factors that distinguish agri-food supply chains from other supply chains. These include: production based on biological processes, type of products, perishability, long production throughput time, degradation of intrinsic quality, bulkiness of supply seasonality, consumer attitudes towards food safety and environmental pressures among others.

Over the last decade or so the management and coordination of the supply chain for agri-food has become increasingly important as a result of fundamental changes in consumer preferences and tastes. Improvement in the supply chain and changes in demand requirements create the need for retailers to deal with organisations which are able to supply on a year-round basis. Food supply chains operate in a complex, dynamic, time-critical environment where product integrity is vital, with an assurance that food is of a certain quality (Bourlakis and Weightman, 2004). It is also important here to recognise the fragility and susceptibility of agri-food supply chains and all the effort that needs to be made to enjoy the availability, convenience and experiences that typifies today's food supply.

The following sections present the different theories as applied to agri-food supply chains.

3.2.1 Agri-food supply chain management

Firms now have to compete as part of a supply chain. This is even more important in agri-food supply chains because of the limited shelf life of products and consumer demand for increasingly safe and environment-friendly foods (Boehlje *et al.*, 1995). Agri-food supply chain management is therefore seen as a means of improving the agri-food supply chain to effectively cater for consumer needs. Wilson (1996) notes that large companies are now able to concentrate on, and understand the workings of the whole supply chain and impose their quality standards to achieve this objective. This consequently reduces the amount of time spent in negotiation and monitoring of the quality of the agri-food products.

There are three types of developments that have stimulated interest in SCM, namely socio-economic, market structure and technological developments. Van der vorst (2000) overviews these developments as applied to the different stages of agri-food supply chains.

3.2.2 Agri-food supply chain performance

The main objective of effectively managing an agri-food supply chain is to improve its performance. When measuring performance of supply chain, there is a need for financial and non-financial performance indicators. But for agri-food supply chain non-financial measures like products and process characteristics are of prime importance (Aramyan, 2007). Characteristics that distinguish agri-food supply chains from others include consumer satisfaction and freshness. According to Apaiah (2006) it is important to take non-qualitative indicators into consideration while measuring agri-food supply chain performance. Therefore the number of indicators that can be used to evaluate an agri-food SCP makes it difficult and also controversial as it involves normative judgements especially as far as qualitative indicators are concerned.

3.2.3 Agri-food supply chain research

Recently research has focused on investigating the factors needed to design and build effective supply chains that respond to specific customer demands. According to Vonderembse *et al.* (2006) supply chain design is partly a function of the product characteristics and expectations of the final customer. Agri-food supply chain research is developing as a research discipline in its own right, at national, regional and international level. Given the specificity of the agri-food supply chain and the increasing proportion of food that it conveys, significant research has gone into actually understanding and characterising it.

3.3 The broiler supply chain

Globally research has been conducted on different aspects of the broiler supply chain. Studies have focused on an overview of the industry as a whole (Chase *et al.*, 2003; Chang, 2004) whereas others have looked at specific aspects along the supply chains. The main studies are presented in the following sections.

3.3.1 Market coordination

There are different types of interfirm business linkages that exist along the broiler supply chain. There is a need to choose a particular governance structure for these linkages. Westgren (1994) assessed the coordination structure of the poultry industry in four countries, namely the United States (US), France, Mexico and the Netherlands. It was found that even if production processes are homogeneous in the global poultry industry, governance structures greatly differ. One way of ensuring coordination is through contracts. The modern broiler industry is vertically integrated and integrators write contracts and offer them to growers. Vukina and Leegomonchai (2006) researched the political economy of regulation of broiler contracts in the US. They show that there is limited regulation in broiler contracts, due to weak empirical evidence of market failures and the greater political influence of the integrator companies. Goodhue (2000) explained that integrators control major inputs as a response to grower heterogeneity, risk aversion and systematic uncertainty.

3.3.2 Value creation

There is a general acknowledgement that poultry is increasingly becoming the meat of choice globally. Insch (2008) used a historical case study approach to identify and explain the triggers and patterns of value creation in the Australian chicken industry. A schema of phases of value creation was developed that can potentially be applied by chicken supply chains in other countries.

Another strand of research focuses on the inputs required for poultry production. Taha (2003) assessed the feed requirement of the poultry sector in Egypt and concluded that the industry is highly dependent on feed imports. This high dependence could impact on the efficiency of the domestic industry in the light of increasing trade liberalisation under the WTO.

3.3.3 Consumer demand

Consumption of poultry meat has been rising steadily worldwide. This has been triggered and boosted by growing consumer concerns related to health, convenience and variety. In the US market, per capita consumption of beef has steadily declined over the last two decades and this is due to a structural change (Kinnucan *et al.*, 1997). Consumers are shifting away from beef to chicken because of concerns over consumption of foods high in cholesterol due to its association with heart disease.

3.3.4 Food safety

In recent years food safety and more specifically meat safety has become a major factor influencing meat purchasing and consumption behaviour. Flake and Patterson (1999) showed the negative impact of food safety information on beef consumption and a corresponding increase in pork and chicken consumption. Other specific concerns have been harmful chemical residues or additives, pathogenic organisms or specific diseases like BSE (Viaene and Verbeke, 1998). Given these concerns, it is important to restore and maintain consumer confidence in the production, processing and distribution of meat. A key instrument is a

functional traceability system that enables tracking of product through the entire supply chain. Golan *et al.* (2003) gives three motives for establishing traceability systems, namely to improve supply-side management, to differentiate and market foods with subtle or undetectable quality attributes and to facilitate trace-back for food safety and quality. Growth of information coupled to the attribution of specific responsibilities to agents has consequently improved food safety along the supply chain (Banterle and Stranieri, 2008). Hooker *et al.* (2005) looked into the crisis management effectiveness of public and private stakeholders after meat and poultry recalls in the US. They concluded that there was no evidence of any difference in management between microbiological and non-microbiological recalls. This is surprising given the higher risk associated with microbiological recalls.

There are costs associated with ensuring food safety along the broiler supply chain. Mangen *et al.* (2005) estimated the potential direct costs related to the implementation of various measures to control *Campylobacter* in the chicken meat chain in Netherlands. The findings were that the indirect costs due to e.g. product changes, non-acceptance by consumers would be far higher than the direct costs such as treatment and testing costs.

Another strand of studies has tried to identify the economic incentives for poultry processing firms to adopt food safety controls. Jayasinghe-Mudalige and Henson (2006) found that market-based incentives have a greater impact on food safety responses of firms as compared to government regulatory actions. They concluded that firms should be encouraged to take food safety initiatives that exceed regulatory requirements.

3.3.5 Globalisation and trade

The poultry-meat supply chain has globalised either by vertical or horizontal integration or the development of business clusters. Manning and Baines (2004) reviewed the key factors that have led to the globalisation of the poultry supply chain and the impact of these changes. The main factors were, speed of technology transfer, cost of capital and labour and its effect on competitiveness, concerns over production methods, production specialisation, food safety and

hygiene standards. Peterson and Orden (2004) analysed the impacts of tariff barriers on high- and low-value poultry trade.

3.3.6 Governance

Governance is the responsibility and accountability for an overall operation of an organisation (Bohen, 1995). It is a means of infusing order and solving conflicts in a relation to realise mutual gain (Williamson, 1999). It is sometimes defined as a structure that ensures long-term decisions, corporation and proper collaboration between multiple organisations (Monks and Minow, 2004). According to Alvarez *et al.*, (2003), three key elements, namely trust, bargaining power, and contracts play a crucial role in maintaining inter-organisational relationship governance and reduce risk and uncertainty in relationships. Later, Gosh and Fedorowicz (2008) came forward with a model (Figure 3.1) of the role of the three governance mechanisms of trust, bargaining power and contracts in facilitating coordination among partners in a supply chain. The three governance mechanisms help chain partners to realign business relationships and contribute to overall chain performance (Gosh and Fedorowicz, 2008).

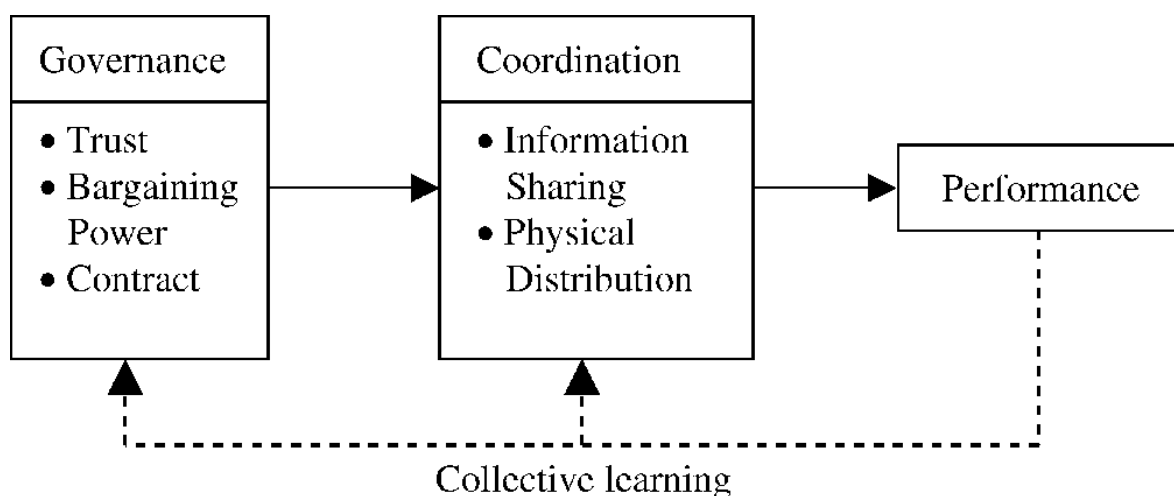


Figure 3.1: Model of supply chain

Source: Gosh and Fedorowicz (2008)

3.3.7 Governance Mechanism

3.3.7.1 Trust

Trust reflects the confidence of one party in a two-way relationship that the other party will not take advantage of its weakness (Sako, 1991; Svensson, 2001). Trust can be applied equally to individuals, groups of individuals, companies, industry groups, political entities, and supply chains (Svensson, 2004). Inter-organisational trust is observed among individual companies with respect to their immediate business partners in the chain (Zaheer *et al.*, 1998). Trust among partners has many advantages such as low transaction cost between buyer and supplier (Zaheer *et al.*, 1998), willingness of supplier to invest in specialised equipment and easiness in adjusting to modified production processes (Sahay, 2003) and consumer satisfaction (Andaleeb, 1996).

3.3.7.2 Bargaining power

When a member along the supply chain controls certain resources that another member needs, it acquires power that enables it to exert influence over others (Andaleeb, 1996). Larger players in the chain have greater bargaining power as compared to small and medium manufacturers.

3.3.7.3 Contract

Legal and written contracts provide a means to enforce coordination in an organisation with multiple sub-units. The contract design should offer a win-win situation to both parties so that every player in the chain earns a profit higher than it would earn without the contract (Giannoccaro and Pontradolfo, 2004). The design and exhaustiveness of a contract and its role in governance and coordination much depend on the nature of production and the structure of the organisation (Roxenhall and Gauri, 2004).

3.3.8 Contract Farming

Contract farming is an important method for perishable commodities in sharing market risks (Birtal *et al.*, 2008). Contract is a form of protection for both the contractor and contractee and should clarify all terms included (Doye *et al.*, 1992). Usually, contract shields farmers from market risks of fluctuating market price and demand (FAO, 2003) and may be in form of leases, production contracts, or marketing contracts (Kunkel *et al.*, 2008). An agricultural production contract is an agreement where the producer or grower agrees to sell or deliver a selected crop or livestock produced in the way specified in the agreement (Kunkel *et al.*, 2008). The contracted producer is paid according to the terms in the contract. Moreover, a production contract specifies in details the inputs to be provided by the contractor, the quality and quantity of the commodity involved, production practices to be used and the mode of payment to the producer.

Livestock production contract

The livestock producer agrees to manage the livestock or poultry farm owned by the contractor until the animals are removed. The payment is usually based on the performance of the animals and terms of the contract.

Terms in a contract may include grower payments, production techniques, incentive clauses, and production items to be furnished by each party and those to be jointly furnished (Doye *et al.*, 1992). The farmer may consult his/her attorney and accountant before signing the contract (Goodhue and Hoffmann, 2006).

Agricultural contracts are usually “Boilerplate” contracts. A boilerplate contract is a standardised contract between two parties that does not allow for negotiation, that is “take it or leave it” (Farnsworth, 2001). Usually unequal bargaining partners enter in to boilerplate contracts as in the case of small farmers and large food organizations (Goodhue and Hoffmann, 2006). Small farmers are in no position to negotiate the standard terms of such contracts.

3.3.8.1 Benefits from contract production

Contract farming is found to be more profitable than independent production (BIRTHAL *et al.*, 2008). According to Ramaswami *et al.*, (2006), in contract farming of broilers, firms endure most of the market and price risks and help producers in mitigating production risks through support services. Sometimes, despite being efficient producers, some smallholders may lose their market place due to high transaction cost (Holloway *et al.*, 2000; Delgado *et al.*, 2008; BIRTHAL *et al.*, 2005; Davis, 2005). As a result of contract farming, sharing of risk and reduction of transaction costs enable contract producers to gain more profit than independent producers.

Moreover, contracts may provide a potential income with a guaranteed market provided that all the terms in the contract, are met. Also through contract production there is a reduction of marketing risk and producers can benefit from technical advices, managerial expertise as well as access to new technological advances provided by the contractor. Consequently, transaction and marketing cost are minimized with more efficient resource allocations.

The benefits of contract farming depend on the scale of production. Large farms, both contracts and independents have lower per unit cost due to bulk buying of inputs. Small producers, having fewer resources at hand, tend to gain significant benefits from their participation in contract farming (BIRTHAL *et al.*, 2008).

3.3.8.2 Limitations of contract production

Contract growers bear two important contracting risks: contract non-renewal and the risk of the contractor not keeping birds on a regular basis. Moreover growers producing below average are penalised monetarily and have little chance for contract renewal (Aust, 1997).

Additionally, by entering into a production contract, the producer may lose the opportunity to increase his profit in case market conditions become more favourable for small farmers. Besides, contracts often limits small producers' interest in the commodities produced and the producers become simple providers producing only for the sake of a fee.

Some authors claim that contract farming is a partnership of unequal players where the producer being the weaker party, is dominated by the contractor (Birthal *et al.*, 2008). The contractors may manipulate terms and conditions to their advantage. In addition, contract farming often favours investment on specific assets, which can render producers as poor bargainers (Wilson, 1990; Little and Watts, 1994; Singh, 2002). Direct transactions with buyers can lead producers with a higher profit but the cost for searching buyer and delivery may be high (Birthal *et al.*, 2008).

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Interrelationships among trust, bargaining power and contracts

Trust, bargaining power and contracts are influenced by each other. Limiting trust between parties allow the establishment of contractual agreements to enhance legal obligations. In turn, over a certain period of time, consistent adherence to contractual terms helps to build trust (Handfield and Bechtel, 2002). Bargaining power has also an effect on trust. When power is exercised, it is likely to have a negative impact on trust (Dyer and Chu, 2003). Trust is a key governance mechanism, which is shaped by and works with contracts and bargaining power to determine the extent of success achieved by information sharing and material flows in the supply chain.

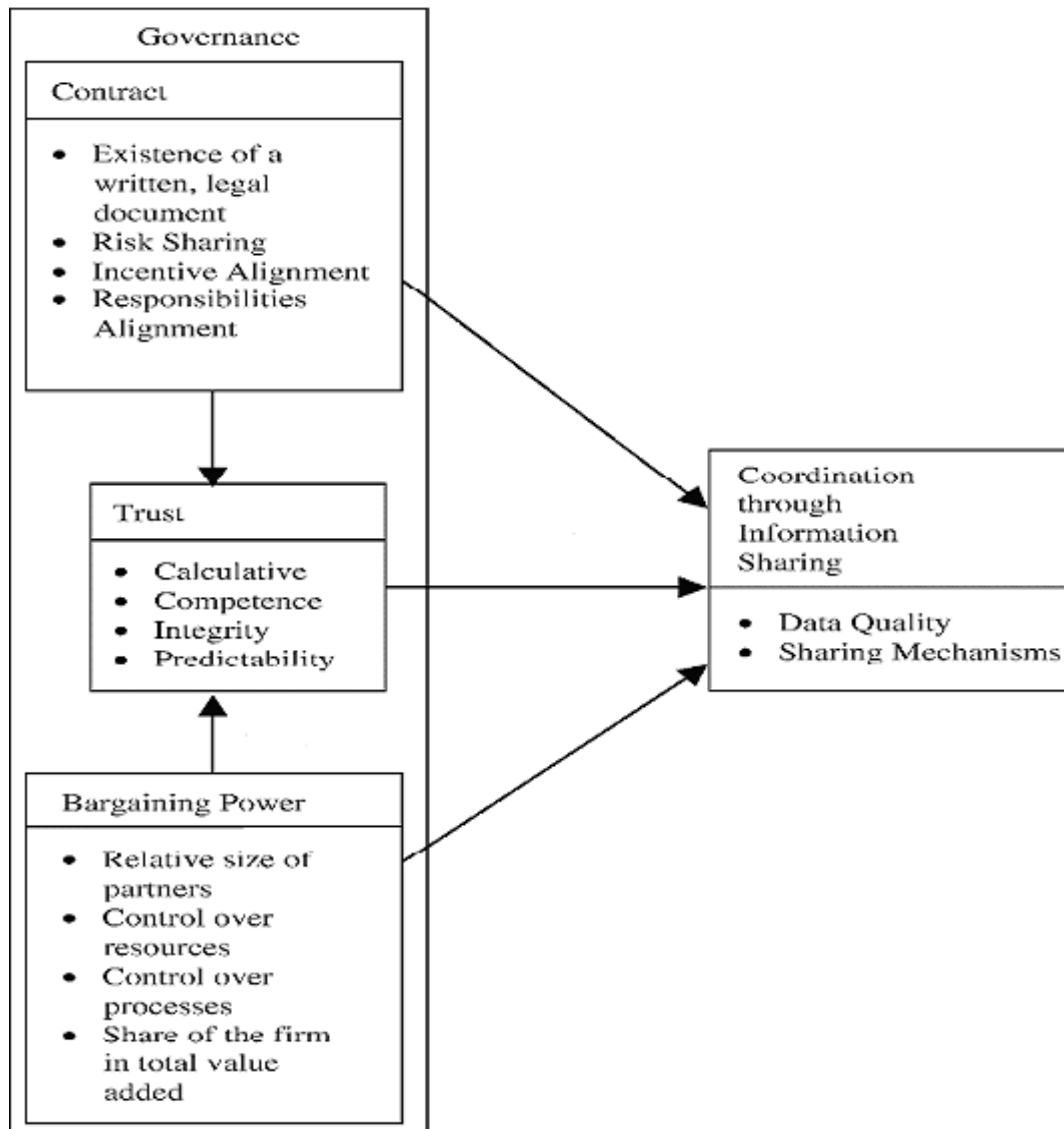


Figure 3.2: Role of governance in supply chain information sharing

Source: Gosh and Fedorowicz, 2008

According to Gosh and Fedorowicz (2008), the adoption of the three governance mechanisms (trust, bargaining power and contract) increase coordination and information sharing among members of a supply chain.

The review of literature on supply chain has enabled us to identify the indicators that can be used to map a supply chain and characterize it in terms of its structure and governance.

Chapter 4: Methodology

This chapter describes the different methods used to collect data relevant to the study.

4.1 Introduction

Data were collected across the whole supply chain (excluding consumers) and key informants at different stages of the supply chain were interviewed. The different methods used for primary data collection included structured questionnaires, face-to-face interviews, telephone surveys and interviews through electronic mails.

4.1.1 Mapping the broiler chain

Based on secondary data gathered from literature review and primary data collected through surveys, the broiler supply chain was mapped. This map was designed to represent the basic broiler production system, that is, from production to consumption. This map was designed bearing in mind that it will be used as the backbone for other more complex maps. The data collection methods used has been elaborated in section 2.5.

4.1.2 Interaction among institutions and actors along the chain

Information from support institutions and different stakeholders along the broiler supply chain, was collected through face to face interviews based on pre-designed questionnaires which have been attached in the Appendix. The questionnaires were designed in such a way that the information gathered could eventually help in understanding the roles of institutions like APD, PBC, AREU, DVS and DBM. The information collected, was used to add more details to the basic broiler production system. Thus, the different broiler inputs and support institutions were fitted in the map, resulting in a more complex one.

4.1.3 Impact of threats on structure, governance and performance

Again based on all the data collected, the impact of threats like the AI, rising price of feed, trade liberalization, cheap imports of broiler products and food safety, was assessed with reference to how and where these threats could affect the broiler supply chain.

4.2 Collection of data

4.2.1 Survey of broiler input suppliers

Broiler input suppliers in the local broiler chicken supply chain, targeted for this study included suppliers of feed, drugs, broiler equipment and broiler chicks. For each group of supplier, a questionnaire was designed which covered several aspects such as types and quality of services or products provided, annual production and impact of external threats. Key representatives from each group of suppliers (excluding feed suppliers) were interviewed. Table 4.0 lists the different companies interviewed and the mode of interviews used.

Table 4.0: Interview of input suppliers

Broiler Inputs	Suppliers	Mode of interviews
Chicks	"Maison du petit aviculteur", CERES (now known as Inicia Ltee)Ltd and PBC	Face-to-face
Feed (Survey for feed suppliers is ongoing)		
Drugs	Vetopharma Ltd, CERES (now known as Inicia Ltee)Ltd and Mauripharm Ltd	Telephone, E-mail and face-to-face
Broiler equipment	Teleport Ltd and Velvindron	Telephone

4.2.2 Information gathering from support institutions

Four main support institutions, namely AREU, DBM, PBC and DVS are directly linked with the broiler industry. A questionnaire was designed and sent to key representatives in each institution.

4.2.3 Survey at producer level

4.2.3.1 Sampling

The list of producers obtained from AREU dates back to June 2007. Consequently, the list might include producers who have stopped broiler production and might exclude those who started broiler production after June 2007. It was therefore supplemented with information from the MAF and stakeholders along the broiler supply chain. Hence, a new list of broiler producers was compiled based on the information available and a population size of 354 broiler producers was established. The sample was determined based on this population. A significance level of 10% yielded a sample of size 76 broiler producers. Stratified sampling was used to select broiler producers from the 5 different regions of Mauritius (Table 4.1).

Table 4.1: Sampling of broiler producers

Region	No. of producers	Proportionate allocation	Sample Size
North	64	13.74	14
East	96	20.61	21
West	32	6.87	7
South	83	17.82	18
Center	79	16.32	16
Total	354	76	76

4.2.3.2 Design of questionnaire for broiler chicken producer

The questionnaires for chicken producers were designed based on the information gathered from relevant documents, meetings with stakeholders and informal interviews from various broiler chicken sectors. While designing the questionnaires, all the objectives of the study were taken into consideration. The questionnaires were divided into sections so as to facilitate data collection.

4.2.3.3 Pre-testing

The questionnaire was pre-tested with broiler producers at Point Aux Piments and Saint-Pierre through face to face interviews. Consequently, several questions were modified and the questionnaire was re-structured.

4.2.3.4 Survey of broiler producers

Broiler producers were first contacted by telephone so as to arrange for meetings at the producers' premises for personal interviews. Thus field surveys were conducted to interview broiler producers in different regions of Mauritius as shown in Table 4.2. 70 broiler chicken producers participated in the survey.

Table 4.2: Survey of broiler producers

Regions	No. of producers	Sample	Survey Done
North	64	14	*18
East	96	21	*24
West	32	7	1
South	83	18	17
Centre	79	16	10
Total	354	76	70

The targeted sample size of 76 producers was not met due to time constraint. Moreover, only one broiler chicken producer was interviewed in the western region because information on broiler producers in the west was unavailable, thus it was difficult to contact them for interviews.

4.2.4 Survey at broiler trader level

4.2.4.1 Sampling of broiler traders and retail outlets

Basically broiler chicken traders include buyers of live broiler, buyers of dressed whole chicken carcass, buyers of chicken cuts, sellers of live broiler, dressed chicken meat sellers and processed chicken meat sellers. A list of broiler chicken traders was obtained from the Ministry of Health & Quality of Life, which included all the chicken sellers holding a permit to sell fresh chicken. As a result, the list comprised of both “Chantefrais” and “Non-Chantefrais” outlets. However, the franchises of “Chantefrais” were excluded from the survey due to lack of corporation from the side of the personnel owning the outlets. Table 4.3 shows the sampling of broiler traders from the five different regions of Mauritius so that the sample was geographically representative of the true population of broiler traders.

Table 4.3: Sampling of broiler chicken traders in different regions in Mauritius

Region	No. of broiler traders	“Chantefrais” outlets	No. of chicken sellers excluding “Chantefrais”	Sample size
North	54	24	30	10
East	22	8	14	5
West	36	10	26	9
South	54	10	44	15
Centre	106	30	76	25
Total	272	82	190	64

*Sample Size was calculated at 10% Confidence Interval.

10 retail outlets including both supermarkets and hypermarkets were surveyed. The sample size was relatively small since the aim of the survey was to obtain a snapshot of the true situation prevailing in retail outlets. Moreover, the study was qualitative in nature and therefore rigorous sampling was not compulsory. These outlets were selected based on convenience and willingness of sales managers to participate in the survey. The sales managers

and assistant sales managers responsible for broiler chicken were first contacted by telephone to arrange for face to face interviews.

4.2.4.2 Designing questionnaire for broiler chicken traders and retail outlets

Based on the literature review and objectives of the study, two different questionnaires were designed for broiler chicken traders and retail outlets. Information relating to terms of contracts with broiler chicken suppliers, procurement and sales of broiler chicken were collected. The interviewees were also questioned about threats which could negatively impact the broiler industry.

The questionnaires were pre-tested at Reduit and Triolet. The purpose of pre-testing was to identify any unforeseen problem, weakness or area for improvement so that the final questionnaire was well-structured and free from ambiguities. The pre-testing revealed that no major modifications were required and thus the questionnaires were finalised.

4.2.4.3 Methods of data collection from broiler traders and retail outlets

Face-to-face interviews with broiler traders were conducted with 57 respondents on their premises (Table 4.4).

Table 4.4: Broiler traders interviewed in different regions in Mauritius

Regions	No. of broiler traders	“Chantefrais” outlets	No. of chicken sellers excluding “Chantefrais”	Sample size	Survey Done
North	54	24	30	10	5
East	22	8	14	5	5
West	36	10	26	9	8
South	54	10	44	15	14
Centre	106	30	76	25	25
Total	272	82	190	64	57

Due to time constraint, only 57 traders were interviewed instead of the targeted sample size of 64 broiler traders. At the level of retail outlets face to face interviews, telephone surveys as well as surveys through electronic mails were conducted with sales managers and assistant sales managers responsible for the broiler section. Furthermore, photographs of broiler products were taken in all the retail outlets visited.

4.2.5 Data collection from institutional clients

Institutional consumers such as Mauritius Prisons Services, Police Department, hospitals, hotels and restaurants were surveyed. A checklist was designed for each institution and the area under research included quantity of chicken supplied, terms of the contract, procurement system in place and suppliers of broiler chicken. Key informants from these institutions were consulted and data were collected.

Institutions such as hospitals, prisons, police department, restaurants and hotels were targeted. One of the main objectives was to calculate the quantity of chicken consumed in these institutions. As a result, a checklist was designed for each institution and the area under research included: supplier of chicken, quantity of chicken supplied over the past 4 years, terms of the contract, procurement system in place and source of chicken. Key persons from these institutions were consulted and data were collected.

12 hotels and 5 restaurants were surveyed. Again, no rigorous sampling was required since the study was qualitative in nature and the aim was to get a snapshot of the real situation. Key informants such as food and beverage managers, purchasing officers and cooks were interviewed by telephone, based on a pre-designed questionnaire. Data collected consisted of information relating to the procurement of broiler chicken, contracts with broiler suppliers and threats which could jeopardise the broiler industry.

Data Processing and Analysis

Once completed, the questionnaires were verified for errors, incompleteness and gaps in the information collected. A codebook for coding the data was subsequently developed. For the open-ended questions, a coding frame was developed, after browsing through the responses in the completed questionnaires. A special data entry program was designed in SPSS version 13.0 for statistical analysis. Individual questions were mainly summarized as percentages.

Chapter 5: Results

The results section is divided into two main parts: the first part provides some quantitative analysis of the different actors and stakeholders surveyed with respect to production and marketing of broiler chicken; and the second part presents some descriptive and qualitative data on the supply chain.

5.1 Survey of broiler producers

The following section presents the main findings at the level of broiler producers

5.1.1 Age of producers

Most of the producers involved in broiler production were aged 31 and above. Figure 5.0 presents the age breakdown.

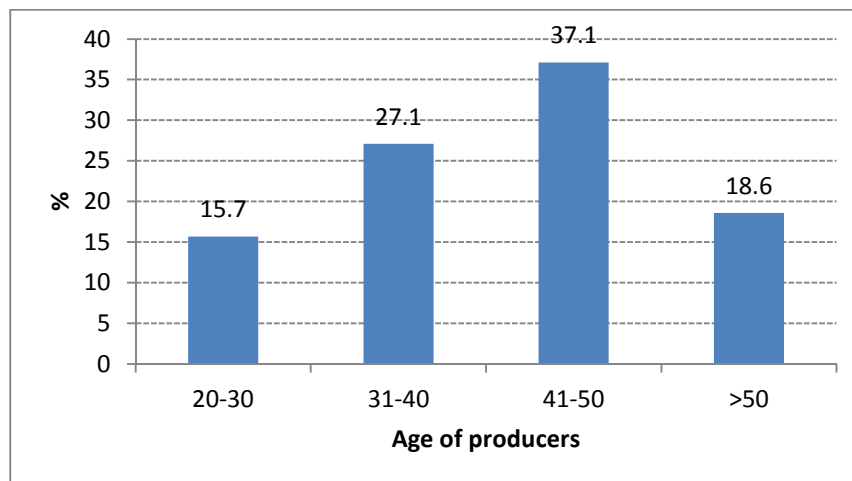


Figure 5.0: Age structure of producers

5.1.2 Occupation as producer

75.7% of respondents claimed that they were involved in broiler production for at the most 10 years, whereas 17.1% of them claimed that they were in the business for more than 10 years (figure 5.1).

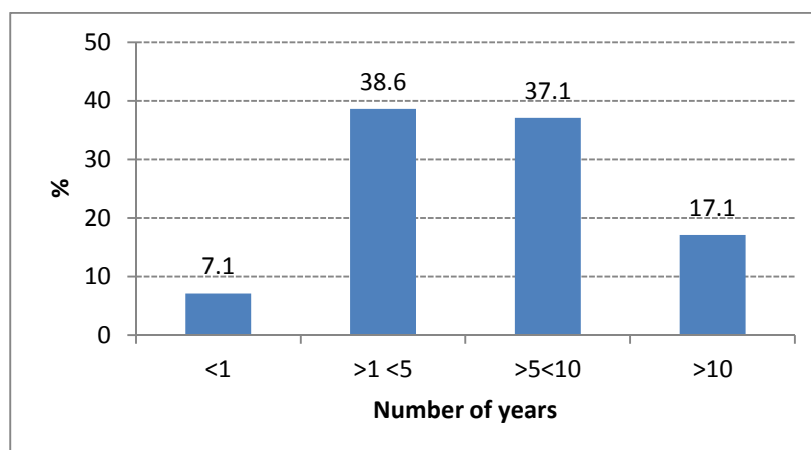


Figure 5.1: Number of years in broiler production

52.9% of producers reported that broiler production was their only business and the remaining producers were involved in production on a part-time basis (figure 5.2).

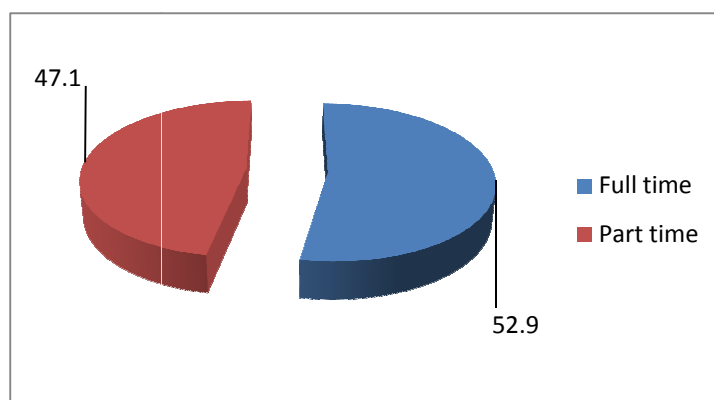


Figure 5.2: Broiler production on a full/part-time basis

Nine out of the 70 respondents claimed that they were involved in other enterprises. Such enterprises included 'crop production' and livestock production'. The remaining respondents (61 out of 70) reported that broiler production was their sole income earner. Out of the 33 part-time producers, 44.3% of them keep broilers throughout the year and the remaining do so at specific period of the year.

5.1.4 Flock size

30% and 65.7% of producers respectively had between 50 and 500 broilers and between 500 and 10000 broilers on their farms at the time of the survey (see figure 5.3 for more details).

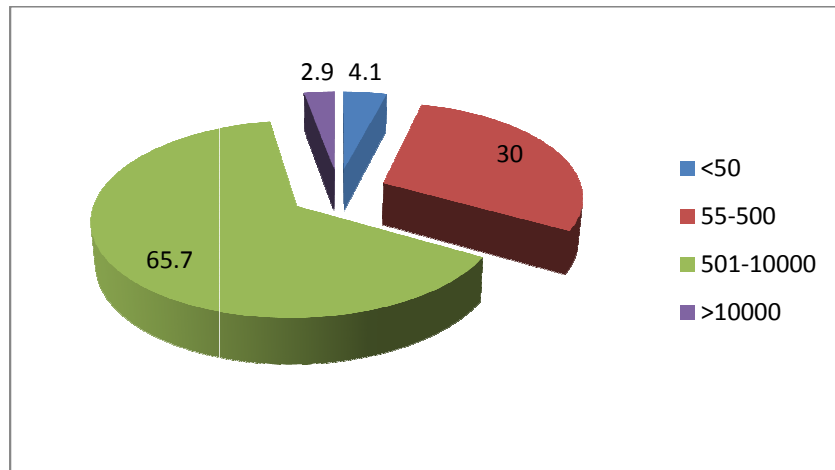


Figure 5.3: Distribution of flock size

7 of them reported that they rented land for broiler production, while the remaining ones owned their land. 31.4% of producers had recourse to their own capital to fund their enterprises, whereas 65.7% and 2.9% of them respectively took loans from banks and relatives to finance their production (see figure 5.4).

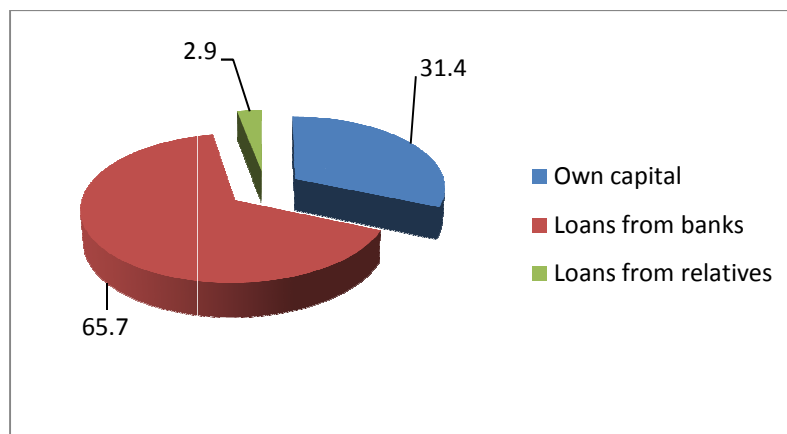


Figure 5.4: Financing of broiler production

5.1.5 Suppliers of chicks

Out of the 70 producers interviewed (including both contract growers & farm owners), 47% of the producers bought chicks from FAIL (Figure 5.5).

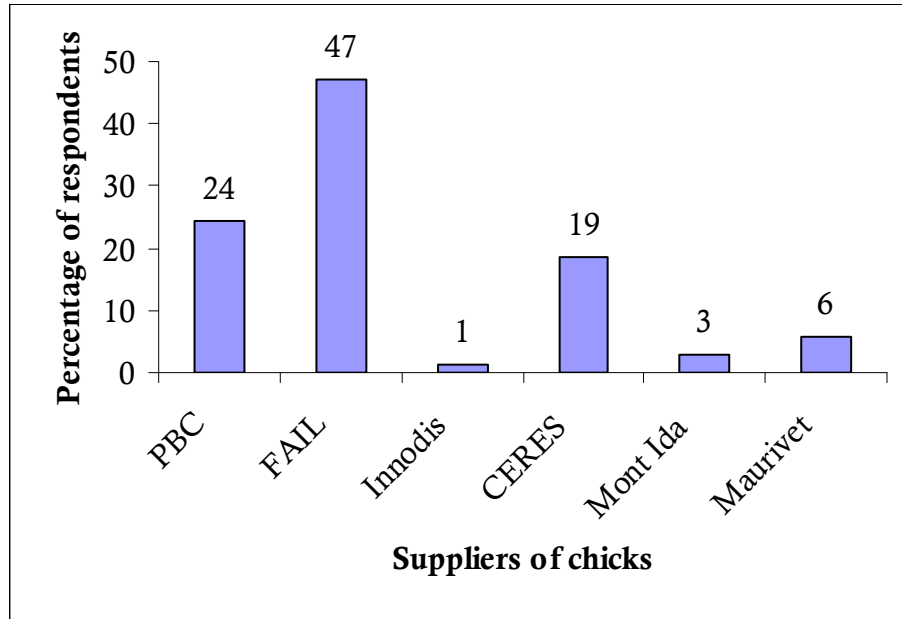


Figure 5.5: Suppliers of chicks

5.1.6 Procurement and types of broiler feed

Table 5.0 shows that the majority of the respondents (46 out of 70) procured broiler starter from LFL while 23 respondents bought broiler starter from Meaders Feed Ltd. Only 1 producer interviewed did not buy any broiler starter since he bought 30 days old birds instead of day old chicks.

Table 5.0: Feed supplier and types of feed

Type of feed Feed supplier	Number of respondents		
	Starter	Grower	Finisher
LFL	46	33	50
Meaders Feed Ltd	23	16	20

5.1.7 Disposal of birds at the end of cycle

Figure 5.6 depicts the way in which the 70 respondents disposed of their live birds. The sum of the percentage of respondents exceeds 100 due to multiple responses.

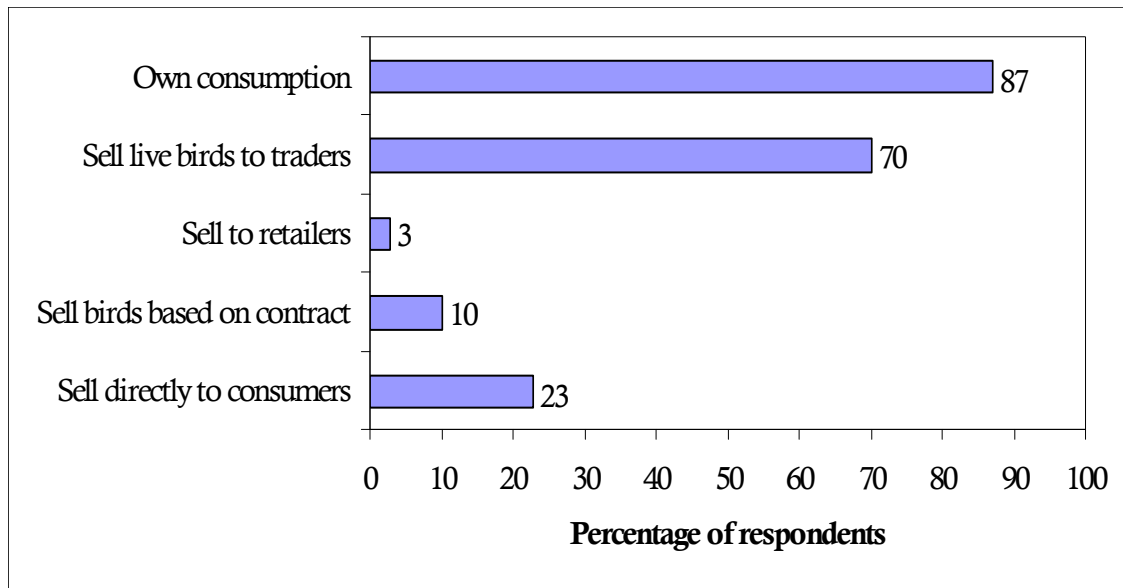


Figure 5.6: Disposal of birds

5.1.8 Contractual arrangement

7 respondents asserted that they produced broilers within a strict contractual agreement with large and industrial producers and all their production was channeled to them. The large and industrial producers were 'Avipro', 'Innodis', 'Mont Ida', 'Malek' and 'Rodia'. The contracts with industrial producers were all formalized and the duration of such contracts varied; 4 of them were between 1 to 3 years, 2 were between 3 and 5 years and one was more than 5 years. Contracts stipulated the provision of chicks, feeds, antibiotics, delivery of inputs and extension advice from the industrial producer, coupled to a fixed selling price per weight. During the survey the selling price varied between Rs 37.50 to Rs 60.00 per bird.

5.1.9 Own consumption: Percentage of birds consumed per cycle

Out of the 70 producers interviewed, 73% consumed less than 1% of their own birds (Figure 5.7). Data for 9 producers, who consumed their own birds, were unavailable.

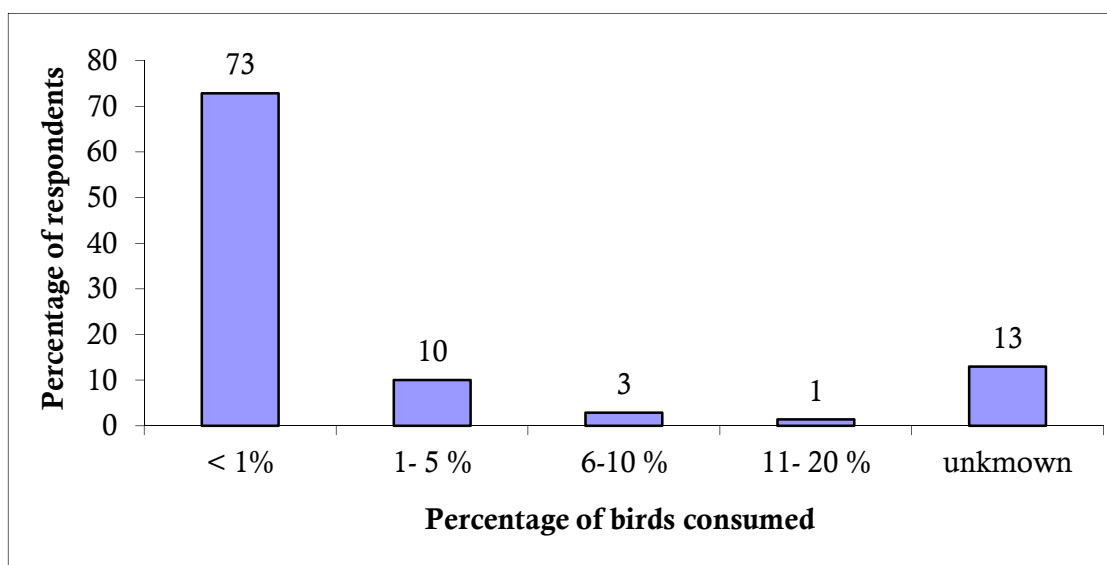


Figure 5.7: Percentage of producers who consumed their own birds

5.1.10 Marketing of broilers and value addition

Most of the producers (68 out of 70) made arrangements to sell their production once the recommended production life cycle of broilers was completed. 49 out of 70 producers reported that they generally marketed their production through traders and that the selling prices were generally mutually agreed. 4 of the 49 producers did report that the selling prices were generally imposed by the traders. 55.7% of producers that marketed their production through traders did so on a credit basis and 12.9% of them sold their broilers for cash (see figure 5.8).

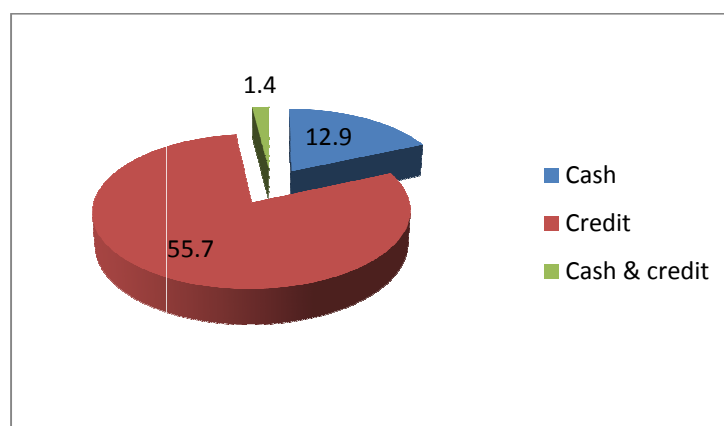


Figure 5.8: Sale of broilers and forms of payment

Some producers reported that they also sold their broilers to traders on an ad-hoc basis, whenever there is a one-off demand and that they had the necessary extra supply. Two out of the 70 producers reported that they sold almost all of their production to retailers holding meat shops. The slaughtering, defeathering and dressing of the birds was effected by the retailers prior to sale. The remaining producers were involved in multiple types of marketing.

16 out of 70 producers sold the majority of their production to consumers, with 10 of them marketing almost all of their production through this channel (figure 5.9).

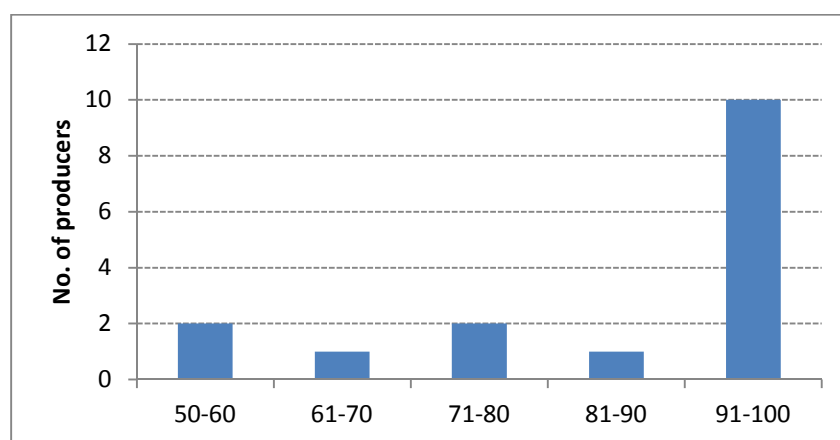


Figure 5.9: Marketing of production through retailers

Out of the 10 producers that directly marketed all of their production to consumers, 7 of them invested in cold storage facilities, including both chilled and frozen facilities.

60 out of the 70 producers reported that they traditionally adopted the same marketing strategy to sell their production, making use of the same marketing channels. Only 10 out of 70 producers were innovative enough to adopt dynamic marketing strategies to reap the maximum from the market. The most common type of marketing in such cases was 'on-the-spot' advertising. Producers that directly marketed their products to consumers used plain plastic bags as forms of packaging.

48.6% of producers bring some form of value addition to their products prior to either selling to retailers and/or consumers. Obviously the degree of value addition was more significant for those producers that sold directly to consumers. Dressing and value addition in terms of different types of cuts were manually done while respecting the basic hygiene and food safety norms. 51.4% of producers reported that they did not bring any value addition to their products. The main reason behind not bringing any value addition to their products was a 'lack of time'. Interestingly 27.8% of those that reported that they did not add value to their products, mentioned that the market demand was for broilers that were undressed. Figure 5.10 below provides the other reasons behind why producers do not add value to their production.

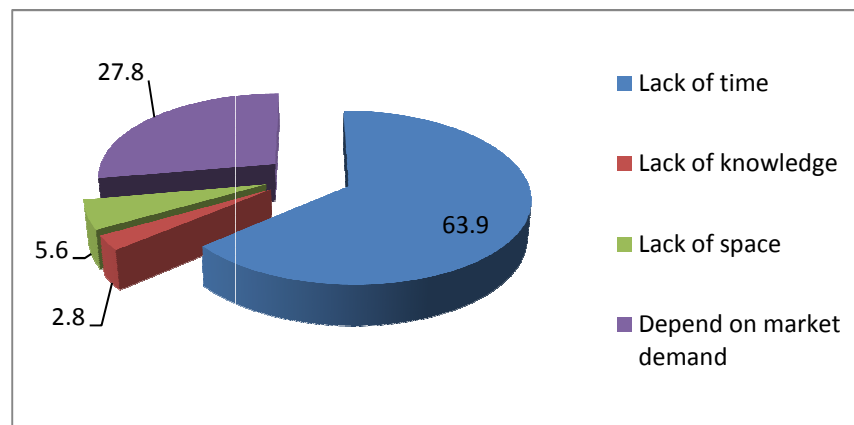


Figure 5.10: Reasons behind lack of value-addition to broiler chicken

5.1.11 Avian influenza as a threat to broiler production

The majority of the respondents (83%) were aware of AI disease (Figure 5.11).

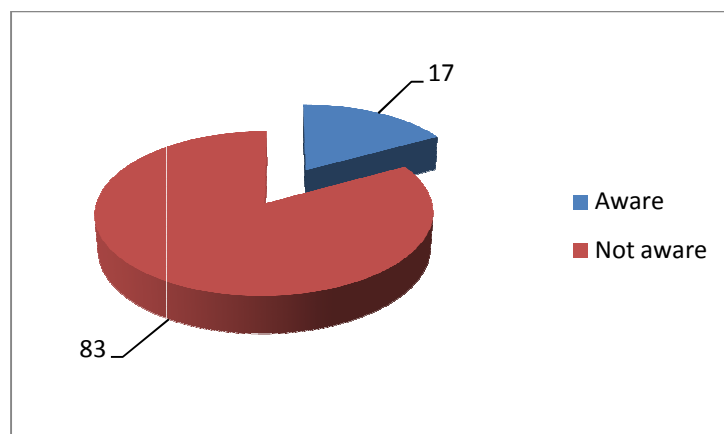


Figure 5.11: Percentage of respondents who were aware of AI

Producers were generally aware of the impacts that avian flu could have on their flocks, but only 19% of them were aware of the symptoms that would be associated with the AI. A similar percentage of producers were not aware of the ways in which avian flu would spread.

In case of an AI outbreak, 77% of the respondents would seek help from MOA (Figure 5.12).

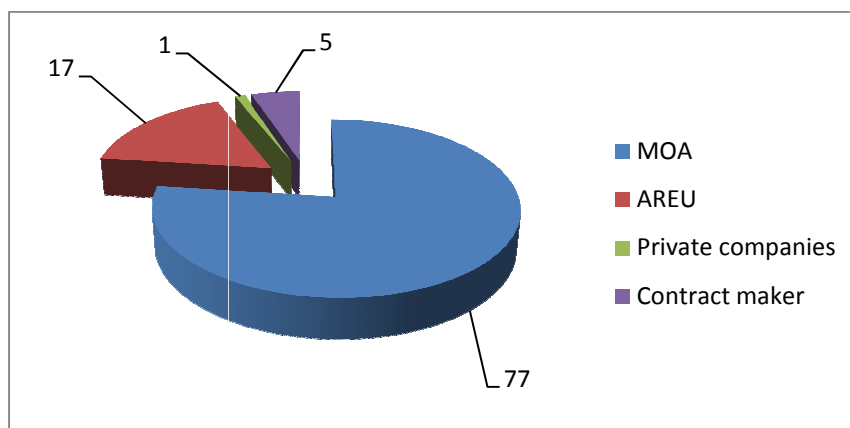


Figure 5.12: Institutions which would be consulted by respondents in case of an AI outbreak

5.1.1.11 Rising price of broiler feed as a threat to broiler production

All the 70 respondents mentioned that the price of broiler feed was too expensive and heavily impacted on their cost of production. The majority of them (78.6%) claimed that feed accounted for between 70-75% of their production costs. Figure 5.13 displays that 71% of the

producers would be forced to give up broiler production in case price of broiler feed continues to rise.

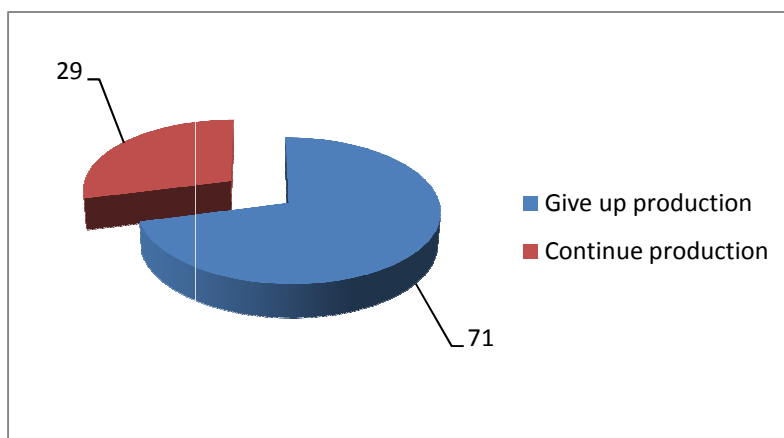


Figure 5.13: Percentage of producers who would continue or give up broiler production in case the price of feed keeps rising

The remaining 29% of producers reported that they would rather increase the price of the products and transfer the increased costs to their buyers. It is interesting to note that those producers who claimed that they would transmit the increase in cost of feed to their buyers were generally directly marketing their products to consumers.

5.1.12 Trade liberalization as a threat to broiler production

The majority of the respondents (97%) were unaware of the term 'trade liberalisation' and they were not aware of how it would affect their business and the local broiler industry in general. The two respondents that claimed to be aware of the effects of trade liberalization, mentioned that it could have dire impact on their production and on the broiler chicken subsector.

5.1.13 Ranking of threats

As shown in the table below, high cost of feed was ranked as the most significant threat among broiler producers followed by an Avian flu outbreak in Mauritius, limited space for broiler

production, complaints by neighbours, waste disposal, feed availability and trade liberalisation (Table 5.1).

Table 5.1: Severity of threats as ranked by broiler producers

Threats	Rank (1=threat having the greatest negative impact on production)
High feed cost	1
Avian Flu	2
Limited space for production	3
Complaints from neighbours	4
Waste disposal	5
Feed availability	6
Trade liberalization & dumping	7

5.1.1.13 Expansion of production

45.7% of respondents reported that they were planning to expand their business, and the remainder had no intention to do so. Those producers planning to expand their production also mentioned that they faced constraints, the main one being the increasing cost of production. Figure 5.14 presents the stated difficulties currently faced by producers to expand their broiler production business.

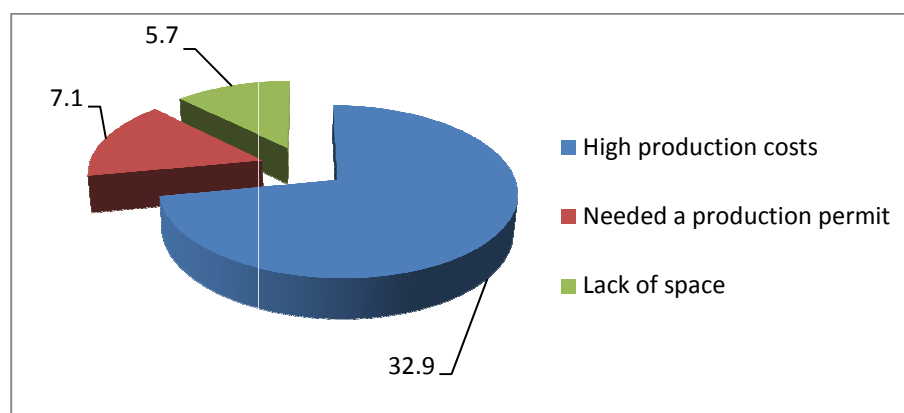


Figure 5.14: Difficulties hindering expansion of business

5.2 Survey of broiler traders³

A convenience survey was carried out with 57 broiler traders along the supply chain. The franchises of “Chantefrais” were excluded from the survey list due to lack of collaboration from the Chantefrais outlet licensees and company outlets. Table 5.2 shows the geographical distribution and coverage of surveys conducted at traders’ level.

Table 5.2: Number of broiler traders in different regions in Mauritius

Region	No. of broiler traders	“Chantefrais” outlets	No. of chicken sellers excluding “Chantefrais”	Sample size	Survey Done
North	54	24	30	10	5
East	22	8	14	5	5
West	36	10	26	9	8
South	54	10	44	15	14
Center	106	30	76	25	25
Total	272	82	190	64	57

5.2.1 Profile of traders

Figure 5.15 provides a snapshot of the age structure of broiler chicken traders. Interestingly all 57 respondents reported that they were involved in their trade on a full time basis.

³ Traders are defined as middlemen that sell broiler chicken from retail shops.

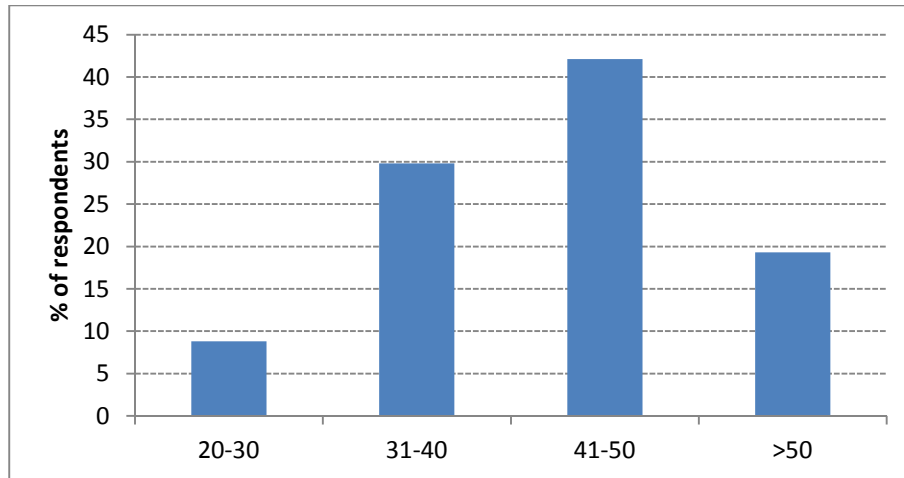


Figure 5.15: Age structure of chicken traders

5.2.3 Activities of broiler traders

43.2% of the traders bought whole dressed chicken from slaughterhouses, abattoirs or industrial producers. 48.3% of respondents sold chicken cuts to consumers. Very few of the respondents bought (3.4%) and sold (1.7%) live broilers. 1.7% of the respondents sold chicken cuts obtained from other traders while some (1.7%) sold chicken meat obtained from their own birds.

5.2.4 Procurement of chicken by chicken traders

47.4% of chicken traders procured chicken from industrial producers like Innodis and Avipro. 31.6% of respondents claimed that they sourced their broiler chicken from medium producers and the remaining ones either procured themselves from small producers or from their own production. Figure 5.16 provides additional information.

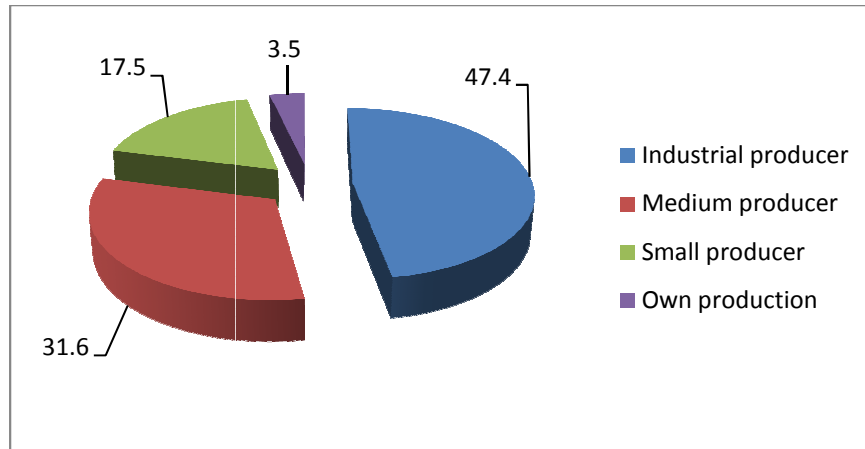


Figure 5.16: Procurement of chicken by broiler traders

43 out of the 55 traders who claimed that they sourced their chicken from third parties producers, reported that they did so from one producer and only 9 of them procured their chicken from more than producer. Most of these traders (44 out of 55) procured their broiler on a daily basis (figure 5.17).

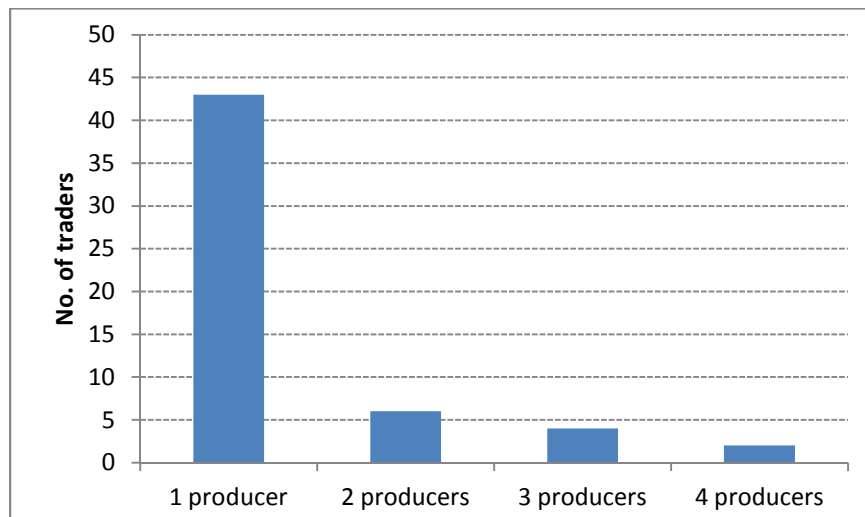


Figure 5.17: Procurement of chicken by broiler traders

5.2.5 Contractual arrangements

Traders (55 out of 57) who claimed that they were sourcing their broiler from producers, affirmed that they had a contractual agreement with producers, but the majority of them (50

out of 55) mentioned that this agreement was informal in nature. Only two traders reported that they formalized their agreement in the form of a written contract with weight, price specifications, mode of delivery and mode of payment. The mode of payment for all traders was both by cash and on credit. In 15 out of 57 cases, producers delivered slaughtered and undressed broilers to traders and in the remaining 42 cases traders took delivery of the broilers at the farm gate.

5.2.6 Minimal processing and marketing of chicken

5 out of the 57 traders bought live birds and slaughtering of the birds was effected in their own slaughter houses, whereas the remaining ones purchased their chicken already slaughtered. Most of the chicken sellers interviewed (91.2%) mostly sold chilled chicken meat to their customers (Figure 5.18), as whole carcass, boneless, whole leg, whole wing, wing drummettes, liver, heart, and neck.

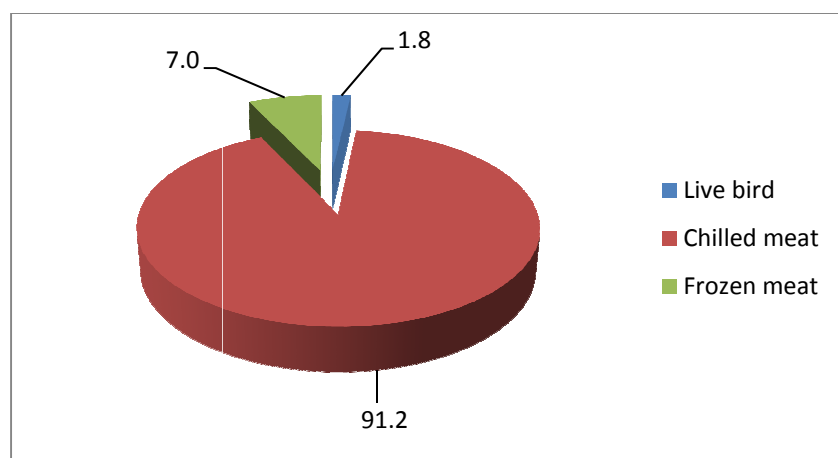


Figure 5.18: Percentage of chicken sellers selling live birds, chilled and frozen meat

89.5% of traders had chilled cabinets in their outlets. Unsold chicken were usually chilled for later use, in some cases they were frozen for later use and in some cases sold to other retailers to be sold in a frozen state.

Table 5.3 also show that 45 of the 57 traders sold 80-90% of their chicken directly to consumers, and 16 of them marketed a maximum of 40% of their chicken through restaurants and fast-food outlets.

Table 5.3: Marketing to different types of consumers

		Category of customers	
		Restaurants & fast-food outlets	General Public
Percentage	< 10%	4	
	10% =< to < 20%	5	
	20% =< to < 30%	4	
	30% =< to < 40%	3	
	40% =< to < 50%		
	50% =< to 60 %		
	60% =< to < 70%		3
	70% =< to < 80%		4
	80% =< to < 90%		5
	90% =< to < 100%		45
Total		16	57

5.2.7 Major competitors

Traditional broiler traders were asked about the competition they faced in selling their products. Figure 5.19 shows that the major competitors of chicken sellers were non-Chantefrais outlets (46.6% of cases), Chantefrais outlets (43.7% of cases), supermarkets and shops (5.8% of cases) and the traditional sellers at market place (1.9% of cases). Chicken sellers reported that supermarkets and chicken sellers at market places were not directly in competition with them. 3.5% of the respondents claimed that they had no competitors in their surroundings.

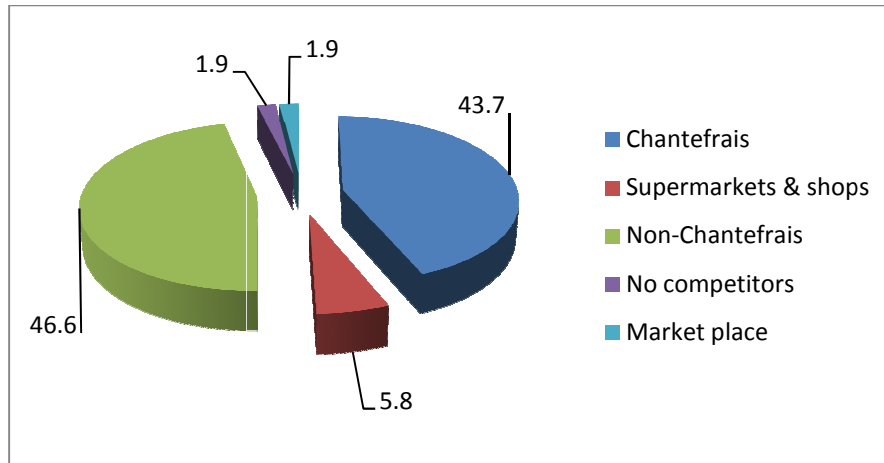


Figure 5.19: Major competitors chicken sellers

Respondents also revealed that they possessed a comparative advantage on 'Chantefrais' and figure 5.20 below provides the perceived reasons.

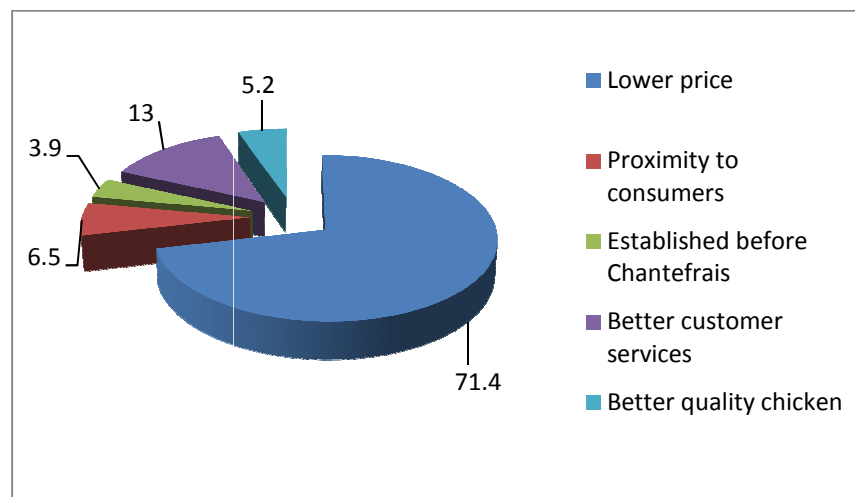


Figure 5.20: Perceived advantage over Chantefrais

Nevertheless chicken sellers also revealed that the emergence of 'Chantefrais' outlets also posed competition to their business and the main reason for such competition was that there was a perception from consumers that 'Chantefrais' offered higher value products (in 47.7% of cases), better hygiene (in 18% of cases), and better services (in 10% of cases).

5.2.8 AI and its impact, as a threat to chicken retailing

Out of the 57 respondents, 45 were aware of the AI disease. Almost 65% of the respondents thought that there would be no supply of chicken at all in case of an avian flu outbreak and a minority of respondents also perceived that in the case of an AI outbreak the demand for chicken would also decrease and that this would affect their business.

35% of responding sellers had no idea about the effect of the disease on their business. Furthermore, 73% believed that they would have to give up broiler production where as the remaining 27% claimed that they would continue with their broiler business once the ban would be lifted.

5.2.9 Food safety issues and their impact, as a threat to chicken retailing

Respondents were asked about how they were ensuring food safety of their products. 45.6% of them claimed that the onus of food safety of their products was laid on chicken producers. 30.9% of them mentioned that they sold all their products on the same day to ensure its safety. The figure 5.21 provides additional information on practices of sellers to ensuring food safety of their products.

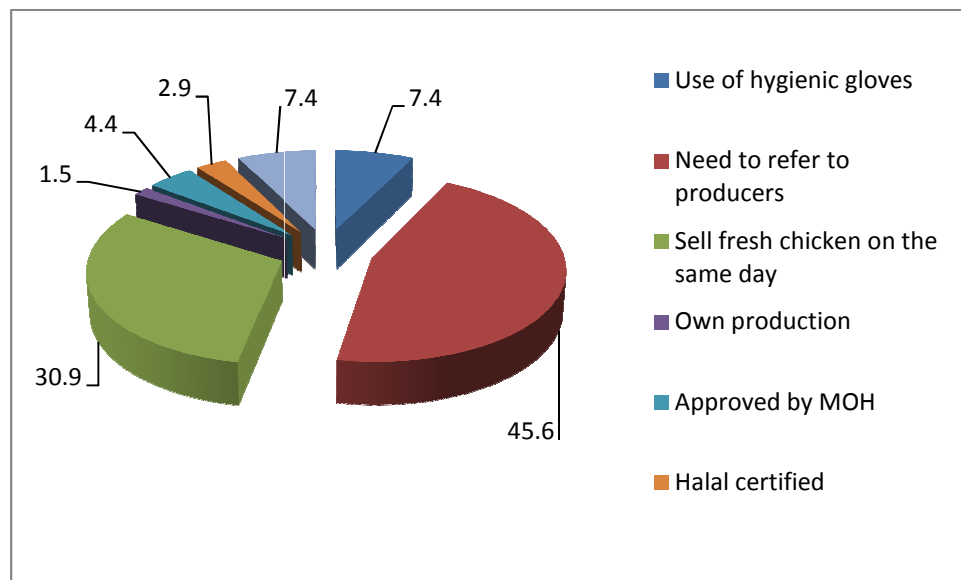


Figure 5.21: Reported measures to ensure food safety

5.2.10 Import of chicken as a threat to retailing

In case of chicken imports, 23% of the respondents believed that they would have to shift from selling fresh chicken to selling frozen chicken. 10.3% believed that the demand of fresh chicken would decrease given that the price of the imported products would be lower. Another 21.8% of respondents believed that the extent to which their business would be affected would depend on other related factors (Figure 5.22).

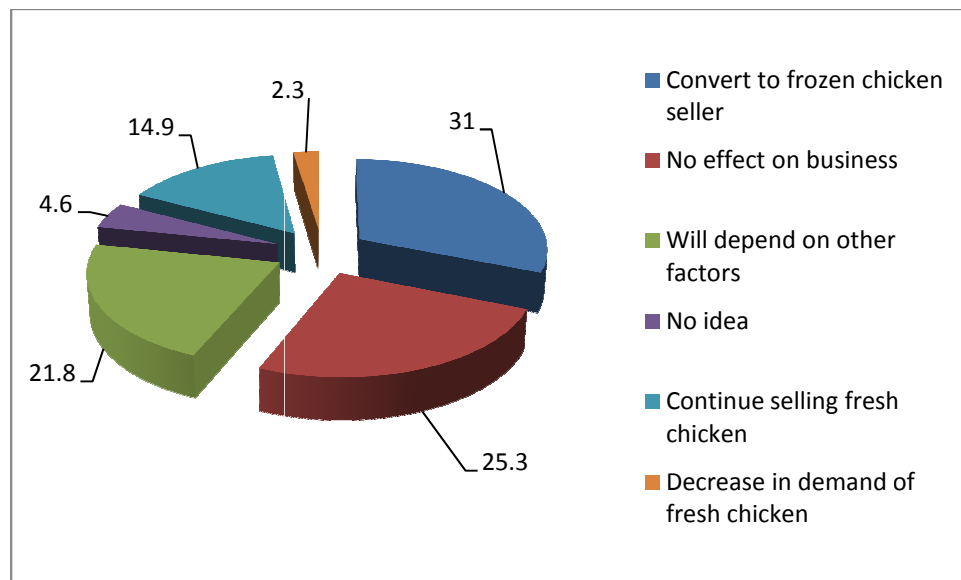


Figure 5.22: Impact of chicken imports on chicken sellers

5.2.11 The effect of rising price of broiler feed on chicken sellers

The chicken sellers interviewed were asked about the impact of the rising price of broiler feed on their broiler business. They all realized that the increase in the price of feed would necessarily increase the cost of production of broilers and the selling price of chicken to them would subsequently also increase. 41% of the respondents reported that they would pass on the increase in cost of production to consumers and increase the selling price of chicken. Such respondents also mentioned that such increases would also depend on their competitors and how they would react to the increase in the price of whole chicken. Some of the respondents (13 out of 34) also mentioned that they could also temporarily absorb some of the increased

cost until the market would stabilise and then pass it fully to consumers. 54.2% of the chicken sellers claimed that they would be confronted with a decrease in the demand of chicken and 4.8% of the respondents believed that the rise in price of broiler feed would have no negative impact on their business.

5.2.12 Awareness of GMOs among broiler traders

The majority of the respondents (96.5%) were unaware that GMOs were used in the manufacture of broiler feed.

5.3 Survey at retail outlets (supermarkets and hypermarkets)

All the hypermarkets and supermarkets surveyed bought broiler chicken from FAIL and Innodis. “Chantecler” (90% of total broiler chicken sales) was the preferred brand of broiler chicken by the consumers. Generally, orders for broiler chicken were placed thrice or twice per week but hypermarkets, receiving more than 12,000 clients per week, placed their orders on a daily basis. The quantity of broiler chicken (both chilled and frozen) supplied to supermarkets and hypermarkets, ranges from 100 Kg to 2.5 tonnes per week. 5 retail outlets out of 10 had a preference for broilers weighing between 1.2-1.8 Kg. All the retail outlets paid for their broiler chicken by credit and the duration of credit varied from 30 to 90 days. 9 retail outlets had a written contract with the suppliers of broiler chicken. All the 10 hypermarkets and supermarkets had frequent promotions on broiler chicken and its products. 8 retail outlets perceived the threat of AI as the one which could have the most negative impact on their broiler chicken business

5.4 Main findings at the level of hotels and restaurants

13 respondents bought broiler chicken from FAIL and Innodis. Orders for broiler chicken were placed thrice or twice per week, depending on the number of clients. The quantity of broiler chicken procured per week, ranges between 60 Kg and 300 Kg. 2 restaurants and 7 hotels had a

preference for broilers weighing between 1.2-1.8 Kg. All the 17 hotels and restaurants paid for their broiler chicken by credit and the duration of credit varied from 30 to 90 days. 6 respondents had a written contract with the suppliers of broiler chicken. 7 respondents perceived the threat of AI as the one which could have the most negative impact on their business.

Figure 5.23: Map of broiler supply chain

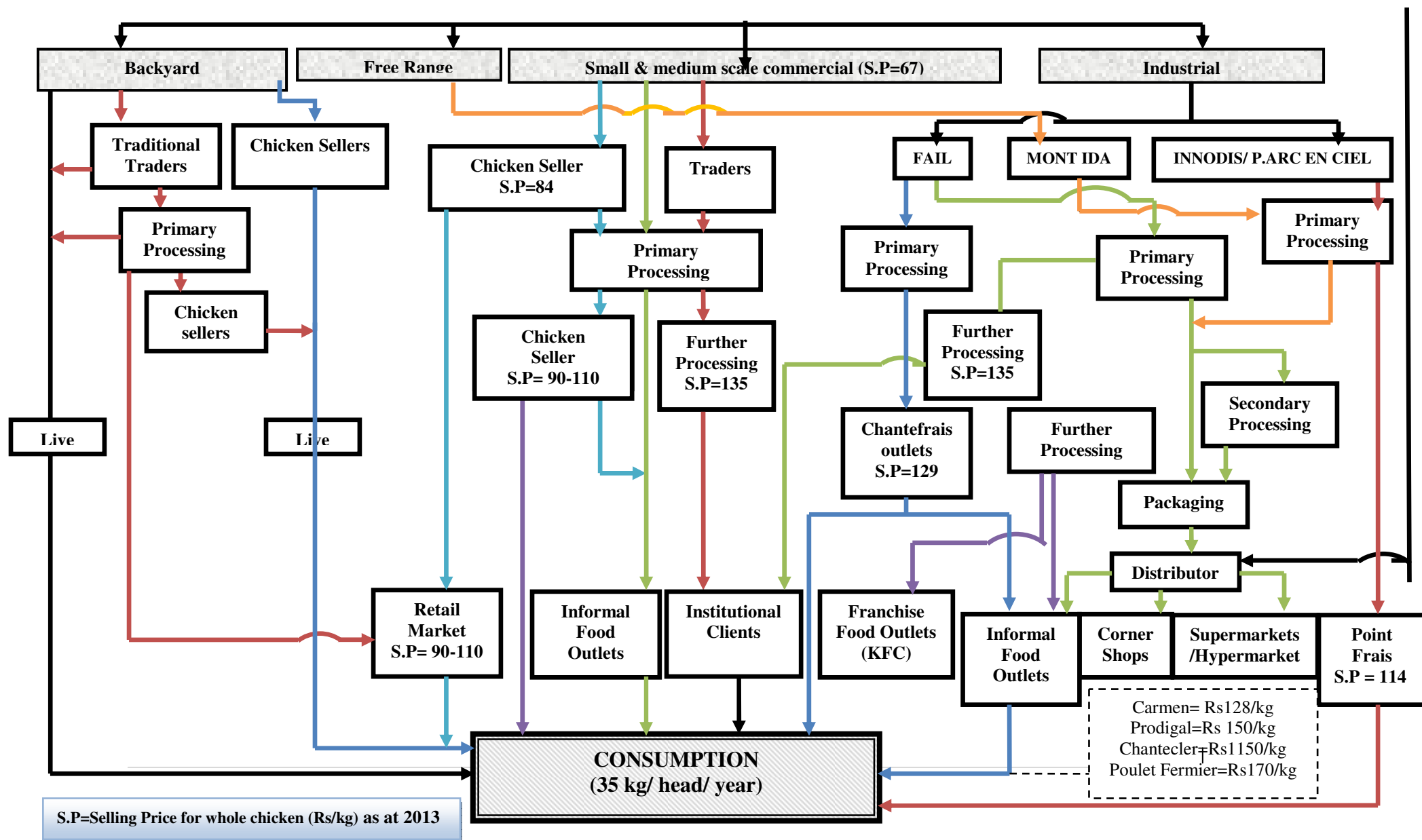


Figure 5.23 depicts the local broiler supply chain, it shows the direct and indirect linkages of the systems of rearing of broilers for meat production with the post farm processing of whole chickens and further value-added, packaging of chicken meat and the wholesaling and retailing of both live broilers and dressed chicken. .For the purpose of this study, a trader was defined as buyers of live chicken and dressed chicken, which they sell to chicken sellers. The latter are defined as sellers of live broiler, dressed chicken and processed chicken meat in market stalls and are registered with the local health authorities.. The market of live birds is very small. Consumers can obtained live birds directly from almost all the backyard and a few small and medium commercial farmers. .In a second scenario, broilers from the backyard production are either bought by the chicken sellers or the traditional traders. These are processed in private abattoirs prior to being retailed as dressed chicken by chicken sellers. .

The small and medium commercial producers sell a share of their live broilers to chicken sellers and chicken traders. Some chicken sellers sell the live broilers in retail markets while the chicken traders and some small and medium commercial producers y process the chicken before selling to informal food retail outlets. Some chicken sellers buy dressed chicken, from the chicken traders and small and medium commercial producers, as described aboveThus, the supply sources for the chicken sellers are birds raised by themselves, purchases from traders, or purchases from small and medium farmers.

The supply chain at the vertically integrated industrial production system is more complex. It involves more stages before the processed chicken reaches the final consumers. The industrial broiler producers supply only dressed and value added chicken. In the free range system, the broilers are processed and marketed by Innodis.

The first processing stage is slaughtering and dressing the chicken at an abattoir. Secondary processing includes portioning the carcass into different chicken cuts while, industrial processing refers to the manufacturing of burgers, sausages, nuggets among other types of poultry products. .

Once industrially processed, the chicken meat is packaged and sent to retail distribution channels like supermarkets, hypermarkets, chicken meat shops, informal food outlets (e.g., shops), franchise food outlets and institutional clients such prisons, police department, hotels and restaurants..

Chapter 6: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

The discussion section of this research work has been centered on two main aspects namely the structure and governance of the broiler chicken supply chain and the effects of external threats on the chain. This section draws heavily on the main findings from both the quantitative and qualitative components of the study.

6.1 The structure and governance of the broiler chicken supply chain

The broiler chicken supply chain in Mauritius is a well-structured one, having produced 47,200 tonnes of chicken in 2012 resulting in a per capita consumption of 36 kg per head per year. The supply chain is well developed with roles and functions of stakeholders clearly mapped out. The supply chain can be divided into several categories of actors ranging from those at the production level, intermediaries at the distribution level; input suppliers, and support institutions.

6.1.1 The relative importance of the different broiler production systems

The local classification of broiler chicken production systems was compared to the FAO (2004) four system classification, and based on a study carried out by Upton (2008), we propose (Table 6.1) a more precise classification and characterisation of the Mauritian broiler production systems adapted to our local specificities. The categories are based on four main quantifiable parameters namely: the flock size (or bird density), level of management control (vertical integration), adoption of formal biosecurity measures, contribution to total poultry meat production.

Table 6.0: Characteristics of the Mauritian broiler chicken production systems

Characteristics	Sectors			
	1	2	3	4
	Industrial and Integrated	High Biosecurity medium-scale commercial	Low biosecurity small-scale commercial	Backyard
Flock size (units of birds)	> 10,000	> 500 - 10,000	50 - 500	< 50
Level of management control (vertical integration)	High to complete backward and forward vertical integration	Low forward vertical integration	None	None
Biosecurity level	High	Moderately high	low	Very low to nil
Contribution to total poultry meat production (%) ⁴	65	25		15
Contribution to total production in 2012 (T)	30,680	11,800		7,080
Location	Urban/Rural areas and in non-residential areas	Urban/Rural areas and in non-residential areas	Rural areas and in non-residential areas	Rural areas and in non-residential areas
Poultry breed	Commercial	Commercial	Commercial	Commercial/native
Housing	Indoors	Indoors	Indoors/partly outdoors	Oudoors/scavenging
Contact with other poultry, domestic birds and wildlife	None	None	Yes	Yes
Type of processing/Product line	Industrial processing/whole frozen/portions frozen/whole chilled/chilled portion cuts/ready to eat chicken	Primary processing into whole fresh carcass and cuts	Live birds/primary processing whole fresh carcass	Live birds
Market	Rural and urban	Rural and	Rural and	Rural and urban

⁴ Source: Approximate % gathered from qualitative interviews

outputs/channel		urban	urban	
Veterinary service	Own veterinarian	Paid veterinary services	Paid veterinary services/some dependence on government veterinary services	Irregular, high dependence on government veterinary services
Source of medicine and vaccine	Market	Market	Market	Government and market
Source of technical information	Company/Associate Input suppliers	Input suppliers	Input suppliers	Government Extension Services (PBC/AREU)
Source of finance	Banks and company funds	Banks and company funds	Development Bank and private informal	Private informal and banks

Note: Framework adapted from Upton (2008) and populated with data collected during the study

6.1.1.1 Sector 1: Industrial and integrated production

This sector consists of the largest and most industrialised enterprises in the poultry industry. The two major players in this category are Avipro (FAIL) and Innodis Co. Ltd. The various stages in the supply chain are integrated from breeding of chicks down to supply of specialised cuts to franchised outlets. This sector has a very high level of biosecurity, and has continuous investments in research and development for innovative poultry products.

6.1.1.2 Sector 2: High biosecurity medium-scale commercial poultry production

This sector consists of enterprises having enough funds or able to raise enough credit for medium to large scale investments in poultry production. Medium scale producers include Mont Ida poultry farm, Poulet Arc en Ciel, Maurivet and Poultry Breeding Centre. They can also act as contract growers for sector 1 for mutual benefits and risk sharing. The level of biosecurity is considered as high as it is in the interest of the owners to prevent disease outbreaks due to high investments and high assets fixity in the business.

6.1.1.3 Sector 3: Low biosecurity small-scale commercial poultry production

This sector retains some of the characteristics of traditional backyard systems especially in terms of the products and marketing channels, that is, sale of live birds through intermediaries or directly to retail shops. There is some investment in commercial equipment (automatic feeders and drinkers), but suboptimal husbandry practices may exist in some cases especially when the activity is done on a part-time basis. The level of biosecurity is very low to even poor as no formal measures are taken to restrict movement of people on the production site as well as prevent contact with other poultry species and wildlife.

6.1.1.4 Sector 4: Backyard poultry production

This sector is mainly concerned with individuals having less than 50 units of chicken in their backyard or close to their residence. Husbandry practices are very traditional and investment in poultry equipment almost nil as recycled household objects may be used as feeders and drinkers (Ramasawmy, 1996). The birds are left mostly in the open, and are fed on household refuse or left to scavenge. It is primarily a non-commercial activity as most of the birds are slaughtered as and when required by the household for its own consumption so that the cycle may even go up to 90 days. However, on an occasional basis, the owner may sell live birds to locals looking for non-industrial chicken meat. The level of biosecurity is nil as the owner uses an open system and the birds are exposed to other species including wildlife.

6.1.2 Structure and governance of the broiler chicken supply chain

Having understood the relative importance of the different broiler production systems, it is worth discussing the various roles and importance of the different actors in the supply chain, as well as their linkages. The analysis of the governance of the broiler chicken supply chain through identifying elements of trust, and formal/informal agreements can also provide a basis for deepening our understanding of the supply chain. Hence this section presents our discussion centered around four thematic issues of importance that will illustrate both the structure and governance of the supply chain: Interlinkages between actors in the supply chain;

adoption of technology; bargaining power of intermediaries; future of small-scale and backyard producers.

6.1.2.1 Interlinkages between actors in the broiler chicken supply chain

Sector 1 producers operating in industrial and integrated production systems have linkages with the other types of production systems with respect to the provision of input supplies such as feed and chicks. There is also contract production which is defined by a formal contract between the industrial producer and contract growers whereby the latter are provided with input supplies and technical advice and are essentially involved in the fattening of the chicks.

6.1.2.2 Adoption of technology

The broiler chicken industry especially the actors in sector 1 (industrial and integrated) makes use of the latest technology starting from the use of commercial breeds with high feed conversion ; and automation of production activities. This large-scale investment in technology has a trickle-down effect to the other sectors of the production systems whereby the medium and to some extent the small scale producers emulate the available technology and hence improve their husbandry practices.

6.1.2.3 Bargaining power of intermediaries

The findings of the study reveal that intermediaries operating in the distribution channel for medium and small-scale commercial producers have a high bargaining power especially as concerns the price at which they buy live broilers. Small-scale producers are especially at the mercy of the intermediaries and are price takers.

6.1.2.4 Future of small-scale and backyard producers

In view of threats on the broiler chicken supply chain, what would be the role and importance of small-scale and backyard producers in the future? There is a possibility that over time and with increased urbanisation of different regions of the country, that backyard broiler production disappears. This situation is exacerbated by young people disengaging with

traditional livestock rearing activities. As regards small-scale commercial broiler production activities, some of the producers may either increase their flock sizes or move into sector 3 (high biosecurity medium-scale commercial broiler production) or close down their business due to increasing costs of production.

6.2 A SWOT analysis of the broiler chicken supply chain

An analysis of key informant interviews have provided us with enough data to list the Strengths, Weaknesses, Opportunities and Threats of the broiler chicken supply chain as shown in Table6.1:

Table 6.1: SWOT analysis of the Mauritian broiler chicken supply chain

<p>Strengths</p> <ul style="list-style-type: none"> • Experienced and qualified human resources in the medium to industrial scale enterprises • Stringent quality control systems • Investment in R&D leading to innovative products • Well-established trademarks and customer loyalty • High consumption of chicken as considered as low-cost source of protein • Good support institutions • Ready access to finance 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Suboptimal husbandry practices in some types of production systems • Varying levels of biosecurity • Price distortions at the level of intermediaries in the distribution channels leading to excessive margins for traders • Proximity of farms with residential areas
<p>Opportunities</p> <ul style="list-style-type: none"> • Potential for more technological advancement at production and 	<p>Threats</p> <ul style="list-style-type: none"> • Price volatility of feed

processing levels <ul style="list-style-type: none"> • Demand for more value-added processed poultry products • Increased demand for chicken products in fast-food outlets 	<ul style="list-style-type: none"> • Disease outbreaks • Dumping of cheaper imported poultry products • Environmental concerns (waste management issues)
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The SWOT analysis indicates that the broiler chicken industry is a strong one with a good institutional support and a number of opportunities for long term strategies for the industry. However, there are a number of weaknesses that can be addressed by actors in the industry with the help of support institutions. The SWOT analysis also helped to identify four main threats to the industry namely the price volatility of feed, impact of disease outbreaks, environmental issues mainly with respect to waste management, and finally dumping of cheaper imported products as a perceived threat to the industry. These threats are discussed in more details in the following section.

6.3 Impacts of external threats on the broiler chicken supply chain

This discussion part analyses the possible impacts of the major threats identified in the study, namely price volatility of feeds, disease outbreaks, environmental issues and the dumping of cheaper poultry products. One of the major threats feared by almost all the producers is the price volatility of the feeds, as a result of increasing world price of feed ingredients.

6.3.1 Price volatility of feed

Feed availability and feed prices are key elements to sustain poultry farming. The poultry industry is highly dependent on imports for its feed ingredients. Feed alone represents more than 60% on the costs of production for broilers. Hence, the fluctuations in the prices of feed ingredients have been identified as having a substantial negative impact on the cost of broiler production and hence affecting their profitability (Louw, Schoeman, and Geyser, 2011). Despite

the high dependency on imported raw materials it was reported mainly by the big commercial farms that the poultry industry has maintained its resilience to the increasing prices of raw materials on the world market. The main feed ingredients are maize and soya bean. The poultry sector consumes 70% of the total imports of maize. Hence, the availability of maize at a competitive price is crucial in maintaining of the sustainability of the sector. However, the domestic production of maize has remained stagnant for the past decade. In Mauritius, feed availability is not a constraint, as there are 2 fully automated private feed mill operators that produces a wide range of livestock feeds and they have sales points dispersed all over the island. Lately some entrepreneurs have started to import cheaper poultry feeds to counteract the rising costs of locally produced feeds.

6.3.2 Disease outbreak

The large farms are subjected to compulsory tests for salmonella and other tests through their own sophisticated laboratories for disease surveillance and diagnostic services.

During the 70s, when the poultry industry was rising, the government provided veterinary care services to local breeders. But since the emergence of private companies, they have always employed their own veterinary consultants and rely very little on the government veterinary services. The prices of vaccines and other animal health products are comparable to international prices and they meet international standards. The operations on those large farms are supported by strict biosecurity and quarantine measures for both the breeder and broiler flocks because in those integrated farms where a large number of birds are concentrated in a limited geographical area, the risk of contracting a disease is high and can thus seriously affect the entire flock. The large integrated poultry farms have their own abattoirs. However, currently poultry are slaughtered in abattoirs without any veterinary inspection as they do not face under the Meat Act. There are also non registered poultry abattoirs that are in operation without any veterinary or public health control and this poses obvious public health risks.

HPAI is an infectious disease of birds caused by the type A strain of the influenza virus. Many studies have reported that once domestic birds are affected AI can be difficult to control and cause major economic impacts for poultry farmers. All the main poultry producers and veterinarians recognised that the HPAI is a major threat to the sustainability of the chicken industry in Mauritius. However, some of the producers have argued that due to their adoption of strict biosecurity measures and a disease surveillance system, HPAI would not represent a major threat to them. Indeed, studies have highlighted the risk of HPAI Virus into a poultry farm is likely to be lower in infected areas where there are a well managed biosecurity measures and vaccine campaigns (Van der Goot et al., 2005, Ellis et al 2006, Sims, 2007). However, it is worth mentioning, that in some intensive production systems, the farm does not necessarily implement biosecurity measures appropriate to any level of a disease risk (Upton, 2007). For example, an outbreak of the AI in Canada has shown that some of the poultry farms that did not adopt strict biosecurity practices on the farm were infected (Power, 2005). DEFRA (2007) have also reported that outbreaks of the HPAI were due to some specific deficiencies in the biosecurity measures. This shows that intensive poultry rearing can represent a higher risk than other production systems. However, it is recognized that in some production system at the small scale and backyard level poses a disease risk, as they invest less in facilities and biosecurity measures. This is feared by the other biosecure farm owners, as they can potentially increase the risk for surrounding farms, given that poultry operations in are largely clustered in several areas across the island. Indeed, modeling studies in outbreak of H5NI HPAI (Truscott et al 2007, Power 2005) have shown that infection can be contained if the infected farm are relatively isolated but there was considerable local spread of the virus in areas with dense population of poultry farms.

Another indirect impact of the HPAI was a drop on consumption and prices of chicken in some countries. For example, when the news of the AI spread, it was reported that the consumption of chicken dropped and this could cause huge losses to the farmers. Mehta and Nambiar (2008) reported the price of chicken dropped from Rs36/kg to Rs16/kg and there was a decline

in production. published a report that shows that In 2006 following the outbreak of HPAI, there was to major consumer shift in the form of reduced consumption, resulting in reduced price chicken, and supply (FAO/OECD, 2006).

In Mauritius, the Government has developed a contingency plan to contain the disease and the compulsory measures are immediate quarantine and movement controls of affected farms and premises, reinforcement of bio security measures, zoning of restricted (infected) area/s (road blocks), control (surveillance) area/s and disease free areas, immediate stamping out and disposal of infected and in-contact birds and litter etc. to terminate the multiplication of virus (Euthanasia), decontamination, surveillance and epidemiological investigations and testing for absence of disease before restocking. Moreover, a series of recommendations have also been made to prevent the entry of the virus into the country (HPAI contingency plan, Mauritius, 2006). However, it was strongly pointed out by the interviews of all parties concerned that the success of this plan depends on an early detection, reporting and diagnosis of disease together with the swift imposition of effective eradication and movement controls are essential in an attempt to contain an outbreak. It is thus essential that there is continued awareness campaign should be maintained at all levels especially where farms are less biosecure as stipulated in the AI contingency plan. There must be awareness programme to farmers' level to update bio-security need. Bio-security will not only maintains a healthy flock but also minimize spread of infectious and zoonotic diseases and subsequently enhance public health.

6.3.2.1 Other Threats

From our in-depth interviews, it was shown that he large integrated poultry farms have their own abattoirs. However, currently poultry are slaughtered in abattoirs without any veterinary inspection as they do not face under the Meat Act. There are also non registered poultry abattoirs that are in operation without any veterinary or public health control and this poses obvious public health risks. Other concerns facing poultry producers are limited availability of litter materials (woodshavings) and shortage of labour (Anon, 2012).

6.3.3 Environmental issues

With the growing trend in the poultry and an increasing number of broilers farms scattered all over the island poses an environmental threat and may degrade the environment through: surface water pollution, soil and water pollution, improper sewage disposal in farms, including improper sewage treatment before release into waters, atmospheric emissions of gaseous substances (ammonia, hydrogen sulfide, carbon dioxide) from intensive poultry systems, – atmospheric emissions of dust substances (dust from litter, storehouses, feed mills) from intensive poultry systems (Gerber, Opio and Steinfield, 2008). In this context, a Technical Advisory Committee (TAC) in 2008 by the Ministry of the Environment was set up to assess the impacts of the environmental problems of the poultry sector. Several recommendations were made on waste management, institutional and legislative framework and location of the industry to achieve environmental sustainability. There is thus a need to protect the environment, and poultry farms have to follow environmental regulations and laws, especially with regards to water quality, manure, dead birds disposal, among other nuisances and hazards as stipulated in the report (Ministry of Environment, TAC, 2008).

6.3.4 Dumping of cheaper poultry products

Brazil⁵ is the biggest poultry chicken exporter (accounting for 31.7% of global poultry meat exports) and it counts three African countries in its top 25 export destinations (South Africa, Angola and Ghana). In 2012, as an anti-dumping measure South Africa imposed extra tariff ranging from 46.6% to 62.9% on whole chicken and chicken breasts from Brazil, complaining that Brazilian suppliers were dumping their products in South Africa. Brazil took South Africa to the World Trade Organisation (WTO) over the imposed tariffs and the anti-dumping duties against Brazil were lifted at the end of 2012 (USDA, 2013). In 2008 frozen imported whole chicken from Brazil illegally entered the Mauritian market highlighting weaknesses in the import system. This episode acted as a wake-up call for all stakeholders involved in poultry production locally. Producers highlighted that dumping of such chicken products could irreversibly destabilise the well-structured broiler supply chain and lead to the downfall of the

⁵ Other cheap global exporters include Thailand and Argentina

local industry. They unanimously remarked that anti-dumping laws should be established to protect local production and interests of local producers. Even though it is important to protect the local poultry industry, it is also fundamental to operate within the confines of the rules and regulations of the WTO. One comparative advantage that local producers have over frozen imports is that local demand over the last two decades has structurally shifted to fresh chicken and that consumers have gradually moved away from frozen chicken. This change is a strong positive determinant for local producers and their strategy should be to increase and improve the availability of retail outlets selling fresh chicken and derived products to 'lock' the preference of Mauritians for fresh chicken.

6.4 Coping strategies of main actors at the production level with respect to identified threats

Table 6.2 is a summary of the coping strategies of the main actors at the production level with respect to identified threats.

Table 6.2: Coping strategies against threats for actors in the different broiler production systems

Main threats	Sectors			
	1	2	3	4
	Industrial and Integrated	High Biosecurity medium-scale commercial	Low biosecurity small-scale commercial	Backyard
Coping strategies				
Price volatility of feed	The feed millers are price takers and cannot influence the purchase prices of the main feed ingredients, namely maize and soybean, as these are imported from Argentina and Brazil.			No strategies required as there is no dependence on industrial feed.
	Feed millers have		Some	

	investigated into the possibility of using better feed formulation strategies to increase the FCR ratio and decrease amount of feed required		producers have reduced their flock sizes to cope with increase prices of feed.	
Disease outbreaks	Coping strategies include: vaccination programmes by Government; enhancement of biosecurity measures on farms; establishment of a contingency plan against disease outbreaks			None
Environmental issues	Waste recycling for use as compost remains the main environmental measure taken. As concerns water quality, dead bird disposal etc, it does not appear that there is a clear implementation by actors concerned of proposed measures			None
Dumping of imported poultry products	Trade barrier at the level of government policy			
	Aggressive marketing to promote local brand name of poultry products focusing on supplying fresh & chilled products	Improve the supply & quality of local fresh & chilled products	None	None
	High investment in R&D of innovative products			

6.5 Resilience of the broiler chicken supply chain to identified threats

At this point in our discussion, one very important question arises: “How far is the broiler chicken supply chain resilient to identified threats?”

A synthesis of our main findings coupled with interviews of the key informants in the sector provides some answers to the above question. As concerns the first identified threat which is the increasing price of industrial feed, it is observed that at the level of leading industrial producers, the increase in cost of production mainly due to feed cost, is passed on to the final consumer. This is reflected in the increase in price of chicken meat over the last few years. But given that chicken is still a low cost source of animal protein as compared to other meat, consumers continue to accept the increasing market prices. So it can be deduced that the supply chain is still resilient with respect to the increasing price of feed. The second threat related to disease outbreaks and mainly directed at HPAI has a direct impact on the supply chain as in spite of strict biosecurity measures and a contingency plan, Mauritius being a small densely populated island, the risk of disease spread in between farms is very high. Hence the resilience of the supply chain faced with a disease outbreak is deduced to be quite low. Although environmental issues are considered as a threat to the supply chain, so long as enforcement measures are not properly implemented, actors will be reticent to adopt environmental-friendly production activities. Hence, the resilience of the supply chain with respect to environmental issues is deemed to be high for the time being. Finally as concerns the threat of dumping of cheaper imported poultry products, so long as the government maintains trade policy measures to protect the local broiler chicken industry, the resilience of that industry will be high.

6.6 Conclusions and recommendations

The poultry industry is one of the dynamic and growing subsectors within the agricultural sector. The supply chain consists mainly of the small scale, medium and industrial producers, the latter providing nearly 65% of the total chicken production. The key structural change spearheading the growth of the sector has been the setting up of the integrated production

systems bringing about the economies of scale and profit necessary for the expansion of the sector. The strength of the industry lies in the use of improved breeds which have high productivity levels (e.g., feed conversion efficiency) at all levels in the production chain, and the high demand for poultry meat, which is still a low cost source of protein relative to the other types of meat.

The poultry industry is well supported by a wide range of public and private institutions that provide a conducive environment for the development of the sector. The vertically integrated units rely on their own feed producing mills for their supplies of feeds.

The main threats that pose risks to the sustainability of the poultry production are (a) price volatility of feed ingredients, especially maize and soyabean, (b) diseases outbreaks, (c) dumping of cheap poultry products on the local market and (d) environmental issues associated with poultry rearing. Biosecurity is a major issue for the Mauritian poultry industry. In this context, there is a high level of preventive measures (e.g., vaccination programmes) and a national contingency plan to protect the industry from potentially hazardous disease outbreaks. In the short term, the poultry industry has been fairly resilient despite the rising cost of production, mainly due to high feed ingredients cost. However, a major consequence of this situation is that the price of chicken meat has inevitably gone up. Another concern is the import or dumping of especially Brazilian poultry products which are produced at a much lower cost than the local ones and the use of GMOs feeds ingredients which are cheaper than non-GMOs ones.

In spite of some of the threats, the future of the poultry sector appears to be bright and it is conservatively estimated that the industry will grow by 5% over the next 10 years, showing that there is spare capacity. With this scenario, the industrial producers with the support of local authorities are planning to export broiler chicken. Reunion Island imports 50% of its poultry

products which represents a tonnage of 12,000-13,000. Such products are imported from France, EU. Mayotte islands imports almost all of its poultry products which amounts to 8000-9000 T. given the proximity of Mauritius to these markets, and that food safety, traceability and export certification conditions are met, producers can contemplate exporting to such markets, pending financial and technical feasibilities. Such exercises should entail costing and valuing all the likely benefits (margins) and costs (import taxes, freight, transaction costs, offers from competitors amongst others) of doing so. Such an assessment should also include a thorough market research to also look at what type of products should be exported. Given that the local broiler supply chain is highly integrated, producers within different production systems are likely to directly and indirectly benefit.

In order to maintain the competitiveness of the poultry industry and to maintain bio security level of the industry, it is recommended that there is a need to:

- Use a more formal classification of the broiler chicken production systems based on clear and quantifiable parameters as defined in section 6.1.1.
- Further studies on the broiler chicken supply chain can include aspects such as a market analysis for the demand for innovative poultry products; scope for increasing production of free range poultry
- Revamp production of maize, the main raw material used in the production of chicken feeds, both locally and regionally through a coherent and implementable sub-sector strategic plan involving the private sector and industrial broiler producers
- Strengthen policies in order to ensure that the poultry farmers operate according to food safety norms and standards
- Enhance the biosecurity level at all levels, especially on low biosecure farms, by upgrading the housing facilities

- Ensure that environmental norms are strictly adhered to, especially with regards to waste disposal system proposed by the Technical Advisory Committee of the Ministry of Environment
- Continue to run awareness campaign at all levels on health and biosecurity measures especially where farms are less biosecure by the extension services.
- Improve the efficiency of production (e,g feed conversion ratio) through adoption of optimal husbandry practices
- Mounting a medium term R&D programme to explore the prospect for alternative broiler feed production through alternative production systems, feedstuffs (e,g., sweet potato) and additives especially for the small and medium commercial or family poultry units.
- Development of an active web based alert system for diseases occurrences for better sharing of information and collaboration among the various actors of the supply chain.

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Appendix 1: Chicks Producer and Supplier

Questionnaire no.:

Date:

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

- 1. Map broiler supply chain in terms of structure and governance**
- 2. To assess performance of the chain in terms of production & marketing of broiler chicken.**
- 3. To assess the likely impact of external threats on the broiler chicken supply chain**
- 4. To identify possible coping strategies of the different producer groups with respect to the above threats**
- 5. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.**

Section 1.0: Company Profile

- 1.1 Company name:
- 1.2 Address of company:
- 1.3 Location of hatchery:
- 1.4 Location of sales outlet:
- 1.5 Tel no.: Fax no.: E-mail:.....
- 1.6 Name and post of contact person:
- 1.7 Principle owner:
- 1.8 Company as:

Chicks Producer ()

Chicks supplier ()

1.9 Length of time in business:

Section 2.0: Chicks Production.....

2.1 When are chicks hatched?

Only when needed by clients () Standard number of chicks hatched everyday ()

Others () Specify:

2.2 Chicks production

Types of customers (I, C & S.C) ⁶	Percentage sold to	Age of chicks/chicken when sold (day)	Selling Price (Rs)	Daily Chicks Production (unit)	Annual Chicks Production (unit)

2.4 Are there different grades of day old chicks sold?

.....
.....
.....

⁶ I: Industrial, C: Commercial & S.C: Semi-Commercial

Section 3.0: Marketing

3.1 Who are the company's major competitors?

3.2 Does the company have any export market of day old chicks?

Yes () No ()

3.2.1 If yes, to which country are chicks exported and what amount?

Country exported	Quantity (tons/year)			Exporting price (Rs/Tons)
	2006	2007	2008	

3.3 Does the company have any branch in the region?

Yes () No ()

3.3.1 If yes, please fill the table below?

Name of Country	Commercial name of chicks produced	Annual production (unit)

3.4 Do you have a quality management system in place?

Yes () No ()

3.4.1 If yes, what is it?

ISO 9001 ()

ISO 2000 ()

3.5 What is your market share of broiler chicks locally compared to your competitors?

Section 4.0: Threats

4.1 Avian flu

4.1.1 What will be the impact on the broiler industry if there is an outbreak of avian flu in Mauritius?

Zoonotic impact-Affect public health ()

Major economic loss ()

Total instability on the poultry industry ()

Complete unavailability of local chicken meat ()

Others ()

Specify please:

4.1.2 What will be the impact on your company if there is an outbreak of the disease avian flu in Mauritius?

.....
.....

4.1.3 What are the bio-security measures that your company would take if there is an outbreak of avian flu?

.....
.....

4.2 Rising price of feed

4.2.1 If the price of broiler feed continues to rise and have a direct impact on the number of broiler producers, what will be the fate of your company?

.....
.....

4.3 Trade liberalisation

4.3.1 What if the import of day old chicks is liberalised locally?

.....
.....

4.3.2 Is it cost-effective to import day old chicks?

Yes () No ()

4.3.2.1 If yes, do you fear competition for cheaper day old chicks' import?

Yes () No ()

Appendix 2.0: Feed Manufacturer

Questionnaire no.:

Date:

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

6. Map broiler supply chain in terms of structure and governance

7. To assess performance of the chain in terms of production & marketing of broiler chicken.

8. To assess the likely impact of external threats on the broiler chicken supply chain

9. To identify possible coping strategies of the different producer groups with respect to the above threats

10. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.

Section 1.0: Company Profile

1.1 Company name:

1.2 Address of company:

1.3 Tel no: Fax no: E-mail:

1.4 Name and post of contact person:

1.5 Principle owner:

1.6 Company as:

Feed manufacturer ()

Feed distributor ()

Others ()

1.7 Product category:

1.8 When was the company launched & what is the length of time in business?

.....

1.9 What were the main objectives on launching the company?

Section 2.0: Feeds

2.2 Types of broiler feed & price:

Types of Broiler feed	Price per year (Rs/50kg/yr)							Year	Annual production of total feed (t)
	2002	2003	2004	2005	2006	2007	2008		
Broiler starter								1990	
								1991	
								1992	
Broiler grower								1993	
								1994	
								1995	
Broiler finisher								1996	
								1998	
								1999	
Broiler post finisher								2000	
								2001	
B Starter elite								2002	
								2003	
								2004	
B. grower elite								2005	
								2006	
B. Finisher elite								2007	
								2008	
Chicken mass									
Others									

[illegible]

Section 3.0: Marketing

3.1 What percentage of your sales goes to the following producer's group?

Producers	Percentage
Industrial	
Commercial	
Semi-commercial	
Traditional	

3.2 Who are the company's major competitors?

.....

.....

.....

.....

3.3 What is your market share of broiler feed locally compared to your competitors?

.....

3.4 Does the company provide free transport for feed delivery to its customers?

Yes ()

No ()

3.5 Does the company have any export market?

Yes ()

No ()

3.5.1 If yes, to which country are feeds exported and the amount?

Types of feed	Quantity (t/yr)	Country exported to	Exporting price (Rs/Unit)

3.5.2 What is the percentage of total production exported?

.....

Does the company have a quality management system in place?

Yes ()

No ()

3.6.1 If yes, which one?

ISO 9001 ()

ISO 22000 ()

Others () Specify Please.....

3.7 Does the company have any subsidiaries? Please can you state them?

.....

.....

.....

.....

Section 4.0: Threats

4.1 Rate the following in order of importance?

Threats	Orders of importance
Avian flu	
Increase price of feed	
Removal of import tariff & import of low value chicken	
Food safety along the broiler supply chain (e.g. traceability)	
A change in customer perception on GMO	

4.2 Avian flu

4.2.1 How will an epidemic of avian flu affect your business?

.....

.....

4.2.2 How easy is it to re-channel your broiler feed production towards export market in case of avian flu outbreak?

.....

.....

4.2.3 How easy can you substitute from producing broiler feed to producing other livestock feed in case of avian flu outbreak?

.....

.....

4.2.4 If there were a major outbreak of avian flu in Mauritius, what will be the fate of your company?

.....

.....

4.3 Rising price of raw materials

4.3.1 What are the major causes of the rising price of broiler feed?

.....

.....

.....

4.3.2 What are the impacts of the rising price of raw material on your business?

.....

.....

.....

4.3.3 How do you deal with such increase in price of raw material?

.....

.....

.....

4.3.4 If the price of raw material goes down, what will be the reaction of your company?

.....

.....

.....

4.3.5 What has been the general increase in the cost of production over the past four years?

Year	Percentage increase in cost of production
2004	
2005	
2006	
2007	
2008	

4.4 Trade liberalisation

4.4.1 Now that import tariffs have been waived, what would be the impact on your company?

.....
.....

4.5 GMO's

4.5.1 Are the raw materials imported for broiler feed production of GMO origin?

Yes (☐) No (☐)

4.5.2 What is the rational of using GMO raw material over conventional ones?

Cheaper price (☐)
Greater availability (☐)
Higher quality (☐)
Others (☐) Specify please:

4.5.3 What is the company's policy on using GMO ingredients in feed production?

.....
.....

4.5.4 How would the company react if there were public concern in the use of GMOs in feed production?

.....
.....

4.5.5 How would the company react if there were a ban in the use of GMOs in broiler feed production?

.....
.....

Appendix 3.0: Poultry Equipment Suppliers

Questionnaire no.:

Date:.....

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

- 11. Map broiler supply chain in terms of structure and governance**
- 12. To assess performance of the chain in terms of production & marketing of broiler chicken.**
- 13. To assess the likely impact of external threats on the broiler chicken supply chain**
- 14. To identify possible coping strategies of the different producer groups with respect to the above threats**
- 15. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.**

Section 1.0: Company Profile

- 1.1 Company name:
- 1.2 Address of company:
- 1.3 Showroom location(s):
- 1.4 Tel no.: Fax no.: E-mail:
- 1.5 Name and post of contact person:
- 1.6 Principle owner:
- 1.7 Length of time in business:
- 1.8 Company type:.....
 - Equipments manufacturer ()
 - Equipments distributor ()

Section 2.0: Broiler equipments

2.1 Types of broiler equipments.

Types of Equipment	Price (Rs)

Section 3.0: Marketing

3.1 Who are the company's potential customers?

Customers	Percentage sold to
Industrial producers	
Commercial producers	
Semi-commercial producers	
Traditional producers	

3.2 Who are the company's major competitors?

.....

.....

Appendix 4.0: Broiler Medication Suppliers

Questionnaire no.:

Date:.....

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

- 16. Map broiler supply chain in terms of structure and governance**
- 17. To assess performance of the chain in terms of production & marketing of broiler chicken.**
- 18. To assess the likely impact of external threats on the broiler chicken supply chain**
- 19. To identify possible coping strategies of the different producer groups with respect to the above threats**
- 20. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.**

Section 1.0: Company Profile

- 1.1 Company name:
- 1.2 Address of company:
- 1.3 Shop location(s):
- 1.4 Tel no.: Fax no.: E-mail:.....
- 1.5 ...Name and post of contact person:
- 1.6 Principle owner:
- 1.8 Product category supplied (Vitamins, Antibiotic, Vaccination, Vermifuges):
- 1.9 Length of time in business:

Section 2.0: Broiler Medication

2.1 Types of broiler medicines and price.

Types	Purpose	Price (Rs)	Annuals sales (Unit)
Vitamins			
Vaccination			
Antibiotic			
Vermifuges			

Section 3.0: Marketing

3.1 Who are the company's potential customers?

Customers	Percentage sold to
Industrial producers	
Commercial producers	
Semi-commercial producers	
Traditional producers	

3.2 Who are the company's major competitors?

.....

.....

.....

.....

3.3 Do you have a quality management system in place?

Yes () No ()

3.3.1 If yes, what is it?

ISO 9001 ()

ISO 22000 ()

Section 4.0: Threats

4.1 Avian flu

4.1.1 What will be the impact on the broiler industry if there is an outbreak of the disease avian flu in Mauritius?

.....

.....

4.1.2 What will be the impact on your company if there is an outbreak of the disease avian flu in Mauritius?

.....
.....

4.1.3 If there were a major outbreak of avian flu in Mauritius, what will be the fate of your company?

.....
.....

Appendix 5.0: Broiler Trader

Questionnaire no.:

Date:.....

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

- 21. Map broiler supply chain in terms of structure and governance**
- 22. To assess performance of the chain in terms of production & marketing of broiler chicken.**
- 23. To assess the likely impact of external threats on the broiler chicken supply chain**
- 24. To identify possible coping strategies of the different producer groups with respect to the above threats**
- 25. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.**

Section 1: Profile of Broiler trader/ chicken seller

- 1.1 Name of respondent (or selling outlet):
- 1.2 Address.
- 1.3 Age:.....
- 1.4 Gender: Male () Female ()
- 1.5 Occupation as broiler trader/ chicken meat seller:
Full-time () Part-time ()
- 1.6 Type of activity:
Buyer of broiler ()
Buyer of dressed whole chicken carcass ()
Buyer of chicken cuts ()
Seller of live broiler ()

Dressed chicken meat seller ()

Processed chicken meat seller ()

Section 2: Marketing of chicken

Trader as buyer

2.1 Source, quantity and price of broiler/chicken meat.

Source: Producers (I, C, S.C & T) ⁷ or Traders	Total number of producers/ traders	Average weight of broiler/dressed chicken (lb/unit)	Total number of broilers/dressed chicken (unit/order)	Price of live bird/dressed chicken (Rs/lb)	Frequency bought/ Week of order

2.2 Do you have a contract with the producer?

Yes ()

No ()

2.2.1 If yes, what sort of contract do you have?

Verbal ()

Written ()

Others () Specify please:.....

2.2.2 What is the mode of payment according to the contract?

Cash ()

Credit ()

Others () Specify please:.....

2.2.3 When do you order the chicken?

Everyday ()

Twice a week ()

Thrice a week ()

Four times a week ()

⁷ I: Industrial, C: Commercial, S.C: Semi-Commercial & T: Traditional

Others () Specify please:.....

2.3 Do you go to the producer's farm to procure your chicken or is it delivered to your doorstep?

Delivered to doorstep ()

Own mode of transport ()

2.4 What are your criteria when buying broilers/chicken meat?

Criteria	Specify where possible
Average age (d)	
Breed	
Average weight (lb/bird)	
Hygienic condition of pen (Poor, fair, good, excellent)	
Health of birds (Poor, fair, good, excellent)	
Uniformity of flock	

Trader as seller

2.5 Do you sell chilled or frozen chicken?

Live birds () Specify percentage sold:%

Chilled meat () Specify percentage sold:%

Frozen meat () Specify percentage sold:%

2.6 Sales of the broilers/chicken meat.

2.6.1 Sell live birds

Category of customer	Number of customers	Quantity sold (unit/wk)	Average liveweight (lb/unit)	Price (Rs/lb)	Selling place	Percentage sold to

2.6.2 Sell dressed chicken

Types of chicken meat	Price (Rs/lb)	Quantity sold	Types of Customers	Percentage sold to	Selling place
-----------------------	---------------	---------------	--------------------	--------------------	---------------

		(lb/week)			
Whole carcass					
Cuts	Halves				
	Boneless				
	Whole leg				
	Thigh				
	Drumstick				
	Whole wing				
	Wing drummettes				
	Liver				
	Heart				
	Neck				
Others					

2.6.2.1 Where do you slaughter the birds?

Own slaughter house ()

Pay for slaughtering () Specify:.....Rs/head

Others () Specify your answer:

2.6.2.2 Do you make use of chilled cabinet?

Yes()

No ()

2.6.2.3 What do you do in case of unsell dressed chicken?

Chilled for later use next day ()

Freeze for later use next day ()

Sell to frozen chicken retailers ()

Process the chicken ()

Never happened ()

Others ()

2.6.2.4 If kept frozen, at price do you sell the chicken on the next day?

Same price as chilled chicken ()

Different price as chilled chicken ()

2.6.3 Sell processed chicken meat

	Types of processed meat	Price (Rs/lb or Rs/unit)	Type of Customers	Selling place
--	-------------------------	--------------------------	-------------------	---------------

Cooked chicken	Roti			
	Fried chicken			
	Chicken curry			
	Marinated chicken			
	Roasted chicken			

2.7 Does your business influenced by seasonality?

Yes ()

No ()

2.7.1 If yes, then by what percentage does it affect?

Seasonality	Percentage affected
End of year festivity period	
Fasting period	
End of months	
Others (Specify:.....)	

2.8 Who are your major competitors?

- Chantefrais ()
- Supermarkets/shops ()
- Non-chantefrais meat shops ()
- Fast food outlets to “chantefrais”?
- Lower price ()
- Proximity to customers ()
- Established before “chantefrais” ()
- Better services ()
- Others () Specify:

2.8.2 How does chantefrais affect your business?

- Better consumer choice in terms of cuts ()
- Better hygiene in selling outlet ()
- Better quality of chicken ()
- Better services ()
- Perception of higher value product ()
- Others () Specify:

2.9 Do you make use of any sort of advertising to facilitate the marketing of your product?

Yes () No ()

2.9.1 If yes, can you specify which type?

- On-spot advertising ()
- Use of Poster ()
- Mass media ()
- Word to mouth ()
- Others () Specify:

Section 3: Financial Management

3.1 How much you have invested to start your business?

..... rupees

3.2 Do you rent your outlet?

Yes ()

No ()

3.3 Do you have quality management system?

Yes ()

Specify which: HACCP ()

ISO 2001 ()

No ()

3.4 Do you have any record keeping activities for better management of your cost?

Yes ()

No ()

3.5 How easy is it for you to convert from a trader of chilled chicken to frozen chicken?

.....
.....

3.6 Are you willing to convert from chilled chicken seller to frozen seller if there is a cheaper supply of frozen chicken import?

Yes ()

No ()

Section 4: External threats

Avian Flu disease

4.1 Are you aware of Avian Flu and its effects on your business of broiler trader/chicken meat seller?

Yes ()

No ()

4.1.1 If yes, how will the disease affect your business?

.....
.....

4.2 Where would you procure chicken in the event that an avian flu epidemic is declared?

.....
.....

4.3 In case of any avian flu outbreaks in Mauritius, will it force you to quit the business or would you be able to wait that the ban is lifted?

- Quit the business ()
- Wait for the ban to be lifted ()
- Others () Specify:

4.4 How would you guarantee that purchased chicken is safe?

.....

.....

Rising price of feed

4.5 Are you aware of the rising price of maize of broiler feed on the local market?

Yes () No ()

4.6 How does this affect your business?

- Higher cost of chicken ()
- Decrease in amount of chicken bought ()
- Decrease in demand due to higher cost of chicken ()
- Others () Specify:

4.7 How do you deal with the higher cost of chicken?

- Transfer this additional cost to consumers ()
- Absorb some of the extra cost yourself and do not transfer the full increase to consumer ()
- Set new prices depending on the price of competitors ()
- Cut in other types of cost ()
- Others ()
- Specify:

4.8 If the price of broiler feed kept rising, will it force you to quit that business?

Yes () No ()

4.8.1 If no, then what solution will you adopt to stay in the business?

.....

Trade liberalisation

4.9 What would happen to your business in case of import & distribution of frozen chicken?

.....

.....

GMO

4.10 Have you heard about the term GMO?

Yes () No ()

4.11 How would it affect your business if feed producers use GMO ingredients in broiler feeds?

.....

.....

Food Safety

4.12 If there is a chicken food scare/poisoning locally, how it would affect your business?

.....

.....

4.13 If you buy chicken from more than one producer, how do you ensure traceability of your products?

.....

.....

4.14 How do you differentiate among different cuts from different batches?

.....

.....

4.15 What are the steps you take to ensure the safety of your products?

.....

.....

Section 5: Future plan

5.1 Do you have any plan to expand your business?

Yes () No ()

5.1.1 If yes, then what are the difficulties in doing so?

.....

5.1.2 If no, specify why you are not interested in expanding the business?

Appendix 6.0: Checklist for support institutions: AREU, APD

Questionnaire no.:

Date:.....

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

- 26. Map broiler supply chain in terms of structure and governance**
- 27. To assess performance of the chain in terms of production & marketing of broiler chicken.**
- 28. To assess the likely impact of external threats on the broiler chicken supply chain**
- 29. To identify possible coping strategies of the different producer groups with respect to the above threats**
- 30. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.**

Section 1.0: Company Profile

- 1.1 Name of Institution:
- 1.2 Address of institution:
- 1.3 Activities:
- 1.4 Tel no.: Fax no.: E-mail:.....
- 1.5 Name and post of contact person:

Section 2.0: Role of institution in broiler sector

2.1 What is your institution's involvement in the broiler industry locally?

- Provide extension services** ()
- Deliver production techniques** ()
- Locate farms** ()

- Give advice** ()
- Provide finance** ()
- Others** () Specify please:.....

2.2 According to you what are the major threats affecting broiler industry locally?

.....

.....

2.3 How does your institution support producer in dealing with threats?

.....

.....

2.4 Rate the following in order of importance?

Threats	Orders of importance
Avian flu	
Increase price of feed	
Removal of import tariff & import of low value chicken	
Food safety along the broiler supply chain (e.g. traceability)	
A change in customer perception on GMO	

2.5 In case of an avian flu outbreak, how will your institution deal with the situation through your services?

.....

.....

2.6 How can your institution support producers in dealing with the increasing price of broiler feed?

.....

.....

2.7 How does your institution contribute towards improving the general productivity of broiler producers locally?

.....

.....

.....

.....

2.8 What is the role of your institution in ensuring food safety along the broiler supply chain?

.....

.....

Appendix 7.0: Checklist for support institution: DBM

Questionnaire no.:

Date:.....

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

31. Map broiler supply chain in terms of structure and governance

32. To assess performance of the chain in terms of production & marketing of broiler chicken.

33. To assess the likely impact of external threats on the broiler chicken supply chain

34. To identify possible coping strategies of the different producer groups with respect to the above threats

35. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.

Section 1.0: Company Profile

1.1 Activities of institution:

1.2 Address of institution:

1.3 Tel no.: Fax no.: E-mail:.....

1.4 Name and post of contact person:

Section 2.0: Role of institution in broiler sector

2.1 What is your institution's involvement in the broiler industry locally?

Give advice ()

Provide loans ()

Others () Specify please:.....

2.1.1 What are the different types of loan & repayment facilities available for broiler producers/traders?

.....
.....

2.2 Rate the following in order of importance?

Threats	Orders of importance
Avian flu	
Increase price of feed	
Removal of import tariff & import of low value chicken	
Food safety along the broiler supply chain (Eg: traceability)	
A change in customer perception on GMO	

2.3 In case of an outbreak of avian flu, how will your institution deal with the situation through your services?

.....

.....

.....

2.4 How can your institution support producers in dealing with the increasing price of broiler feed?

.....

.....

.....

2.5 How can your institution assist if small & medium producers want to upgrade the scale of their activities?

.....

.....

2.6 What is your general feeling about the further development of the broiler industry locally (especially concerning small v/s medium v/s industrial producers)?

.....

.....

Appendix 8.0: Checklist for support institutions: Veterinary Services

Questionnaire no.:

Date:.....

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

1. Map broiler supply chain in terms of structure and governance
2. To assess performance of the chain in terms of production & marketing of broiler chicken.
3. To assess the likely impact of external threats on the broiler chicken supply chain
4. To identify possible coping strategies of the different producer groups with respect to the above threats
5. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.

Section 1.0: Company Profile

- 1.1 Activities of institution:
- 1.2 Address of institution:
- 1.3 Tel no.: Fax no.: E-mail.....
- 1.4 Name and post of contact person:

Section 2.0: Role of institution

- 2.1 What is your institution's involvement in the broiler industry locally?

.....
.....
.....

- 2.2 According to you what are the major threats affecting broiler industry locally?

.....
.....
.....

2.3 How does your institution support producer in dealing with threats?

.....

.....

.....

.....

.....

.....

2.4 Rate the following in order of importance?

Threats	Orders of importance
Avian flu	
Increase price of feed	
Removal of import tariff & import of low value chicken	
Food safety along the broiler supply chain (e.g. traceability)	
A change in customer perception on GMO	

2.5 In case of an avian flu outbreak, how will your institution deal with the situation through your services?

.....

.....

.....

.....

.....

.....

2.6 What are the procedures prior to the import of frozen broiler chicken locally?

.....

.....

.....

2.7 Is import of broiler chicken actually allowed into Mauritius?

Yes ()

No ()

2.8 What are the conditions that an importer needs to comply with, prior to obtaining a broiler chicken import permit?

.....

.....

.....

.....

.....

.....

2.9 What is the role of Veterinary Services in ensuring food safety along the broiler supply chain?

.....

.....

.....

2.10 What is your general feeling about the further development of the broiler industry locally (especially concerning small v/s medium v/s industrial producers)?

.....

.....

.....

Appendix 9.0: Checklist for APD

1. Price of chicks at Poultry Breeding Centre (from 1960 to 2007)

	1960				2007
d-old chicks					
d-old layers					
Wk-old chicks					
2-wk old chicks					

2. Production & revenue at the PBC

	1960				2007
Egg incubated					
d-old broiler chicks produced					
d-old chicks sold					
Mortality of chicks					
Broiler meat sold					
Live bird sold for meat					

3. Cost of production at the PBC

Variable cost

Feed	
Vaccination	
Veterinary services	
Litter	
Transport	
Labour	
Opportunity cost	
Utilities - Water	
- Electricity	
- Telephone	
Parent stock imported	
Chicks imported	
Total	

Variable cost

Assurance	
Labour	
Materials - drinker - feeder	
Building	

5. Types of feed supplied to chicks

Types of feed	Price
Broiler starter	
Broiler finisher	
Chicks feed	
Growing mash	
Poultry all mash	

6. Farm capacity (per head or per year)

1960				2007

7. Species of parent stock throughout the year

8. Henhawkers

Years	1960			2007
Import of parent stock (head)				
Species of parent stock				
Country of import of the species				
Export of chicks (head)				
Country of export				

- When they appear?
- What were their activities?
- How they have contributed in the development of the poultry sector?
- A marketing channel (from production to consumer level) in which they are involved?

9. Feed production from Livestock Feed Limited.

Poultry feed	1960			2007
Chicks feed				
Broiler finisher				
Broiler starter				
Growing mash				
Poultry all mash				

Import of meat & meat products

9. A

Years	1959			2007
Frozen beef				
Frozen mutton				
Poultry meat				
Poultry meat				

marketing channel of poultry production at the PBC (From production to consumer level).

10. The objectives of the PBC have kept on changing throughout the year. What have been the objectives and policies of the PBC from its initial set up since now?

1960:

1965:

1970:

2007:

Appendix 10.0: Questionnaire for broiler producers

Questionnaire no.:

Date:.....

Title of project: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Objectives of the project.

- 36. Map broiler supply chain in terms of structure and governance**
- 37. To assess performance of the chain in terms of production & marketing of broiler chicken.**
- 38. To assess the likely impact of external threats on the broiler chicken supply chain**
- 39. To identify possible coping strategies of the different producer groups with respect to the above threats**
- 40. To recommend appropriate measures to stakeholders to ensure the economic sustainability of the sector.**

Section 1: Profile of producer

2.1 Name of producer:

2.2 Address of producer:

2.3 Age of producer: years old

2.4 Gender: Male () Female ()

2.5 Number of children:

2.6 Occupation as poultry keeper:

Full-time () Part-time ()

Please specify your full time activity:

Sector	Specify where necessary
Civil servant	
Private sector	
Own business	

1.5.1 If you are part-time broiler producer, can you please indicate whether you produce broiler throughout the year or in a specific time of the year?

Throughout the year () No. of cycle per year: cycle(s)

Specific time of the year () Please specify time:

2.7 Do you have any other enterprise (Crop/Livestock production)?

Yes () No ()

If yes can you please specify?

2.8 For how long are you involved in the production of broiler?

< 1 year	$1 \leq \text{Yr} < 5$	$5 \leq \text{Yr} < 10$	≥ 10 years

2.9 What is the number of birds in your farm? Birds⁸

1.9 What is the size of the farm? m²

1.10 What is the farm capacity? heads (Estimated or real)

1.11 Number of poultry farms and their respective addresses.

No. of poultry farms	Location

Section 2: Types of business

2.1 Types of business.

Owner/Manager ()

Tenant ()

Contractual agreement with industrial producers ()

Others Please specify

⁸ Trad/Bckyrd (< 50), S.Scale (50 - ≤500), M.Scale (500 - ≤10 000) & Industrial Scale (> 10000)

Own business

2.2 Why have you chosen broiler chicken production?

Parental inheritance ()

Hobby ()

Earn a living ()

Own consumption ()

Others () Please specify:.....

2.3 Do you employ labour?

Types of labour	Family members	Casual labour	Permanent labour
No. of labour			
Work done by labour			
Salary of one labour			

2.4 Source of chicks and price

	Please tick below	Number of chicks bought	Price of chicks (Rs)	Age of chicks when bought (days)
PBC				
FAIL				
Innodis				
Ceres				
Mont Ida				
Neighbour/Friends				
Others. Specify:				

2.5 How many cycles do you have per year?Cycles

2.6 What is the length of a cycle in your farm?days

2.7 What is the time interval between each cycle?days

2.8 What is the time interval between batches?days

2.9 At what frequency do you purchase chicks?

2.10 Are you familiar with the different breeds on the local market?

Yes () No ()

If with which breed are you familiar?

2.11 Have you ever tried any other breeds?

.....

2.12 Do you have any preference of any breed or colour?

Breeds Specify: Function of price ()

Availability ()

Tastier meat ()

Greater feed conversion into protein ()

Others ()

Colour Specify why?

Contract Production

2.13 With which industrial producers have you got a contractual arrangement?

FAIL ()

Innodis ()

Mont Ida ()

Others ()

Please specify

2.14 What form of contract do you have with the broiler producer?

Written () Verbal () Others ()

2.15 How long is the contract duration?

<1 than year () 1 - < 3 years () 3 - < 5 years () ≥ than 5 years ()

2.16 What are provided according to the agreement of the contract?

Inputs	Types	Quantity (Kg) & Number	Price (Rs)
Chicks			
Feeds			
Feeding Materials			
Drinking Mat			

Antibiotics			
Drugs			
Litter			
Others:.....			

Services	Please tick
Transport	
Advices	
Labour	
Veterinary facilities	
Waste disposal	
Others:.....	

2.17 What inputs are not provided by the industrial producer and why?

Inputs not provided	Reasons behind
.....
.....
.....

2.18 What is the approximate length of a cycle in one batch?days

2.19 How many cycles do you have per year?cycles

2.20 What kind of norms you have to follow concerning the following criteria:

	Specifications
Feeding management	
Vaccination of chicks	
Litter management	
Disinfection of pen	
Medications	
Others	

2.21 What is the selling price of the birds according to the contract?

.....

2.2 What happen when the broilers are not supplied at time?

.....

2.23 What happens if you default?

.....

Section 3: Management of technical & variables inputs.

3.0 Housing

3.1 What type of system have you adopted?

Deep litter system ()

Battery system ()

Others () Please specify.....

Deep litter system

3.2 Source of litter.

Types of litter	Source (Where)	Price per bag (Rs/kg)	Quantity used / cycle (Kg/cycle)	Frequency per cycle (Days)
Sawdust				
Wood shaving				
Bagasse				
Others				

Battery system

3.3 Source of battery.

Manufactured-Imported ()

Manufactured-Local ()

Home made ()

3.4 What are the systems of battery used?

Single row ()

Vertical tier ()

Others ()

3.4 What is the dimension of battery?

3.5 Material used for battery?

Wood ()
 Metal ()
 Others () Please specify

3.6 What is the number of birds per battery?

3.7 Useful life of battery?yrs

3.8 Cost of 1 battery?rupees

3.9 What is the repair and maintenance cost of the battery?

Feed

3.10 Types of feed used

Types of feed used	Source of feed (Where)	Age of birds when fed	Cost of feeds/bag (Rs/kg)	Feed used/bag/cycle
Starter				
Grower				
Finisher				
Others				

3.11 If any other feed not used: Why?

3.12 Transport cost

Place where feeds are bought	Location	Transport cost
Cooperative		
Retail shop		
Feed manufacturer		
Delivered by feed manufacturer		
Others.		

3.13 What is the frequency of feed purchase per cycle?

.....

3.14 Where are feeds stored?

.....

3.15 What sort of problem you encounter with storage of feed?

.....

3.16 Do you have any storage cost?

..... rupees

Feeders

3.17 Types of feeders used for chicks and adult broilers?

Types of feeders	Chicks	Adult	Price of feeders (Rs)	Source of feeders ⁹
Flat tray				
Tube feeders				
Trough feeders				
Home made				

3.18 Material used for feeders

Iron ()

Wood ()

Plastic ()

3.19 Number of feeders used per batch.

3.20 Uselife of feeders.Years

3.21 How much is the repair & maintenance cost of feeders on average per year? rupees

Water

3.22 Source of water.

Domestic supply () Cost of water {CWA}:Rs/week

River/lakes () Others ()

3.23 Where do you store the water used for poultry production?

.....

⁹ Source of feeders: Manufactured-Imported (M-I), Manufactured-Local (M-L) & Home made (H-M)

3.24 Do you make use of a water pump?

Yes () No ()

If you make use of a pump, how much is the repair & maintenance cost of pump?..... rupees

Drinker

3.25 Types of drinkers used for chicks and adult broilers and their respective price?

Types of drinkers	Chicks	Adult	Price of drinkers (Rs)	Source of drinker ¹⁰
Fountain drinker				
Automatic round drinker				
Home made				
Others				

3.26 What is the number of drinkers per batch? drinkers

3.27 Lifespan of drinker. Years

3.28 How much do you pay for repair and maintenance of drinkers?.....

Brooding management

3.29 Types of brooder used

Gas () Electric () Infrared () Others ()

3.30 Price of brooder. rupees

3.31 Source of brooder.

Manufactured – Imported ()

Manufactured – Local ()

Home made ()

Others ()

3.32 Uselife of brooder. years

3.33 What is the amount of money spent in repair and maintenance of brooder?

¹⁰ Source of drinkers: Manufactured-Imported (M-I), Manufactured-Local (M-L) & Home made (H-M)

.....

Pest and Disease management

3.34 Disease symptoms often encountered among the birds.

	Symptoms	Associated disease
1.
2.
3.
4.
5.

3.3 What measures you take when birds are sick?

- Own treatment () Please specify:
- Contact DVS (MOA) at Reduit ()
- Seek advice from AREU ()
- Seek help from other broiler chicken producers ()
- Seek help from friends/neighbour ()
- Do nothing ()
- Others ()

3.36 Are the birds vaccinated?

Yes () No ()

3.37 Types of vaccines used and their purpose.

Types of vaccine	Dosage	Age of birds	Cost of vaccine	Source of vaccine ¹¹

3.38 What is the mortality rate of the flock per cycle or per year?

¹¹ A : DVS, B : IBL Medical Trading, C : Maurivet & specify others

...../cycle or./year

3.39 Do you use extra broiler chicks to catch for any mortality?

Yes () Please specify the number of chicks:

No ()

3.40 Are visitors allowed to enter your poultry unit?

Yes () No () If no why?

3.41 Is there any footbath when moving from one pen to another?

Yes () Specify disinfectant used:

.....No () If no why?

Waste management

3.42 After how long do you remove waste from the pens?

.....

3.43 Disposal of litter.

Litter disposal	Percentage dispose (%)	Price per bag (Rs/kg) if applicable
Sell to planters/public		
Give away to planters/public		
Others:Specify:		

3.44 What are the problems associated with waste disposal?

Section 4: Financial Management

4.1 Equipment

Minor tools	Useful life (Yr)	Price (Rs)
Spade		
Knife		
Rake		
Basket		
Others		

4.2 Do you take land on rent where you are presently carrying out the broiler enterprise?

Yes () No ()

4.2.1 If yes, how much do you pay for the rental? rupees

4.3 What is the source of capital for carrying out the poultry business?

Own capital (Equity) ()

Loan from banks ()

	Previous loans	Current loans	Future loans
Year			
Amount borrowed/to be borrowed			
Interest Rate			
Repayment period			

Others () Specify please:.....

4.4 Transport facilities related to broiler production.(Please tick where appropriate)

	Own	Hired
Bicycle		
Motocycle		
Car		
Van/Lorry		
Bus		
Others		

4.5 Transport cost

Use	Transport cost
Chicks delivery	
Medication/drugs	
Litter disposal	
Purpose for feeds	
Others	

4.6 Do you have any record keeping activities for better management of your cost?

Yes ()

No ()

4.6.1 If yes, on which activities do you keep records and how?

Activities	Manual-M, Computer-C

4.6.2 If no, why?

.....

Section 5: Marketing of broilers

5.1 How do you dispose of the birds when they are ready?

Own consumption () Specify % consumed:.....%

Specify weight and age of bird: kg & days

Sell live birds to neighbour/friends/ relatives () Specify % sold:%

(If you sell the birds to neighbour/friends/relatives, please answer the following questions)

Specify weight of birds: kg

Price:Rs/lb

Is the price fixed or does it vary?

Fixed () No fixed price ()

Is the price tagged with the on-going market price or with other producers?

On-going market price () Other producers ()

No influence from external agents, fix my own price()

Others () Specify please:

Do you sell processed meat to neighbour/friends/relatives?

Yes () Specify price: Rs/lb

No ()

Sell live birds to traders () Specify % sold:%

(If you sell the birds to traders, please answer the following questions)

Specify weight of birds: kg PriceRs/lb

Who decides the price for the birds?

The trader () I, myself ()

Both of us after bargaining ()

What is the mode of payment?

Cash () Credit () Others () Please specify:

Types of traders

One-off () Specify please:

Frequent () Specify please:

Sell to retailers () Specify % sold:%

(If you sell the birds to retailers, please answer the following questions)

Specify weight of birds: kg

Types of retailers

Fast-food outlets ()

Fast-food seller ()

Meat shop ()

Others () Specify please:

How often do the retailer buy the birds?

One-off () Specify please:

Frequent () Specify please:

How do you market the birds?

Live () Specify price: Rs/lb

Slaughtered & defeathered whole carcass () Price:..... Rs/lb

Different cuts () Specify price:..... Rs/lb

Chilled carcass () Specify price: Rs/lb

Others () Specify your answer:

Sell to the market () Specify % sold:%

(If you sell the birds to market, please answer the following questions)

Specify weight of birds: kg

How do you sell the birds at market place?

Live () Specify price: Rs/lb

Slaughtered & defeathered whole carcass () Price: Rs/lb

Different cuts () Specify price: Rs/lb

Chilled carcass ()	Specify price: Rs/lb
Others ()	Specify your answer:
At what frequency you sell the birds to the market? per week	
Do you have any transport cost?	Yes () Specify:
	No ()
Sell to contract-maker ()	Specify % sold:%
Specify weight of birds: kg	
Sell directly to consumers ()	Specify % sold:%
<i>(If you sell the birds directly to consumers, please answer the following questions)</i>	
Specify weight of birds: kg	How do you market the birds?
Live ()	Price: Rs/lb
Slaughtered & defeathered whole carcass ()	Price: Rs/lb
Different cuts ()	Price: Rs/lb
Chilled carcass ()	Price: Rs/lb
Others ()	Specify your answer:
Is the price fix or it varies?	
Fix ()	No fix price ()
Is the price tagged with the on-going market price or with other fresh chicken outlets?	
On-going market price ()	Fresh chicken outlets ()
No influence from external agents, fix my own price ()	
What are the types of consumers?	
Frequent ()	One-off ()
Others ()	Specify:.....
5.2 Do you have a regular marketing channel?	
Yes ()	No ()
5.2.1 If no, then what do you do if the birds are not sold at the right time?	
Reduce the selling price of the birds ()	
Slaughter the birds and freeze the carcass ()	
Others ()	Specify please:

5.3 Do you make use of any sort of advertising to facilitate the marketing of your product?

Yes () No ()

5.3.1 If yes, can you specify which type?

On-spot advertising ()

Use of Poster ()

Mass media ()

Others () Specify:

5.4 Based on what criteria you sell your birds?

Age () Specify age:

Weight () Liveweight:

Demand ()

Others ()

5.5 Do you make use of cold storage processing?

Yes () No ()

5.5.1 If yes, please specify place of storage along with repair & maintenance cost?

.....

..... rupees

5.6 Do you make use of any type of packaging?

Newspaper ()

Plastic bags ()

Others () Specify please:

5.7 Do you have any marketing cost?

Yes () No ()

5.7.1 If yes, specify please?

Handling () rupees

Transport () rupees

Advertising () rupees

Others () Specify please:

5.8 Are you ready to add value to your meat yourself?

Yes () No ()

5.8.1 If no, then what are the problems in doing so?

.....

Section 6: External threats

Avian Flu disease

6.1 Are you aware of Avian Flu and its effects on poultry?

Yes () No ()

6.1.1 If yes, what kind of effects?

.....

6.2 Do you know the symptoms of the disease?

Yes () No ()

6.3 Are you familiar with the methods of spreading of the disease?

Yes () No ()

6.4 In case of any avian flu outbreaks, where will you seek help for preventives measures?

Do nothing ()

Veterinary services, MOA ()

Extension services, AREU ()

Others ()

Rising price of poultry feeds

6.5 Are you aware of the rising price of maize on the international market and the impact on poultry feed?

Yes () No ()

6.6 Are you satisfied with the price you are paying for poultry feed?

Yes () No ()

6.6.1 If no, state the reason behind?

.....

6.7 About how much do you spend on poultry feed per cycle of production? (See section on feed) Rs/cycle

6.8 If the price of poultry feed kept rising, will it force you to quit that business?

Yes () No ()

6.8.1 If no, then what solution will you adopt to stay in the business?

.....

Trade liberalisation

6.9 Are you familiar with the term trade liberalisation?

Yes () No ()

6.9.1 If yes, do you know the consequences on local poultry industry?

Yes () Please specify your answer

No ()

6.10 If trade is liberalized, will it be an obstacle in the continuity of your business?

Yes () No ()

6.11 How do you think the influx of cheaper frozen chicken import affect your business?

Go out of business ()

Try to compete using more efficient ways of production ()

No impact, because consumer prefer chilled chicken ()

Reduce production ()

Others () Specify please.....

6.12 What are the ways that you can reduce your cost of production?

More government subsidies of inputs ()

Production of maize locally ()

Others () Specify please:.....

6.13 Rate the threats according to degree of severity: (1 to 5, 1 being the minor and 5 the major)

Threats	Degree of severity (1,2,3,4,5)
Poultry diseases	
Feed cost	
Feed availability	
Limited space	
Neighbour	
Waste	
Others:	

Section 7: Technical aspects

Constraints faced

7.1 Have you ever got complaints?

Yes () No ()

7.1.1 If yes, from whom and why?

.....

7.1.2 Have these complaints created problems in your business?

Yes () No ()

7.1.3 How have you managed to solve the problem?

.....

7.2 Do you face problems from natural calamities such as cyclones and drought?

Yes () No ()

7.2.1 If yes, then how do you manage with the problems?

.....
7.3 What kinds of problems do you encounter concerning the following?

Feed

Water

Chicks

Vaccines

Litter

Waste disposal

Marketing of chicken

Others

Extension services and advices

7.4 Are you visited by extension offices?

Yes () No ()

7.4.1 If yes, please specify in the table below?

Extension services	Frequency of visits (Per month)
AREU	
FAIL	
Innodis	
Others:.....	

7.5 If you need any information concerning poultry production, from where do you seek help?

Ask neighbour/friends/relatives ()

AREU ()

MOA ()

Internet ()

Books ()

Others () Please specify:

Future plan

7.6 Do you have any plan to expand your business?

Yes () No ()

7.41 If yes, then what are the difficulties in doing so?

.....

7.7 Are members of the family interested in the production of broiler?

Yes ()

No ()

Appendix 11.0: Questionnaire for supermarkets/Hypermarkets

Questionnaire number:.....

Date:

Project Title: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Section 1: Profile of Supermarkets/ Hypermarkets

Name of outlet:

Location:

Post held by interviewee

Size/ Surface area (m²) :

Surface area reserved for broiler and its products (m²) :

Number of clients per day/week/month:

Section 2: Procurement and sales of broilers

6. (i) From whom do you procure your broiler chicken and its products? (Multiple answers possible)

FAIL () Innodis ()

Poulet Arc en Ciel () Small-scale Producers ()

Medium-scale () Backyard producers ()

Others:

(ii) What quantity of broiler and chicken products (kg) do you buy. Please specify from which supplier?

.....

.....

.....

(iii) What is the frequency of procurement?

Broilers

Chicken products

7. Out of total sales, what percentage is made up of the sales broiler or chicken products?

.....

8. Do you have your own branded broilers or broiler products?

Yes ()

No ()

(i) If yes, please specify the brand.....

9. (i) How often do you order your chicken or its products?

Daily ()

Weekly ()

Twice a week ()

Others:

(ii) How do you place your order?

Telephone ()

Fax ()

Email ()

Others:

(iii) What is the time delay between placing your order and delivery?

.....

(iv) Do you have a preference for the size of broilers?

.....

10. What is the shelf life of the following:

Fresh

Frozen

Chilled

11. Is the quantity of chicken bought or sold influenced by seasonality?

Yes ()

No ()

(i) If yes, by what percentage?

12. Which types of chicken cuts or products do you sell mostly? Please explain why?

.....

13. Do you have a contract with your suppliers?

Yes ()

No ()

(i) If yes, what type of contract?

Verbal ()

Written ()

Others:

(ii) Which of the following is included in your contract? (Multiple answers possible)

Desired product qualities ()	Location of delivery ()
Quantity of product to be delivered ()	Time of delivery ()
HACCP ()	Price of product ()
Temperature ()	

14. How do you pay your suppliers?

Cash () Credit () Others

(i) In case of credit, please specify duration of credit?

.....

15. Do you have any kind of agreement concerning new broiler products introduced by your suppliers?

Yes () No ()

(i) If yes, what kind of agreement?

.....

16. Do you have promotions on chicken and its products?

Yes () No ()

(i) If yes, when do you have promotions?

.....

(ii) Do your suppliers have a say concerning promotions?

.....

17. In case, the chicken products are not sold, what do you do with them?

.....

18. Which supplier or brands of chicken do you prefer? Please explain why?

.....

19. Have you changed suppliers over the past years?

Yes () No ()

(i) If yes, please explain why?

.....

Section 3: Food safety & threats

20. Do you insist that your suppliers follow certain standards to ensure food safety? (For example hygiene, environment)

Yes ()

No ()

(i) If yes, please elaborate on the standards.

.....

(ii) What happens if the suppliers fail to meet your requirements or standards?

.....

(iii) Do you conduct audits to monitor the performance of your suppliers and compliance to standards?

Yes ()

No ()

21. Do you provide assistance to your suppliers in order to help them meet your standards or requirements?

Yes ()

No ()

(i) If yes, what kind of assistance do you provide? (Financial, technology, skills)

.....

22. Which of these threats would have the most negative impact on your business?

(1=highest priority, 3=least priority)

Avian flu ()

Rising price of feed ()

Attitudes of consumers related to GMOs ()

Regional trade liberalisation ()

Cheap imports of low quality chicken products ()

23. According to you, is there any other threat, which could influence the broiler industry?

.....

Appendix 12.0 : Questionnaire for Hotels/Restaurants

Questionnaire number:

Date:

Project Title: Mapping the supply chain of broiler chicken in Mauritius to assess the impact of external threats.

Section 1: Profile of Hotels

Name of outlet:

Location:

Size:

Number of clients per day/week/month:

Post held by interviewee

Section 2: Procurement and sales of broiler chicken

24. From whom to you procure your broiler chicken?

FAIL ()

Innodis ()

Poulet Arc en Ciel ()

Small Producers ()

Others:

(i) Which types of chicken do you mostly buy?

Fresh ()

Chilled ()

Frozen ()

25. How often do you purchase/order your chicken?

Daily ()

Twice a week ()

Weekly ()

Others:

26. What quantity of chicken (kg) do you buy?

27. Which types of chicken cuts do you buy mostly? Please explain why?

.....

.....

28. Is the quantity of chicken bought influenced by seasonality?

Yes ()

No ()

(i) If yes, by what percentage?

29. Do you have a contract with your supplier?

Yes ()

No ()

(i) If yes, what type of contract?

Verbal ()

Written ()

Others:

(iii) Which of the following is included in your contract? (Multiple answers possible)

Desired product qualities () Location of delivery ()

Quantity of product to be delivered () Time of delivery ()

Safety standards () Price of product ()

30. Do you have any special agreement with any of your suppliers?

Yes ()

No ()

(i) If yes, what kind of agreement?

.....

31. How do you pay your suppliers?

Cash ()

Credit ()

Others

32. Which supplier or brands of chicken do you prefer? Please explain why?

.....

Section 3: Food safety & threats

33. Do you insist that your suppliers follow certain standards to ensure food safety? (For example hygiene, environment, HACCP, ISO standards)

Yes ()

No ()

(i) If yes, please elaborate on these standards.

(ii) Do you conduct audits to monitor the performance of your suppliers and compliance to standards?

Yes ()

No ()

(iii) Do you provide assistance to your suppliers in order to help them you're your standards and requirements?

Yes ()

No ()

If yes, what kind of assistance do you provide? (Financial, technology, skills)

.....

34. What happens if the suppliers fail your meet your requirements?

35. Which of these threats would have the most negative impact on your business?

(1=highest priority, 3=least priority)

Avian flu ()

Rising price of feed ()

Consumer concerns related to GMOs ()

Please explain how these factors would affect your business?