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Participatory risk assessment for harvesting of impala (*Aepyceros melampus*) and the distribution of by-products

by

Dr. Shashikala Ramrajh

Submitted in partial fulfillment of the requirements for the degree Master of Veterinary Medicine (Hyg) in the Faculty of Veterinary Science, University of Pretoria.

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DEDICATION

To my late Dad, **Mr. Ramrajh Jugroop**, who has always been a source of inspiration to me. Also to my children, **Nishanth, Sarina** and **Jaishal** for their constant support, unconditional love and understanding during the most challenging time of this research study. **I love you always.**

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DECLARATION

I, **Dr. Shashikala Ramrajh,** hereby declare that the dissertation submitted for the degree M.Med.Vet.(Hyg.),to the University of Pretoria, is my own original work and has not previously been submitted to any other institution of higher education. I further declare that all sources cited or quoted are indicated and acknowledged by means of a comprehensive list of references.

SIGNED

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DR.SHASHIKALA RAMRAJH DATE

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ABBREVIATIONS

CAC	Codex Alimentarius Commission
CCP	Critical Control Point
EU	European Union
DoA	Department of Agriculture
DoH	Department of Health
FAO	Food and Agriculture Organization
HACCP	Hazard Analysis Critical Points
HAS	Hygiene Assessment System
HIV	Human Immunodeficiency Virus
HMS	Hygiene Management Systems
ICOPAH	International Conference on Pathogens at the Animal – Human Interface
ILRI	International Livestock Research Institute
KZN	Kwazulu Natal
NAMC	National Agricultural Marketing Council
OIE	*Office International des Epizooties*
PDGC	Partially Dressed Game Carcasses
PRA	Participatory Risk Analysis
UKDM	Umkhanyakude District Municipality
USA	United States of America
SFFF	"Safe Food, Fair Food"
VPN	Veterinary Procedural Notices

SUMMARY

Participatory risk assessment for harvesting of impala (Aepyceros melampus) and the distribution of by-products

by

Shashikala Ramrajh

Promoter: Professor C.M.E. McCrindle
Department: Paraclinical Sciences
Degree: M Med Vet (Hyg)

The demand for the control of safe food, from consumers the world over, has revolutionized the manner in which wild game meat harvesting occurs. In developed countries, food quality, food and human safety with quality controlling systems embracing environmental carbon footprint issues are constantly improving, for international harmonization at each level of production “from stable to table”, “farm to fork”, “field to yield” as well as from “cradle to grave”.

Food industries globally have adopted the in Hazard Analysis Critical control Point (HACCP) system. This is a risk assessment process using Hygiene Assessment Systems (HAS) as a mitigating strategy for risk communication through training. It is also a holistic system that is compatible with international trends designed not only for food safety and quality, but it also embraces other aspects of farming such as animal welfare, environmental management and Occupational Safety and Health.

Global marketing for international trade demands quality assurance from trading partners thereby promoting economic growth for developing countries. The watch dog bodies such as the World Trade Organisation (WTO) prohibit trading for non-compliance, therefore trade barriers are in place for uncertified food of animal origin, EU regulations are stringent requirements that need compliance and so too the OIE regulations for disease control, while the *Codex Alimentarius Commission* maintains trade harmonization.

In South Africa Hygiene Assessment Systems (HAS) is a National Hygiene management strategy implemented at abattoirs, that promotes and facilitates quality and hygiene and is reflective of South African quality abroad. It is prescribed under the section, "Essential National Standards" in the Meat Safety Act, 2000, (Act 40 of 2000). This Act covers red meat and includes both domestic animals and game. The Veterinary Procedural Notices (VPN's) are used for export of game and give far more detailed guidelines than the legislation for game meat sold and consumed locally in South Africa.

The objective of the Hygiene Assessment System (HAS) is to create a national awareness of quality to better improve the quality of life of all South Africans, whilst at the same time it is used as an auditing tool for Veterinary Public Health to effectively compare essential standards within the nine provinces. Currently this programme is referred to as the National Abattoir Rating Scheme (NARS), which is only applicable to the high and low throughput Red Meat and Poultry abattoirs in South Africa and not to the Game or Rural abattoirs, thereby further compounding the duality of food standards with food safety being compromised.

This study has been undertaken because there are inadequate risk control measures such as introduction of Hazard Analysis Critical Control Point (HACCP) guidelines on primary and secondary meat inspection, specifically on game for local consumption, not only within South Africa, but in the international arena as well. A revision of the HAS document and audit will also be needed to meet with the local (not just export) criteria for wild game harvesting, to enable food safety, thus enabling food security in the remote non - agricultural areas in KwaZulu -Natal.

Venison is the meat of today because of health priorities that have arisen over the last ten years. It is low in trans - fatty acids and is regarded internationally as a healthy product produced organically in a free range situation. South Africa has a large potential export market for venison to the European Union because the demand, for venison, exceeds supply in Europe. However, the European Union's "*safe food regulation*" that was introduced between 2005 and 2007 with an implementation date of 2008 (Regulation1021/2008) has made it imperative that the HACCP principle is applied to any food or food product of animal origin imported into the European Union or its member states. Also, HACCP specifies that a multidisciplinary team of experts is selected. This then lends itself to a participatory approach to risk assessment as wide consultation is required.

This participatory approach was used, including expert opinion surveys and focus group discussions with stakeholders and role-players in the game industry such as commercial hunters, state veterinary services and game ranch owners. Such participants may have better insight into existing conditions than external experts with recognised educational qualifications, usually used in the HACCP team. From this and the relevant Veterinary Procedural Notices for game harvesting, a HACCP process flow and critical control points were derived for the primary phase of meat inspection, including slaughter, primary meat inspection and loading for transport to the abattoir. This was modified during a phase or trial harvesting and then implemented during the harvest of 1758 impala carcasses which were subsequently exported. In addition, environmental risks were considered and a risk mitigation strategy designed, to reduce any possible environmental impacts.

In northern Kwazulu Natal, game ranches and conservation areas are in close proximity to the rural poor where food is scarce and comes at a premium price.

These game farms harvest seasonally for either the local or export market, hence there is abundance of game offal and by-products available, yet it is at present left in the field or taken to the vulture restaurants (in line with the VPN). Participatory risk analysis was thus also used to investigate the feasibility of using edible offal from impala (*Aepyceros melampus*) as a source of renewable protein, to address food security issues in impoverished communities in the study area, the districts of uPongola and Jozini, in northern KwaZulu Natal. Structured interviews on the cultural acceptability of impala offal were held with 162 randomly sampled adult respondents in veterinary districts associated with dip tanks. A two stage cluster design was used where the state veterinary areas were stage one and the dip tanks (with proportional random sampling of community members) were the second stage. Offal is a popular food in South Africa in different cultures, called “ithumbu” in IsiZulu, “ boti” by the Indian group, “afval” in Afrikaans and “tripe” in English. Generally demand outstrips supply of offal at red meat abattoirs in South Africa. It was found that there was no significant difference between those who would eat impala offal and those who would eat the offal of sheep.

It was concluded that it is feasible to use inspected game offal from impala as a protein source in much the same way as red meat offal is used and that the current practice of leaving the offal for predators was likely, if it continues, to cause imbalances in the predator/ prey ratio on game farms.

It is recommended that the VPN for game be amended to encompass inspected offal being allowed into the formal food chain, in line with the standard operating procedure developed during this study. Also that current fragmentation of legislation and the implementation thereof is revisited for effective control for harmonisation of food safety standards for game meat within South Africa**.**

CHAPTER 1
INTRODUCTION

1.1 Introduction

Wild game meat is the meat of today because of health priorities that have arisen over the last decade. It is low on trans-fatty acids and is regarded internationally as a healthy product, produced organically in a free range situation. South Africa has a large potential export market for wild game meat to the European Union because the demand for wild game meat exceeds supply in Europe. However, the European Union's "safe food regulation" that was introduced between 2005 and 2007 with an implementation date of 2008 (Regulation 1021/2008) has made it imperative that the Hazard Analysis Critical Control Point (HACCP) principle is applied to any food or food product of animal origin imported into the European Union or its member states. HACCP guidelines further specify that a multi-disciplinary team is selected. This then lends itself to a participatory approach to risk assessment as wide consultation is required.

Harvesting of game therefore, provides possibilities for poverty alleviation in the area, not only due to the knock-on effects of export opportunities but also job creation, and the possibility of informal marketing of low-cost by-products. These by products could provide food security, improved health, for both, those children afflicted by Kwashiorkor, and immuno- compromised individuals, job creation, as well as poverty alleviation.

Similarly, the holistic approach of wild game harvesting from "cradle to grave" or harvest to disposal of condemned products into vulture restaurants adds to the food chain for predators and scavengers including jackals, hyena, wild dogs and vultures.

This study has been undertaken because there are inadequate risk control measures such as introduction of HACCP guidelines for primary and secondary meat inspection for game, not only within South Africa, but in the international arena as well. This research is aimed at developing innovative participatory HACCP strategies to be adopted in the food value chain as commitment to the food industry, both locally and internationally. The HACCP strategy has, of recent, been implemented in the food industry and is being adopted in most other food environments as a benchmark of quality. This radical innovative HACCP strategy for game will bring about a whole new concept for change into the game industry that would be a catalyst for international trade and economic development for adoption by the European Union in compliance with global trade in game. The principles of HACCP to be applied will be specific, measurable, attainable, realistic and time related for “Safe Food, Fair Food” (Grace et al, 2008).

The South African antelope known as “Impala” *(Aepyceros melampus)*, currently the most sought after game species, has been chosen as a model for the development and recording of standard operating procedures and critical control points. Participatory risk assessment, as part of HACCP, will be done to estimate the risk of hazards likely to decrease the quality and safety of wild game meat derived from culling and /or harvesting of Impala (Plate 1.1).

Plate 1.1 Herd of wild Impala does

Therefore, this study aims at conducting risk analysis using a combination of traditional and participatory methods, which can contribute towards improved standards for export products as well as poverty alleviation in the communities proximal to game production areas.

1.2 Justification

Mervyn Cowie (1961), who is an East African stated:

"When the Africans realise that some land is more valuable for producing wild animal products than for ranching useless scrub cattle, or trying to grow very scanty crops, they will appreciate that our endowment of wild life is an asset of great value".

Carruthers (2008) mentions that this sentiment was shared by Darling (1960), another internationally renowned British scientist with similar ideas, and his work contained a warning about future shortages of protein for a growing world population, a shortfall that could be remedied through game ranching, a very old practice. Onyango *et al.* (1998) maintains such meats play an important role as a substitute for beef in many regions. Child (1991) says that wildlife is generally regarded as a renewable resource. The topography of the land and environment to economically support higher numbers of cattle is reduced. In adopting game farming in these areas makes it a viable and lucrative enterprise.

During the past 30 years, the South African wildlife industry has transformed into a multimillion dollar industry (Sims- Castley et *al.*, 2005; Van Der Waal & Dekker, 1998). Today South Africa is one of the worlds' leading game meat exporters (Field, 2004). In 2008, the abattoir at Mosstrich estimated that the largest quantity of wild game harvested in South Africa originated from the uPongola area, in Kwazulu-Natal, South Africa (personal communication, DeVilliers, Mosstrich export abattoir, Mossel Bay, 2009)

Very little scientific research, has so far, been dedicated to the domestic marketing chains of South African game meat products. Few studies dedicated to the application of HACCP-principles in the production and processing of game meat have been conducted. The lack of previously generated scientific information concerning the focus of research has been one of the greatest challenges to writing a review of past literature for the present study.

The quality and safety of meat remains a challenge to both developed and emerging countries for international trade. It has become essential to adhere to international food safety management systems like HACCP and guidelines in the form of Veterinary Procedural Notices (VPN's) have been written by the National Department of Agriculture, to address this deficiency in South Africa (Table 1.1).

The HACCP approach for wild game meat extends from the "bush to the table", rather than "stable to table". These VPN's provide the response to a rationale for primary game meat inspection to reduce the likelihood of introducing a hazard which may adversely affect the safety of food or its suitability for consumption at later stages of the food chain.

Table 1.1: Veterinary Procedural Notices for Game [1]

VPN number	VPN name
VPN / 05 / 2010-11	Standard for the registration or re-registration of game farms as a source of game for export of game
VPN / 08 / 2010-11	Standard for the registration of hunters for harvesting wild game intended for export of game meat
VPN / 09 / 2010-11	Standard for the ante and post-mortem meat inspection and hygiene control at point of harvest
VPN / 10 / 2010-11	Standard for post-mortem meat inspection and hygiene control at game meat establishments
VPN / 15 / 2010-11	Standard for the microbiological monitoring of meat

The Impala is one of the most common and predominant sources of wild game meat in KwaZulu-Natal and probably in South Africa, thus was selected as the

[1] http://www.nda.agric.za/vetweb/VPN%20&%20SOP/VPN_SOPs.htm

experimental animal for this research study. It is proposed that this study in culled impala will include logistics and measures to avoid the use of areas where the environment poses a threat to the safety of food, controlling contaminants, pests and diseases in such a way as not to pose a threat to food safety, whilst adopting practices and measures to ensure food is produced under appropriately hygienic conditions.

The muscles of game animals, and especially Impala, contain only very little sub-cutaneous and intramuscular fat when compared to domestic species. For this reason, amongst other, game meat has the potential to be sold as a health product (Hoffman, 2000; Hoffman *et al*., 2005). Thus, it was decided to develop a HACCP system for wild game (represented by Impala) harvested in KwaZulu-Natal to comply with the European Union regulation described above. HACCP specifies that a multidisciplinary team is selected. This lends itself to a participatory approach to risk assessment, as wide consultation is required. Usually these are experts, however, the participatory approach allows for inclusion of stakeholders, role players and end users in the “team”. Such people may have better insight into existing conditions than external experts with recognised educational qualifications.

In addition to export of the wild game meat, there is a market for the offal and secondary cuts resulting from the primary cuts. These by-products could be used to promote food security in low income communities on a regular seasonal basis, which coincides with the winter months, a time of year when crops are scarce, due to low rainfall in the study area: a summer rainfall zone.

The game industry should operate within the legal parameters that are already in place to monitor the quality and safety of meat and meat products in South Africa. These requirements are listed and described in the Meat Safety Act,(Act 40, of 2000) (DoA, 2000).

Currently the legislation with regard to harvesting of game has been promulgated but has not yet been finalized; therefore the compliance with international regulations is done on an "*ad hoc*" basis. The final draft was sent through for public comment only in October, 2012. The VPN's (See Table 1) are used as guidelines for harmonization within the nine provinces, in compliance with the National Department of Agriculture.(DoA 2000) There is no standard operating procedure for disposal of by-products or the handling of waste generated from harvesting game. This has potential consequences for environmental protection.
In effect, game harvesting is still in an "informal" marketing phase although it is commercially viable. It could potentially contribute greatly to job creation and poverty alleviation, in the study area, where it has been observed by the researcher, that living standards of the rural population are low and there is a high level of unemployment and HIV/AIDS positive community members.

Food of animal origin is high in protein and thus a valuable source for the under-nourished and immuno-compromised sectors of society. Therefore affordable and accessible protein is crucial to meet these needs. It is suggested that by-products from the wild game industry, such as offal, shanks and heads, which are currently discarded, could be an affordable source of human food.

Participatory risk analysis (Grace et al, 2008) could be used in such communities to draw a flow chart for impala meat and offal and evaluate potential food safety risks of using these products in informal markets. This innovative strategy could ultimately not only fulfill the socio – economic and nutritional needs of the people in the study area, but it would also develop international standards of HACCP for meat of wild game from other species, thus significantly boosting the economic growth and development of the area thereby sustaining South Africa as a global economic trading partner.

1.3 Hypothesis

That it will be possible to describe the value chains for game meat (impala) and formulate HACCP strategies to comply with international standards of food safety while opening a market for safe, affordable and accessible protein in low income communities, using participatory risk analysis.

1.4 Benefits

The benefits of this research will be:-

- A flow diagram, in line with Hazard Analysis Critical Control Points (HACCP) legislation for red meat and poultry (Meat Safety Act 40, of 2000), for game slaughter, likened to a "field to fork" model for export quality venison.
- A Hygiene Assessment System (HAS) and pre-requisites for (Hazard Analysis Critical Control HACCP, during slaughter and primary meat inspection of game, with impala as the study model.
- An auditing framework for slaughter and primary meat inspection during harvesting linked to control points that promote food safety, meat hygiene and animal welfare of impala.
- Improved food security through distribution of inspected, low cost by-products (offal) as an affordable source of protein for vulnerable local communities.

1.5 Aim

This research aims at developing participatory risk analysis to facilitate HACCP in the game food value chain, as a commitment for safe food to the food industry, both locally and internationally. The scientific and technological advantages and spin offs will not only be of benefit to the wellbeing of humans in all strata of life, but will also protect the environment. The HACCP strategy has only recently been implemented in the food industry and is not yet in place for game meat, although it is being adopted in most other food environments as a standard measure of quality. (Achterbosch & Van Tongeren, 2002).

Both formal and informal marketing chains for game meat will be investigated and recorded. This study will identify the critical control points during the harvesting process, simultaneously; mitigating measures will be put into place to reduce risks. Suggestions shall be made for improving methods for poverty alleviation, significantly improving the dietary requirements of the immuno-compromised, enhancing animal welfare concerns, and environmentally friendly strategies for the disposal of waste products generated from the game harvesting. Ultimately, the aim of this study is to provide evidence that Impala offal is consumed in the rural communities surrounding the wild game areas of this study in KwaZulu-Natal, South Africa.

1.6 Objectives

1. To obtain updated data on the export of game, including impala in South Africa.
2. To develop a practical value chain from field to fork for impala harvesting in northern KZN, using the VPN's as a guideline, in consultation with stakeholders.
3. To use participatory methods including focus groups and expert interviews, with stakeholders in game harvesting to identify CP's and CCP's along the value chain.
4. To facilitate a sustainable approach to supplying safe, affordable animal protein from inspected game by-products to vulnerable local communities.
5. To investigate whether cooked impala offal would be acceptable as food to the community in northern KZN, in particular school feeding schemes.

CHAPTER 2
LITERATURE REVIEW

2.1 Northern KwaZulu-Natal

The Pongola or “uPhongolo” and “Umkhanyakude” local municipalities are located near to Swaziland in the north of the Zululand District Municipality. This portion of Northen KwaZulu Natal (KZN) is under private ownership used for commercial agriculture game farming and nature conservation. A map of this area is shown below in Fig 2.1.

Fig 2.1 Map of Northern Kwazulu Natal (Source: UKDM, 2012)

In this part of KZN income levels are generally low and most formal employment opportunities are provided by the public sector, while the informal sector is consistently growing. However people are also employed in agriculture, which includes game ranching and conservation. There are private game farms and Nature Conservation Parks in this area as well as 12 registered game abattoirs (Adato et al 2004; UKDM, 2012).

The Provincial Department of Agriculture employs veterinarians, meat inspectors and animal health technicians and these offer a service both to the community and commercial farming, including game farmers. They are also actively involved with animal health, import and export certification, veterinary public health and meat safety, in line with the provisions of the Meat Safety Act (DoA, 2000) and the Animal Diseases Act (DoA, 1984). Part of their duties involves the registration of game farms where game animals, including impala, are culled for export. The export abattoir involved in this activity is Mosstrich (GAME SA, 2012).

2.2 South African wild game

In general the main type of game meat exported comes from wild antelope. Springbok are the major source of game meat exported, but over the study period, 3000 impala were culled for export in northern KZN (GAME SA, 2012).

2.2.1 General overview

South African game meat production is predominantly based on wild, free-running animals (Hoffman & Wiklund, 2006). It is largely free of human intervention as well as independent from the use of steroids, pesticides and hormones (Radder & Le Roux, 2005).

According to the National Agricultural Marketing Council (NAMC), privately owned South African game ranches covered an area of approximately 20.5 million hectares in 2006. This is equal to approximately 16.8% of the country's total land area. Different reasons such as declining profitability of livestock farming ,contributes to an increase in stock theft, and the re-emergence of South Africa into the world community, have led to a growing attractiveness of wildlife ranching (Cousins *et al.*, 2008). During the past 30 years, the South African wildlife industry has been transformed into a multi - million dollar industry (Sims-Castley *et al.*, 2005) and today South Africa is one of the world's leading game meat exporters (FAOSTAT, 2012; Field, 2004, van Zyl & Ferreira, 2004).

2.2.2 Impala (*Aepyceros Melampus*)

The impala, *Aepyceros Melampus,* is a common indigenous wild antelope free-ranging in the African savannas. It is currently classified as the only species in the subfamily *Aepycerotinae.* Impala have wide distribution in Southern Africa and their relative abundance make them well suited to continuous cropping for game meat production (Feron *et al.*, 1998; Hoffman, 2000; Kritzinger *et al.*, 2003; Kohn *et al*, 2005; van Zyl & Ferreira, 2004).

In South Africa, the name “Impala” is derived from its traditional Zulu name *iMpala,* whilst the Tswana people of the Limpopo province, refer to it as *phala.* The distribution of the naturally occurring impala, within South Africa, extends from Kuruman in the west, towards the Drakensberg escarpment in the east and the northern low-veld areas of KwaZulu-Natal, Swaziland, Mpumalanga and Limpopo. Impala, have recently been successfully introduced into the Eastern Cape region, the Free State and the Eastern Karoo (Hoffman, 2000)

Game animals can be utilized consumptively or non-consumptively, whereby non-consumptive utilization is the provision of services to tourists, for example activities such as game viewing, bird watching and wildlife photography. The consumptive utilization, on the other hand, comprises game meat production, trophy hunting, recreational hunting as well as live capture and sales (Mostert & Hoffman, 2007). The combination of the above processes is regarded as an appropriate way to sustainably utilize wildlife by different conservationists. Additionally, both may create incentives for community conservation (Ashley & Jones, 2001).

This study will exclusively focus on the consumptive utilization of game animals. When looking at the major ways to consumptively utilize game animals, trophy hunting reportedly brings along the highest net return on capital, followed by biltong, recreational hunting and live sales. In this context, game meat production is associated with the lowest returns on capital. Nevertheless, when considering the small number of trophy animals per particular game ranch, it becomes clear that, per unit area, trophy hunting in fact results in the lowest return (Mostert & Hoffman, 2007).

2.3 Definitions

According to Carruthers (2008) the term "game" in some cases appears to be reserved for animals that are hunted for amusement, while the term "wildlife" comprises all indigenous animals of a region. However, problems arise when trying to distinguish between "game" and "wildlife" in the South African context as there is no such distinction made in either, the English or the Afrikaans language. In these languages the terms "wild", which is pronounced "***vilt***" in Afrikaans, refers to both game animals and other wild animals to the same extent.

Game ranching has been defined as "*the scientific management of certain species of wild animals in their natural habitat without an effort to domesticate them".* Wildlife management is defined, in contrast, as "*the discipline of keeping game at desirable levels or the art of making land produce sustained annual crops of wildlife for recreational use*". "Game farming" is carried out on comparatively small, restricted, fenced areas within which game animals are intensively managed, or domesticated, in order to produce and harvest marketable products (Carruthers, 2008; Pollock, 1969). In the case of "game ranching", wildlife products, predominantly of ungulate species, are utilized through hunting, sales, tourism and other forms of indirect use (Carruthers, 2008).

2.4 Consumptive game utilization in South Africa

In South Africa, the commercial utilization of game animals has shown tremendous growth during the past 20 to 25 years. The demand for venison in European countries fuels the export of game meat products (Mostert & Hoffman, 2007).

2.4.1 Current status

In Africa in general, the informal game meat sector is expected to grow at a considerable rate as there is an increasing demand as a result of the strong growth in human population. The commercial utilization of game meat has potential for increasing food security locally as well as for increasing export revenue.

In South Africa there are substantial wildlife resources outside protected areas, due to the dominance of privately owned farms and ranches as many of the protected areas were established in the early 1900's (Bigalke, 2000). In contrast to Australia, New Zealand, the European Union (EU) and the United States of America (USA), where venison is chiefly harvested from farmed game, the South African game meat production is predominantly based on wild, free-roaming antelope (Hoffman & Wiklund, 2006). The meat is thus regarded as suitable for health conscious consumers, as it is free of steroids, pesticides, antimicrobial drugs and hormones (Radder & Le Roux, 2005).

Venison is a relatively inexpensive form of animal protein in South Africa and is not exclusively a luxury item, as it is in many other parts of the world (Hoffman *et al*., 2005; Hoffman et *al*., 2007b) Game meat is a relatively popular component of human nutrition and is consumed widely by different demographic groups of the population (Hoffman & Wiklund, 2006). Kohn *et al*., (2005) have suggested that there is an obvious movement away from conventional livestock production towards game production. Traditionally, many South Africans consumed game meat as a dried, salted product known as "Biltong", however, consumption of game meat within the South African hotel and restaurant sector is increasing (Mostert & Hoffman, 2007).

If game meat products are to compete with other meat products, the necessity of scientifically based information on its quality cannot be denied (Mostert & Hoffman, 2007). Animal health, trans boundary diseases and food associated diseases such trichinosis, must also be considered (Field, 2004, OIE, 2012).

2.4.2 Export of game meat

The main market for exported game meat is the EU (Bekker *et al.,* 2011; van der Merwe *et al*., 2011). It was estimated that, in 2005, South Africa exported the deboned meat of 160,000 game animal carcasses and springbok accounted for more than 80% of this amount. Blesbok and kudu also contributed significantly to the exports while the meat of other species such as zebra, impala and gemsbok were exported in smaller numbers. Most of the South African game meat produced for export is entering the EU (Hoffman & Wiklund, 2006). According to FAOSTAT (2012) South Africa produced 18,000 tonnes of game meat in 2007. However, this equals only 2.2% of the total quantity of beef produced in the same year. When looking at different annual statistics provided by the rapid increase of the country's game meat production is becoming apparent. In 1969, 500 tons of game meat was produced in South Africa, this number increased tenfold by 1977. By 1987, it had doubled again to 10,000 tons. In 1997, 13,000 tons of game meat was produced. Therefore, between 1997 and 2007, the production of South African game meat has increased by more than 38%. An upward trend has continued as shown in the graph of game meat exported from South Africa between 2000 and 2010, below (Fig 2.2). Although the marketing of game meat is growing at local and international level, a great potential for the expansion of target markets for game meat products remains (Féron *et al*., 1998; Mostert & Hoffman, 2007).

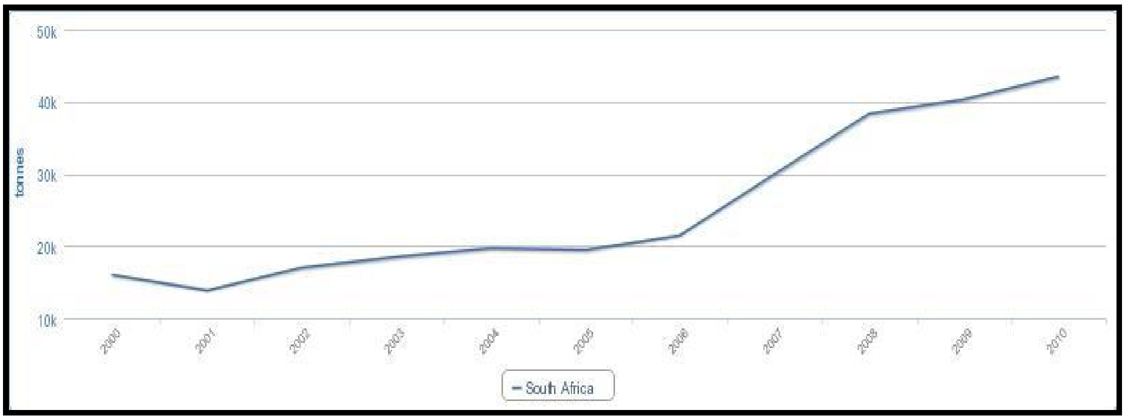

Fig 2.2 Tonnes of game meat exported from South Africa 2000-2010 (Source: FAOSTAT, 2012)

It is seen as imperative that the meat safety and quality of game meat must be in line with international standards if export levels are to keep increasing. These standards are published in *Codex Alimentarius* Commission (CAC, 2005) and the FAO (FAO, 2004) manuals.

2.4.3 Harvesting of game for export

Due to the variation of the farming terrain in terms of size and area, in South Africa, there are different methods of game harvesting applied compared to the game meat producing countries in other parts of the world such as European countries and New Zealand. Another reason is long distances between production centers and markets (Kritzinger *et al.*, 2003). For export purposes, a game farm has to be registered by a state veterinarian as a source of game. This farm is then captured and maintained on a database by the National Department of Agriculture and the farm is assigned a specific ZA number. It must be inspected annually by the Animal Health Technician reporting to the local state veterinarian who registered the farm, to maintain registration. All game hunters and harvesters must also be registered (DoA, 2003-2005; GAMESA, 2012). Owners must also supply a stock report and a report on any stock remedies or veterinary medicines used, for all game on the farm, annually (DoA, 2003-2005).

The majority of game animals used for meat are slaughtered in the field (Gill, 2007). According to (Hoffman *et al.* 2004) game meat is traditionally obtained during the winter, due to low ambient temperatures that prevent rapid spoilage of carcasses prior to dressing and cooling. However, “game harvesting” or “game cropping” can also be conducted during hotter times of the year if cooling facilities are available and the dressing of carcasses is carried out immediately (Hoffman *et al.*, 2004).

Currently, game animals that are harvested for export come from large privately owned game ranches. When game animals are harvested, this is usually carried out by well-trained marksmen using a spotlight after dark to blind the game animal. Head shots are usual (Hoffman & Wiklund, 2006). Kritzinger *et al*. (2003) suggest that night hunting reduces stress in the animals. When compared to hunting during the day these authors indicated that meat from impala shot at night had better initial pH, slower pH decline, and drip loss. However cold shortening may be more likely to occur during night cropping, especially if temperatures are very low.

After an animal has been killed in the field the carcass is generally eviscerated at or very close to the spot. Also, in the course of the evisceration, damaged as well as visibly contaminated tissue is removed. Prior to any further dressing, the carcasses which have been eviscerated in the field are most commonly hung by the hind legs and the body cavity can be propped open to enhance the drying of the internal surfaces which have been exposed in the course of evisceration (GAMESA, 2012; Gill, 2007). Over many years where springbok were harvested in the Karoo and still today, wild antelope have been not skinned until they reach the abattoir for dressing. Only the heads and feet are removed and the carcass is eviscerated. These carcasses are known as partially dressed game carcasses (PDGC) in terms of the Veterinary Procedural Notices (VPN's) of the National Directorate of Animal Health (DoA, 2003-2005).

The harvester needs to ensure that game animals are culled according to animal welfare requirements that result in the immediate death of the animal and prevention of contamination. Harvesting of clinically sick animals is not allowed and any animal that does not pass the primary inspection by a game meat inspector, because it is diseased or inadequately shot, may not enter the cooler truck. Every collecting vehicle with a harvesting team needs to be accompanied by a game meat inspector. Both the collecting vehicle and the cooler truck must meet with prescribed standards for export. Game depots are constructed for the holding of game animal carcasses only. In most cases, such facilities are cooler trucks that are used for the transport of game animal carcasses within South Africa (Hoffman & Wiklund, 2006; GAME SA, 2012).

Furthermore, a strict dress code needs to be followed by all workers, whereby the colour of the protective clothing used needs to be suitable for the specific function of each worker. Brown overalls are worn by those assistants working with the loading and offloading of harvested impala, whilst white PPE's is worn by those working in the clean area doing the evisceration of impala carcasses. Staff, loading these carcasses, into the chiller truck wears hooded capes, in addition to white PPE's in compliance with best practices. The cooler trucks transporting inspected carcasses are sealed with a departmental seal that has a unique number. These carcasses are then transported to processing facilities. Before the carcasses can be offloaded from the truck for further processing in these processing facilities, the controlling authority, State Veterinarian, at the export abattoir, checks the integrity of these seals. Within the processing facilities, at registered export game abattoirs stringent regulations for the export of South African game meat need to be complied with (GAMESA, 2012)

2.5 Food Safety criteria for game meat

In 1997, it was reported that food safety rules or standards were virtually or completely non-existent in the processing and marketing of game meat products in Africa and the quality of products traded on the markets varied widely (Ntiamoa-Baidu, 1997). South Africa had been exporting springbok for many years prior to this and there were already food safety criteria in place (Personal communication, Prof C M Veary). As mentioned above, the CAC and FAO have excellent guidelines available internationally for game meat safety (CAC, 2005, FAO, 2004). In South Africa a Meat Inspectors Manual for game has been published by the Directorate of Veterinary Services (Bergh, 2007). The Meat Safety Act, 40 of 2000 (DoA, 2000) also applies to game meat, but most provisions of this Act, are not enforced if game is shot for own consumption. In addition, there are VPN's formulated for game meat intended for export (DoA, 2003-2005). In South Africa, meat inspectors fall under the Department of Health.

In 2011, the South African Parliament heard from the Red Meat Forum that there was little cooperation with the Department of Agriculture with regard to meat inspection services[1]. This was as a result of fragmentation of meat inspection, which lies both with the Department of Health and the Department of Agriculture. The training and duties of meat inspectors falls under the Department of Health and is governed by the Health Act , 63 of 1977 and the Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972 and the Occupational Health and Safety Act 85, of 1993 (DoH, 1972; DoH, 1977, DoH, 1993).

There is also some confusion about the name of the qualification of meat inspectors as they are called "Environmental Health Practitioners", as well as "Occupational Health and Safety Officers" or "Veterinary Public Health Practitioners". In terms of the Meat Safety act, a designated person may perform the duties of a meat inspector (DoA, 2000). Such a "designated person" may also have other qualifications such as Animal Health Technician or even Veterinary Science. The list of pertinent legislations is included in Addendum 1.

2.5.1 Ante-mortem inspection and slaughter

Although Codex, OIE and FAO mention ante-mortem inspection of animals for slaughter as well as slaughter methods, these are covered very superficially for game (CAC, 2005; FAO, 2004; OIE, 2012). In South Africa, the same situation exists, the red meat legislation and VPN's, even those for game, give few details on hygienic standards and animal welfare prior to slaughter of game, although these are more effectively specified for domestic animals (DoA, 2000, DoA 2003-2005).

Of necessity, wild animals are shot and the exsanguination and evisceration takes place under field conditions, not in an abattoir. In fact, it is deemed acceptable that bleeding out can take place as long as 10 minutes after shooting (Bergh, 2007). It is noted that head shots are preferred (DoA, 2003-2005), but in

[1] " Meat Inspection Services a Must", Http://www.parliament.gov.za/live/content.php?_ID=1672

this case the animal dies rapidly and it is unlikely that much blood would come out if the throat was cut 10 minutes later.

2.5.2 Risk Assessment in meat safety

Risk based evaluation for meat is based initially on organoleptic post mortem inspection procedures, which includes primary meat inspection by a meat examiner and secondary meat inspection by a designated veterinarian. This applies to both red meat and game (CAC, 2005).

The verification of process control of meat hygiene is by microbiological testing. In South Africa, such testing of game meat is performed on a routine basis in export abattoirs and is legislated by the Meat Safety Act 40,of 2000 (Bekker *et al*., 2011, CAC, 2005:DoA, 2000, DoA 2003-2005). The hygienic quality of the meat of game animals are pre-determined by the types of microorganisms that each species carryies on its hide, in the gastro-intestinal tract, or in the muscle tissue itself. Other factors influencing the hygienic quality are the way the animal is killed and the subsequent dressing, butchering and storage conditions.

The extent to which the presence of food borne pathogenic bacteria is associated with game meat is unclear. It has also been assumed that, if *Salmonella spp.* has been detected in game meat, that the environment of these animals has been heavily contaminated by other animals. Hence more likely in the case of intensively raised and farmed game than for wild game (Gill, 2007; van der Merwe *et al*., 2011). Game meat hygiene, according to Paulsen, et al. (2011) in addition to the microbiology, also includes epidemiology, risk analysis and quality assurance.

2.5.3 Auditing and managing meat safety

Monitoring hygiene at abattoirs was the first step in managing and auditing meat quality at abattoirs. These were called Hygiene Management Systems (HMS)[2]

[2] IMQAS website Http://www.imqas.co.za

and were followed, in the United Kingdom, by Hygiene Assessment Systems (HAS)[2], which introduced auditing, so that the level of compliance could be measured. Following the British system HAS audits have been instituted in most South African abattoirs.

In HAS, auditing the Critical Control Points (CCP's) can be identified for remediation and this has been prescribed for game culling audits (DoA, 2003-2005). Both of which are now applied as prerequisites for the Hazard Analysis Critical Control Point process, which is legislated in the Meat Safety Act, 2000 (DoA, 2000). The steps are shown in Fig 2.3 below. Before HACCP can be applied, all prerequisites should be in place. These are usually aligned to HAS audits and these can often be used more easily in informal systems on farm to make sure that hygiene, animal health and animal welfare are in place before an animal is slaughtered.

According to the Codex Manual on Hygienic Practices for Meat, (CAC, 2005), HACCP is part of a risk based approach, as quoted below:

"A contemporary risk-based approach to meat hygiene requires that hygiene measures should be applied at those points in the food chain where they will be of greatest value in reducing food-borne risks to consumers. This should be reflected in application of specific measures based on science and risk assessment, with a greater emphasis on prevention and control of contamination during all aspects of production of meat and its further processing. Application of HACCP principles is an essential element. The measure of success of contemporary programmes, is an objective demonstration of levels of hazard control in food that are correlated with required levels of consumer protection, rather than by concentrating on detailed and prescriptive measures that give an unknown outcome."

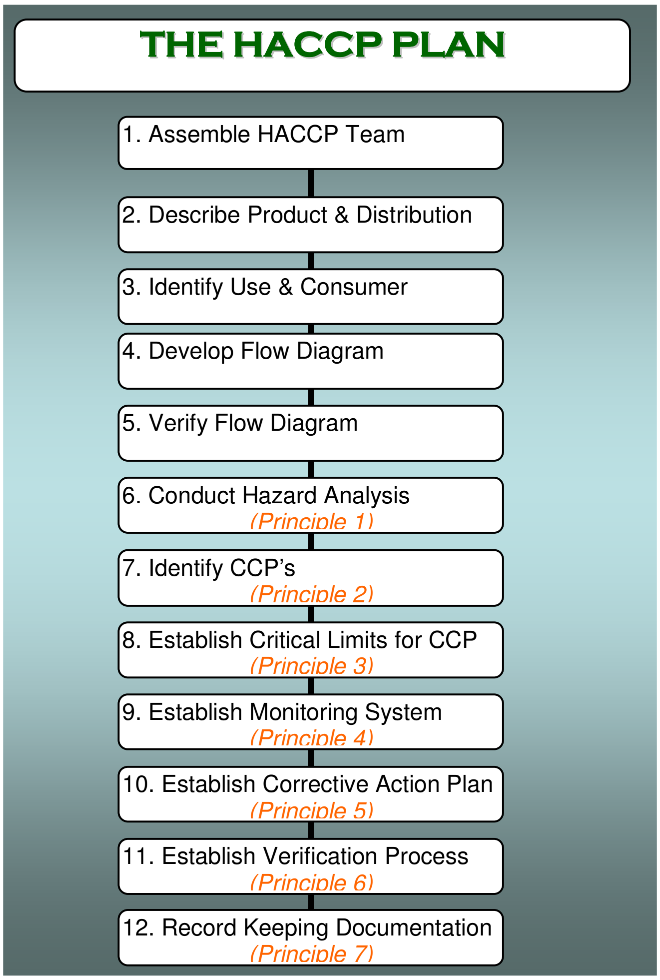

Fig 2.3 The steps in the HACCP plan, including the 7 principles

HACCP systems are risk management programmes (Coleman and Marks, 1999) in the form of preventative approaches towards sustainable food safety. They are essentially different from traditional approaches that rely chiefly on the sampling of end-products and their inspection (Ababouch, 2000a). Also, different to traditional approaches of food safety control, HACCP systems are integrated into the design of a given production process and they are of a comparatively high cost-effectiveness (Motarjemi *et al.*, 1996). Therefore, as a key advantage over conventional reactive approaches, the basic principle of the HACCP system is the possibility to identify potential hazards and inadequate practices at an early stage of food processing (Ehiri *et al.*, 1995).

HACCP comprises the identification of critical control points of processing as well as the identification of processing parameters for these critical control points, which will guarantee product safety if maintained (Coleman and Marks, 1999). In this context, a HACCP system is a scientific, rational and systematic approach to identify, assess and control hazards that may occur during the production, processing, manufacturing, preparation or the use of food so that the consumption of unsafe food can be avoided for the sake of the health of consumers (Motarjemi *et al.*, 1996).

HACCP comprises seven fundamental principles (See Fig 2.3 above). These principles are:

1. Conduction of the hazard analysis and consideration of all ingredients, processing steps, handling procedures and other activities which take place in the course of a foodstuff's production,
2. The identification of critical control points,
3. The determination of critical limits in order to be able to ensure the control of each of these critical control points,
4. The establishment of monitoring procedures that are used to determine if critical limits have been exceeded and the definition of procedures for the maintenance of control,
5. The definition of corrective actions that will be taken if control should on occasions be lost,
6. The establishment of effective procedures of documentation and record-keeping for the developed HACCP procedure and, last but not least,
7. The establishment of verification procedures in order to routinely assess the effectiveness of the implemented HACCP procedure (Ropkins and Beck, 2000).

Experiences from many different countries show that the implementation of HACCP systems in their food industries resulted in the much more efficient prevention of foodborne diseases (Motarjemi *et al.*, 1996). However, opposed to industrialized countries, there are still constraints and problems in the developing world, which aggravate the development and application of HACCP.

There are biological, physical and chemical hazards that should be indentified along the food chain from field to fork and these can be aligned to Critical Control Points (CCP's) along the food chain (CAC, 2005; DoA, 2000 Rooney & Wall, 2003). The steps in the identification of a CCP using decision tree analysis are shown in the diagram in Fig 2.4 below.

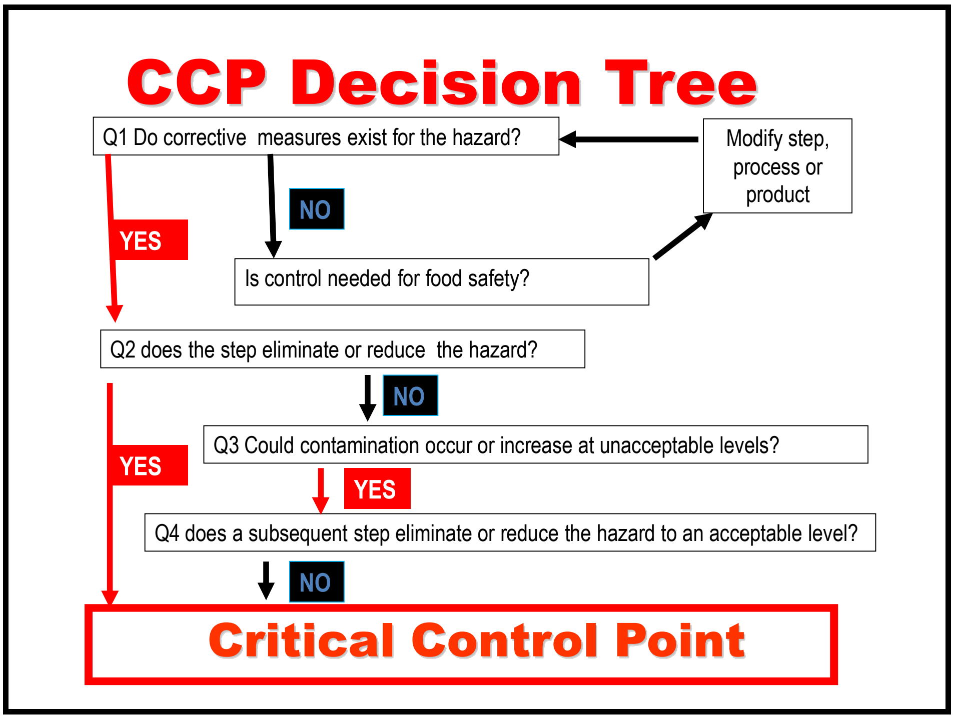

Fig 2.4 Decision tree for CCP

In general, these CCP's are only indentified at the abattoir, during slaughter and processing. However, there is a school of thought which suggests it should be applied during production as well (CAC, 2005; DoA 2003-2005; FAO, 2004). In a recent research study Bekker *et al.* (2011) found that respondents are unfamiliar with the meaning of a hazard analysis and the differences between biological, chemical and physical hazards. It is necessary to be aware of the possible hazards that may be present in game meat and to conduct a proper and accurate hazard analysis (including risk analysis).

2.5.4 Environmental risks

In the last decade, environmental risk assessment has become more prominent and animal production and processing facilities in South Africa must comply with legislation relating to solid waste management, effluents and pollution (DoA, 2000; DoE, 2008). In abattoirs, including game abattoirs, disposal of ingesta and condemned material is part of good management practices to prevent environmental pollution and risks to human and animal health (Bergh, 2007, DoA, 2000; DoA, 1984; DoA, 2002).

2.5.5 Participatory risk analysis

The establishment of HACCP systems in developing countries faces manifold problems (Jirathana, 1998) and, to stay realistic, a systematic implementation of HACCP-based food safety approaches throughout these countries cannot be expected to take place very soon (Motarjemi *et al.*, 1996). In developing countries there are often only few or even no local experts of HACCP. For this reason foreigners often need to be employed at considerable expenses, which can in many cases not or not fully be afforded by government bodies and the local food processing industry. Furthermore, overseas experts may only improve the situation substantially if they are able to make themselves aware of the specific problems of the countries in which they will promote HACCP adoption. Also, much HACCP training by these experts in developing countries have appeared to be chiefly of abstract character.

Such training does not offer the possibility for trainees to learn about HACCP in practice, because they lack particular products and processes. Unfortunately, another problem in developing countries is the fact, that, in many cases, inexperienced and under-qualified persons are chosen to take part in these HACCP-training courses. This reflects the general problem of many developing countries of a lack of people, who are qualified enough to eventually benefit from such training courses. In addition to this, the apparent brain-drain in many developing countries, whereby qualified personnel move to other economies in order to obtain higher salaries surely further increases the difficulties of HACCP establishment in the developing world.

In addition to this, communication and lack of sufficient skills, in the English language in large parts of the populations of many third world countries, further compounds the problem. Most foreign experts, available, use English as their vehicle of instruction and almost all literature pertaining to HACCP is available only in the English language (Jirathana, 1998). In many developing countries underdeveloped logistic conditions are another major constraint in the implementation of HACCP systems (Henson *et al.*, 2000). Nevertheless, in the food industries of most developing countries the awareness of the necessity of HACCP systems is increasing although the introduction of HACCP to developing countries will continue to struggle with numerous problems and constraints (Jirathana, 1998).

Schlundt (1999) defines risk as "*a function of the probability of an adverse effect and the magnitude of that effect, consequential to a hazard or hazards in food*" Risk is ubiquitous and unavoidable (Morris, 2002).

Risk analysis in food safety is a new science-based approach to effectively enable governments to protect consumers against food borne diseases and to respond appropriately if necessary. It makes it possible to systematically link epidemiological data relating to food borne hazards. Risk analysis is used as a framework to view and react to food safety problems in a systematic, scientific and structured way. A risk analysis framework offers a process to systematically and transparently collect, analyze and evaluate both scientific and non-scientific information that is of importance concerning chemical, biological or physical hazard possibilities. However, any risk analysis should be based on all scientific evidence and information on perceptions, costs and environmental and cultural factors that are available (FAO/WHO, 2005a; Rooney & Wall, 2003).).

The development of food safety evaluations has reached a substantial parting of the ways as modern biology is utilized in aspects of food safety (FAO/WHO, 2005b). Food safety risk analysis is applied by international as well as by national and regional food safety authorities and there are some notable differences between these processes to be found at these different levels: At international level, different Codex Committees recommend food safety standards and take the role of risk managers, while national food authorities are generally in charge of the execution of risk analysis. Components of risk analysis that have been conducted at the international level can be successfully used in the national context (FAO/WHO, 2006). Both, the FAO and WHO were key players in the development of food safety risk analysis. As early as 1991, the “Joint FAO/WHO Conference on Food Standards, Chemicals in Food and Food Trade” advocated the incorporation of risk assessment principles into the decision-making process of the Codex Alimentarius Commission (CAC), that is currently in place today (FAO/WHO, 2005a).

Risk analysis comprises of risk assessment, risk management and risk communication (Schlundt, 1999). Each of these components is essential in the risk analysis process as each one is of complementary importance (FAO/WHO, 2005a). However, the starting point of a risk analysis has to be risk assessment Although risk assessment and HACCP are related they are fundamentally different processes. Risk assessment is a process based on science which is applied to estimate the likelihood and severity of risk with accompanying uncertainty. In this context, many organizations identify four major elements of risk assessment, which are hazard identification, exposure assessment, dose-response assessment or hazard characterization and risk characterization (Schlundt, 1999).

Risk management is the process of weighing policy alternatives by mutual consent with all interested parties. Thereby, risk assessment and other factors important for the protection of consumers' health and for the promotion of fair trade practices are taken into consideration. If necessary, the selection of suitable prevention and control options is also taken into account. Both, risk management and risk assessment need to be performed within an open and transparent environment as well as on the basis of communication and dialogue. (Schlundt, 1999).

Risk communication means the interactive exchange of information and opinions throughout the risk analysis process in terms of risk, risk-related factors and risk conception amongst risk assessors, risk managers, consumers, industry, the academic community and other interested parties. In many cases, the procedure peaks in the implementation and continuous monitoring by risk managers. Additionally, the explanation of statements of risk assessment and the basis of risk management decisions is carried out (FAO/WHO, 2005a). Subsequent to a risk analysis, models that help to identify the most suitable strategies to manage the identified risks can be generated and tested for their suitability to boost a desired future development of a given situation (SFFF, 2012).

Already in the early 1970s development professionals focusing on developing countries had to cope with the failure of formal data collection methods, which were applied to recover cost-effective and reliable data for the planning of projects. As a result, a system called 'Rapid Rural Appraisal' (RRA) was developed in the 1980s, which aimed to merge the knowledge and skills of the targeted aid recipients with scientific knowledge in development projects. Nowadays, an advancement of the PRA, the 'Participatory Rural Appraisal' (PRA), is widely applied by development projects, which is based on a crucial participation of aid recipients (Catley & Mohammed, 1996).

In recent years, participatory research methods have become very popular as top-down, input oriented approaches rarely meet the needs of the people living in particular areas (Kroll & Kruger, 1998). As change is connected to perceptions, it is consequently only achievable by listening to people and observing a situation objectively. Therefore all interactions and both intrinsic and extrinsic variables of a particular system should be identified, analyzed and evaluated in a participatory way. Similar to an ecosystem, intrinsic factors are affected and influenced by extrinsic factors. Intrinsic factors of a system may be people, animals and diseases. Extrinsic factors may be environmental, socio-economic and socio-political factors. The interdependency between all these variables in any system can only be determined if the evaluation is holistic. People, capital and the access to resources but also all constraints should be included (McCrindle, 2003).

Amongst different participatory approaches, participatory risk assessment is an approach that is applied to gain insights into how risks are generated and how they can be reduced for it can be applied in virtually any context and within any specific sector (Holloway *et al.*, 2008). Grace *et al.* (2008) assumed that a participatory risk assessment may allow the involvement and the empowerment of participants as well as the rapid generation of reasonable and valid data. The Safe Food Fair Food project, which incorporates this study, has a diagram showing how the aims of participatory risk analysis can be achieved (Fig 2.5)

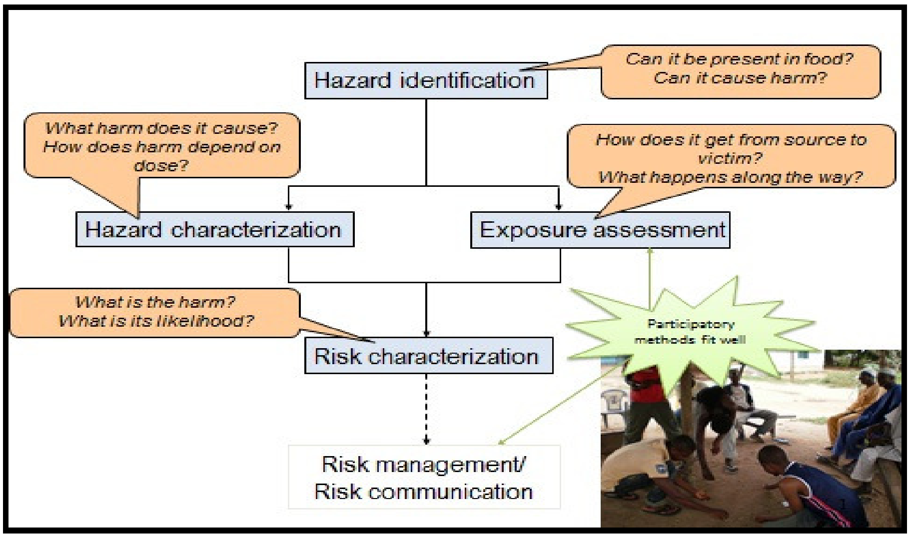

Fig 2.5 Participatory Risk Analysis (Source SFFF, 2012)

Previous studies dealing with food safety indicated that the participatory approaches are very helpful in overcoming problems of information collection in the case of research issues that are constrained by problems such as data scarcity, an insufficient building of stakeholder ownership and difficulties in ensuring a sustainable risk management. If risks are assessed, managed and communicated in a way that is appropriate to the preconditions in developing countries, substantial capacities in food safety management may be built and evidences of impact may be provided. The "Farm to fork" principle, is promising when it is aimed at determining where risks can be managed most sufficiently. Commodities of high potential which have been identified in the course of earlier studies and which are constrained by food safety related problems and suboptimal ties should be the major focus of such approaches (SFFF, 2012).

2.5.6 Game meat and food security

Participatory risk analysis is recommended by the International Livestock Research Institute (ILRI), for use in informal food markets (SFFF). Game is an indigenous food and can be a renewable natural resource in the study area and be used for improving food security.

2.6 Game offal

Biological waste condemned for aesthetic reasons, includes rough offal, heads, feet and trimmings (DoA, 2000). In terms of game regulations, these are covered by VPN 09/2010-2011, as shown in Table 1.1. Although passed as fit for human consumption, edible offal from game is sent to vulture restaurants, or is left out for the predators on game farms, or in some instances it is sent to crocodile farms. Condemnation of bio-hazardous materials, which are septic condemned material, are buried in compliance with the promulgated guidelines of the appropriate Veterinary Procedural Notices (VPN/09/2003-05) for red meat.

CHAPTER 3
MATERIALS AND METHODS

3.1 Study Area

The study area was the uPongola and Umkhanyakude Districts, of Northern KZN, in South Africa, which encompasses large game reserves, many private game farms, commercial livestock farms, as well as small scale, emerging and communal farmers (See Fig 3.1 below).

This area is not ideal for commercial livestock production due to the presence of trypanosomiasis, foot and mouth and other tropical diseases, low and unpredictable rainfall patterns, high humidity and daily temperature and low carrying capacity. Crop and vegetable production is also compromised by the climate and poor soils as well as irregular precipitation.

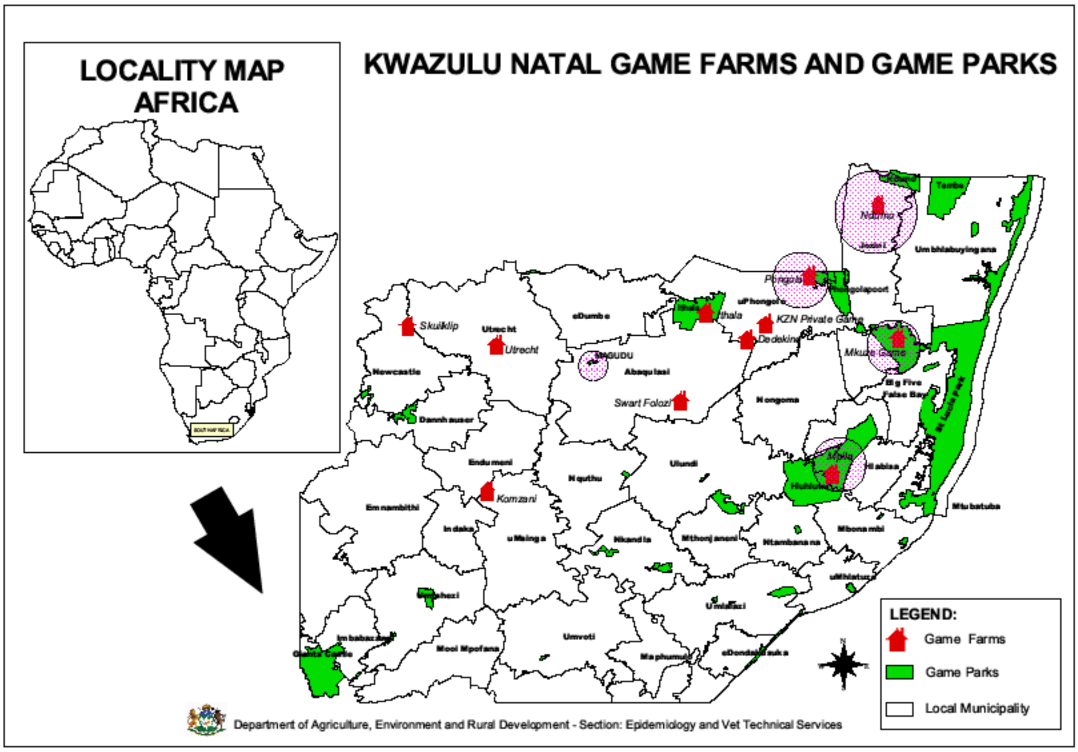

Fig 3.1 Geographical Information Systems (GIS) map of study area

Game farming predominates in this area and harvesting of game takes place seasonally usually in winter, between the months of May until August. During harvesting various species of game are hunted and Impala, predominant in the research study area, forms the largest proportion of the game that is exported to the EU. In 2008, the largest export consignment of Impala for South Africa, originated from this area (See Table 4.1 and 4.2).

Impala, the most sought after game species, has been chosen as a model for the development and recording of standard operating procedures and critical control points. Hygiene assessment auditing and HACCP will be done to estimate the risk of hazards likely to decrease the quality and safety of game meat derived from culling and or harvesting of Impala.

3.2 Experimental design

This will be an observational study. Participatory risk analysis (Grace *et al*., 2008) will be used to characterize potential hazards to the environment, human and animal health and to formulate risk mitigation and communication. Observations of Impala harvesting will be done between May and August 2008.
There will be two facets investigated:

- Food safety risk analysis during harvesting of impala
- Interviews with end users (consumers) of inspected impala offal to determine cultural acceptability

3.3 Food safety risk analysis

Risk analysis will be qualitative and based on the principles of meat safety of game meat outlined in the Meat Safety Act of 2000, the applicable VPN's and the meat hygiene guidelines published by the FAO, Codex and OIE, as well as the FAO & WHO document on Food Safety Risk Analysis (CAC, 2005; DoA, 2000; DoA 2003-2005; FAO 2004; FAO & WHO, 2006). Methods for describing process flows for game harvesting, as well as development of HACCP and CCP's for impala harvesting, will be based on Red Meat Regulations in the

Meat Safety Act 40 of 2000 and the Foodstuffs, Cosmetics and Disinfectants Act, 54 of 1972 as well as the relevant VPN's (DoA, 2000; DoA 2003-2005, DoA, 2012; DoH,, 1972). Primary inspection of impala meat was modified according to the Game Meat Inspectors Manual (DoA, 2002) as well as Meat Inspectors Manual: Game, edited by Tertius Bergh (Bergh, 2007).

3.3.1 Participatory risk assessment

Expert interviews will be conducted with harvesters, who were registered with the National Department of Agriculture as hunters for game, destined for export to the European Union (EU), using a checklist (see Table 3.1 below).

Table 3.1 Checklist for harvesters (n=10)

- Name, age and gender (demographics)
- Number of years registered as a hunter?
- What challenges do you face when hunting?
- What are the usual reasons for harvesting?
- Usual method (aerial/ bush/ boma) - which is better?
- Do you kill all animals or only selected animals
- Average misplaced shots per 100 carcases
- Type of equipment/ rifles
- Choice team members
- How often do they hunt
- Opinion on welfare of impala during culling
- Time taken before exsanguinations
- Placement of shot
- What about diseased animals/ very young animals?
- What about damaged carcasses, carcasses not suitable – leave in field?
- What happens to the offal in the field usually
- What happens to heads and feet usually
- What ablution facilities are available in the field

Similar interviews were done with those doing meat inspection in the field and at the abattoir (n=10). For the checklist see Table 3.2 below.

Table 3.2 Opinions of meat inspectors (in the field and at the abattoir) n=10

- Name, age and gender (demographics)
- Number of years experience
- Opinions on the quality of impala carcases from study
- Documentation required
- What happens to rough offal?
- What happens to red offal usually?
- What happens to condemned carcasses (septic and non-septic)
- Ablution facilities

These informal expert discussions have been summarized in section 4.5 under Results

3.4 Structured interviews on offal

Structured interviews were used with randomly selected respondents in the study area, to find out about the cultural acceptability of consuming offal from game animals. A consent form (see Addendum 2) was used with respondents and the questionnaire was administered in their language by qualified Animal Health Technicians in whose district each dip tank was located.

3.4.1 Study design and sampling frame

The sampling method used in this study was proportional random sampling. The dip tanks were used as a point of reference. It is at these sites that members of the community gather on specific days to plunge-dip their livestock to prevent tick borne diseases with Ascaracides. These occasions then afford the Animal Health Technicians an opportunity to interact with the livestock owners for purposes of disease surveillance or other such surveys. Dip tanks involved in the study area were listed and so were all the participants together with the total number of livestock owners. Then proportional sampling of dip tanks was done. On average each State Veterinarian has 40 dip tanks under his/her control. Put all 40 dip tanks in a hat and pick out ten. Then use proportional random sampling.

The sampling frame was all the dip tanks in all the state veterinary districts within the study area. This was a two stage cluster design:

- First stage: In the randomly chosen State Veterinary area randomly selected dip tanks were used.
- Second stage: Proportional : select dip tank owners randomly, then randomly select community members who brought cattle to the dip tanks

Steps in the process were:

1. Sampling frame: all the dip tanks in a particular SV area.
2. Randomly select dip tanks
3. Then randomly select cattle owners of these dip tanks.

3.4.2 Sample size calculation.

It was be estimated that there is an estimated 50% prevalence of people who eat game offal.

$$n = 1.96^2 \, p\,(1-p)/d^2$$

Where n is the desired sample size, p is the prevalence and d is the desired level of precision in this case set at 5% (0.05).

Therefore $n = 3.84 \times 0.5(1-0.5)/0.05^2$

$n = 384$

So 384 people need to be interviewed

The inclusion criteria were community members that reside near the dip tanks of the study areas.

3.4.3 Study population

Unfortunately due to inclement weather and the Foot and Mouth Disease outbreak in the study area, it proved impossible to locate all the subjects randomly selected. In the end, a total of 162 respondents (local community members) from 14 dip tanks took part in the study on cultural acceptability of game offal. It was considered a sufficiently large sample to proceed with the study.

All dip tanks were in state veterinary districts under Umkhanyakude or uPongola Districts. Twelve of the dip tanks comprising 118 (72%) respondents were from State Vet area Jozini, whilst, two dip tanks consisting of 45 (28%) respondents were from State Vet Vryheid area. Of the randomly selected respondents, 62 (38%) were females and 100 (62%) were men. The youngest respondents were 17 years old and all were males whilst the oldest was 83 and he was male.

3.4.3.1 Demographics:

The following variables were collected: age, gender, religion, and race.

3.4.4 Data analysis

The answers to the questionnaires were captured on EPI-Info software and they were subsequently transferred to statistical software STATA, 11.0 (Statacorp, College Station Texas, USA) Descriptive Statistics: Descriptive tables were used to show frequencies, proportions, medians and variables.

Chi-squared analysis was used in the study to assess for any associations between:

- Gender and consumption of impala offal
- Age and consumption of impala offal

CHAPTER 4
RESULTS

4.1 Introduction

In this chapter the food value chain (process flow) for game harvesting of (impala), from "farm to fork", will be described in terms of integrity, wholesomeness as well as traceability, in compliance with EU regulations for export. Plate 4.1 shows partially dressed impala carcasses hanging on a frame at the temporary field depot, ready to be loaded into a chiller truck for transport to the export abattoir.

Results of structured interviews, expert opinion surveys and focus group discussions with stakeholders as well as observations made during the harvesting process and hygiene management were used to identify CP and CCP's along the chain. A cold chain for game offal was developed from consultations and focus groups with relevant stakeholders. The results from a survey in the study area for edible offal from impala will also be reported.

Plate 4.1 Partially dressed game carcasses (PDGC) with tagged offal

4.2 Game meat export sales

Information on game meat export including impala was obtained from the Marketing Manager Charl de Villiers, at the Mosstrich game export abattoir, in Mossel Bay, which is in the Western Cape Province in South Africa. The trend in the increased demand for impala from 2005 – 2008 has grown due to consumer demand in the European Union markets (Table 4.1)

Table 4.1 Trend in game harvested and kg exported 2005-2008

Approximate Number of Animals Harvested for Export				
Species	**2005**	**2006**	**2007**	**2008**
Springbok	52000	43000	50000	55706
Blesbok	7000	6000	8000	11687
Kudu	2300	1500	1800	2369
Zebra	450	600	700	364
Impala	**850**	**1000**	**1300**	**2810**
Wildebeest	800	1000	1200	3998
Other	1555	930	1260	1579
TOTAL	**64955**	**54030**	**64260**	**78513**
Approximate kg Meat Exported				
	2005	**2006**	**2007**	**2008**
Species	**YTD kg**	**YTD kg**	**YTD kg**	**YTD kg**
Springbok	249422	218594	249074	307465
Blesbok	81711	74584	97289	130138
Kudu	64722	44736	52604	55721
Zebra	22275	29700	34650	14908
Impala	**8807**	**10981**	**13988**	**20858**
Wildebeest	22512	29824	35070	106750
Other	27348	17335	23014	28722
TOTAL	**476796**	**425753**	**505689**	**664562**

Game species harvested in the study area over the study period are shown in Table 4.2 below. All impala marked in the table (Table 4.2), were harvested and observed as part of the study. The researcher, however, monitored and observed all the species harvested over the period that are shown in the Table.

Table 4.2: Number of Exported Game species harvested in the study area over the study period.

Blesbok (n=1)	Gnu (n=370)	Kudu (n=193)	Impala (n=1765)	Zebra (n=120)	Date
1	19	34	**123**	8	26/08/2008
	24	12	**72**	13	29/08/2008
	19	30	**137**	9	27/08/2008
	44	6	**62**	11	02/09/2008
	37	6	**12**	17	04/09/2008
	46	1	**1**	20	04/09/2008
	23		**193**	10	06/09/2008
	49	5	**37**		05/09/2008
	14	3	**253**		10/10/2008
	22	25	**172**		18/10/2008
	30	11	**82**	13	22/10/2008
	21	9	**116**	11	23/10/2008
	10	17	**89**	8	24/10/2008
		8	**259**		27/10/2008
	12	26	**157**		18/10/2008
1	370	193	**1765**	120	TOTAL

An additional two tons of game not shown in the table, that included impala, were condemned due a breakdown in the cold chain, during loading and transport, as a result of chiller mechanism failure in the truck. This substantiated the choice of chiller temperature as a CCP, in the process flow diagram for harvesting impala.

4.3 Process flow field to fork

Figure 4.1 below is the process flow from field to fork, using the VPN's as a benchmark, for game as discussed using participatory methods at the opening meeting, with the team leader of the harvesting team, his hunters and meat inspectors.

Also present were the KwaZulu-Natal Provincial Veterinary Services - staff from Veterinary Public Health, Laboratory staff, Animal Health, a representative from the National Department of Agriculture (Dr. T Bergh) and two researchers (L J

Bekker & M van de Merwe) from the Tshwane University of Technology and all other stake-holders and role-players present. See photographs below (Plate 4.2 a and b).

Plate 4.2 (a and b): Stakeholders and role-players during opening meeting

In essence, this was a participatory approach to establishing a "HACCP team", which, in an abattoir, would consist of experts and not be a wide-based consultation with participants who had relevant field experience. From this meeting, the process flow was agreed on and implemented as shown below in Fig 4.1.

- **First head shot = slaughter=culling=harvesting**
- **Transport to fixed frame depot**
- **Primary meat inspection and evisceration**
- **Numbered ,tagged with red offal for correlation**
- **Weighed**
- **Loaded onto refrigerated truck accompanied by relevant documentation**
- **Transported to registered export abattoir**
- **Documentation checked**
- **Flaying and dressing process undertaken**
- **Secondary inspection**
- **Deboned, packaged, boxed, x-rayed**
- **Transported in refrigerated truck /container for export**

Fig 4.1 Process flow for impala harvesting

4.4 HACCP flow chart for impala with identified Critical Control Points

A HACCP flow chart (food value chain) see (Fig 4.2) below, for primary impala meat harvesting was developed for the harvesting process itself, in consultation with a HACCP team consisting of all stakeholders and role players (See Plate 4.1 a and b) .

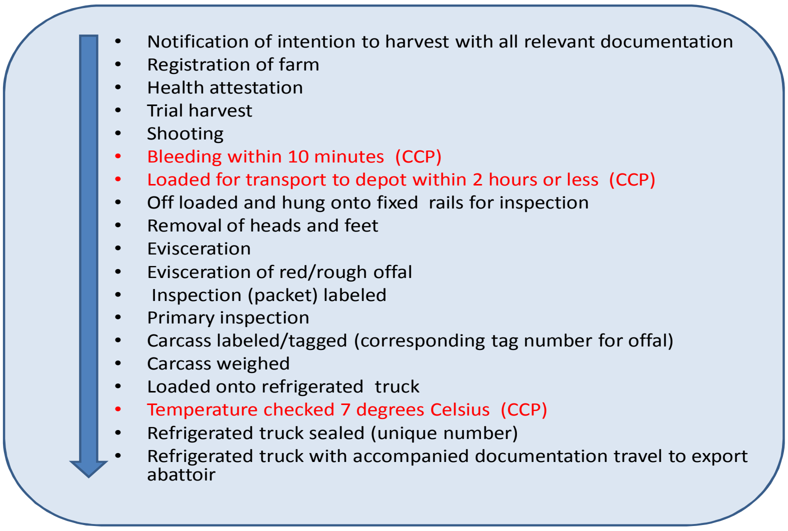

Fig 4.2 HACCP process flow diagram with identified CCP’s

During the game harvest, three CCP’s were identified that are highlighted above (Fig 4.2). The first CCP, bleeding within 10 minutes of shooting, is prescribed in the VPN. However, a focus group discussion with the professional hunters indicated that they aimed at an interval of less than 3 minutes, as otherwise there was very little exsanguination. This was because culling for export was done with head shots and special rifles and ammunition, which resulted in rapid death of the Impala and thus also promoted animal welfare (Plate 4.2).

The second CCP is also related to time. Although the revised VPN allows for 4 hours between loading these carcasses in the field after shooting and hanging on the frame at the depot for evisceration, removal of heads and feet and primary meat inspection, the stakeholders meeting and hunter's focus group held earlier, agreed on 2 hours.

Plate 4.3: Highly accurate rifles and special ammunition as used in harvesting

Plate 4.2 a and b. In the Veary PhD thesis (Veary, 1991) "bloating" is mentioned as a reason for condemning game carcasses and that this is related to the time between shooting and evisceration, as well as ambient temperature (Plate 4.4 a and b).

Plate 4.4 (a) Evisceration (b) hanging carcasses, feet and heads removed

The third CCP is the temperature of the refrigerated truck, which should not exceed 7 °C. (Plate 4.5) Before loading carcasses, the temperature is brought down to less than 7 °C, often as low as 0-1 °C.

Each impala had attached to it, a bag containing inspected red offal, with an identification number that is the same as that of the carcass for traceability. Prior to loading, each carcass is weighed and this number is recorded. The loading of about 20 impala can take about 20-40 minutes. As the batch is completed, the core temperature of the first carcass, one in the middle and the one nearest the door, are recorded after loading. The core temperature is usually between 7 and 12 °C

Plate 4.5 Chiller truck parked close to the frames (temporary depot)

To maintain the temperature, two trucks are often used. A group of inspected carcasses is loaded, the doors are closed and the temperature drops. The next group is loaded into a second truck and again doors are closed. In an average truck there are two rows of impala and once the second truck is full, the chilled impala are often re-loaded into the first truck so it can leave for the abattoir. The core temperatures are monitored again just before departure. It usually takes between 1-2 hours (depending on ambient temperature) for the core temperature of the carcasses to reach 7 °C, but this often happens before departure, depending on how long it takes to shoot, convey, dress and inspect the carcasses during the harvest.

In the study area, it was observed that harvesting was done in the early morning and evening, during winter (May to August). According to Veary (1991), wind chill alone brought the core temperature of the *pectoralis profundus* muscle of culled springbok down to 7.25 °C within 2 hours of slaughter, if slaughtered at night, in winter. Night harvesting was also done in the study area, however, due to time constraints it had to be extended to early morning and evening as well. Focus group discussions indicated that harvesting teams were not happy to continue harvesting if ambient temperature went above 20 °C, as this resulted in an increase in condemnations due to bloating.

In each truck a thermo-logger was placed in the refrigerated section, with the carcasses, to monitor temperature fluctuations. At the destination export abattoir this device was connected to a computer, demonstrating a temperature curve for the time between loading and arrival at the abattoir. A temperature monitor was also mounted in the front, on the dashboard, so that the driver could monitor the temperature in the refrigerator (Plate 4.6 a and b). If any chiller failure occurred there was no alarm, so the driver needed to check this monitor while waiting at the depot, with the engine on and while driving.

Plate 4.6 (a) Monitoring device on dashboard (b) Thermo logger

4.5 Challenges

According to the expert opinion checklists and focus group discussions with stakeholders and role players, there are several challenges to successful game harvesting, as summarised below.

4.5.1 Weather

Harvesting is usually done during the winter months, but temperatures in the area of the research study can sometimes be high during the day even in winter. The higher temperatures could comprise meat safety and ultimately the shelf life of the final product. On the other end of the scale water freezes in some areas of South Africa during winter affecting sterilization of equipment, washing of hands, and cleaning of drip trays. Even chemical sterilization becomes a challenge as the water in the taps is frozen and the flow of water ceases.

4.5.2 Insects

Daytime harvesting attracts flies whilst the bright lights used during night harvesting attract insects. Night harvesting is the route of choice for several reasons such as insects being the lesser evil than flies. The use of UV lights however assists in attracting the insects to one designated area, away from the hanging carcasses.

4.5.3 Flies

Naturally attracted by the smell of blood during the day, drip trays are used to collect the blood to minimize attraction of flies. These drip trays are emptied and washed often as an effective fly control measure. Restrictions on the use of pesticides limit fly control measures. Invention of natural remedies can be adopted like adding a sugar solution to an empty beer bottle. This attracts the flies and traps them as well.

4.5.4 Chilling of carcasses

Chilling of carcasses is much more rapid if they are left hanging on the hooks of the rails as the temperatures dips well below zero degrees in those areas of South Africa were winter temperatures plummet to below freezing.

4.5.5 Protective clothing

Protective clothing, such as plastic aprons. plastic capes, plastic boots and hard hats worn in the research area where winter temperatures can go up to 30℃ add to the discomfort of the workers and could lead to heat stroke and compromise human safety .

4.5.6 BSE compliance

South Africa is currently considered to be free of BSE and is therefore classified as category 3-status unknown. BSE has been found to be present in the brain of antelope in Europe and for this reason it is suggested that the brain be removed from the heads before it enters the proposed food chain in order to avoid any future risks of food safety.

4.5.7 Welfare

Challenges for welfare are always in mind and strategies are developed to improve welfare so that there is less criticism from welfare bodies. Hunters especially, also mentioned that they do not like to see animals suffer. Other stakeholders agreed that it also has an effect on meat and carcass quality.

4.5.8 Environmental hazards

During investigation of the food supply chain for game meat, certain environmental hazards, impacts and consequences were observed and mitigation strategies proposed. These are summarized in Table 4.3 below.

Table 4.3 Observed environmental hazards and mitigation strategies

Environmental hazards	Mitigation strategies
Biological waste : aesthetic condemnations	Vulture restaurants, predators
Biological waste:biohazardous condemnations	Burial in line with VPN
Ingesta inside rumen and intestines	Collected and sent to vulture restaurants
Contaminated effluent (water)	Correct drainage avoid water-table contamination
Contaminated effluent (blood)	Collected on drip trays to avoid environmental contamination.

4.6 Using edible offal to increase food security

Focus group discussions on edible offal indicated that it was discarded on the farms where the temporary depots were erected for harvesting. It was generally left out for scavengers and vultures. Discussions indicated that this was probably not a good environmental practice because:

- It could upset the ecological balance between scavengers, predators and prey as it was very sporadic and seasonal
- If repeated harvesting took place, it could pollute the soil and underground water

It was additionally suggested that as the edible offal from harvested game was inspected and therefore declared fit for human consumption, it could be used as an affordable source of protein and improve food security in the study area. The focus group eventually reached consensus that school feeding schemes, already existing in the study are, could the beneficiaries.

However, there were certain constraints that had to be overcome in order to make this practically feasible:

- The offal, heads and feet were removed in a field depot, not at an abattoir, so hygiene audits will have to be rigorously applied to prevent contamination by dust or insects.
- An appropriate and affordable cold chain will have to be instituted.
- Although edible offal from cattle and sheep is bought from red meat abattoirs and is known to be a sought-after food in South Africa, called "etumbu" in Zulu, "boti" in the Indian community, "afval" in Afrikaans and "tripe" in English, it was not known if there were cultural prejudices against offal derived from game.

4.6.1 Hygiene assessment audit, modified for game

The edible offal came from game harvested for export; therefore the hygiene audit was rigorous for slaughter and handling according to VPN/ 09/2010-2011. However, the VPN suggests using the offal for vultures and predators. Thus, Section E (Hygiene Audit for Offal), which is part of the Meat Safety Act 40, of 2000, were applied. When this audit was applied to impala carcasses, by a registered and designated game meat inspector, in the same way that it would be applied in a red meat abattoir for cattle and sheep, a 100% compliance with the auditor was found.

4.6.2 Developing a cold chain for edible offal from Impala

In the study area, one farmer had a large chiller, suitable for chilling and packing offal for distribution and storage. As the offal was removed from the carcasses it was placed into clean containers, with lids, similar to those used in a rural red meat abattoir. There was far more offal produced than could be used for human consumption, during the harvest, so the remainder was sent to the vulture restaurants.

The collected edible offal was moved in the closed containers onto a vehicle and transported to the chiller room, within 20 minutes of evisceration. The chiller room is in small, registered game abattoir, where there are facilities for cleaning and packaging offal under the supervision of a registered game meat inspector. After cleaning and packaging, the offal was frozen so that it could be stored for later distribution. The process flow is shown in Fig 4.3 below.

An arrangement was made to deliver the frozen packages to three school feeding schemes nearby. This has become a sustainable method of utilization and at this stage (2012), demand now exceeds supply.

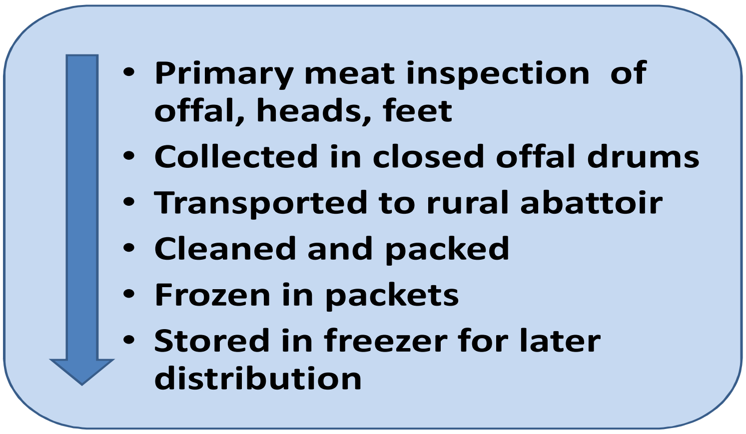

Fig 4.3 Process flow chart for cold chain for edible offal from impala

In the area, work done together with Alexander Heeb (Heeb *et al.,* 2011). Informal traders were interviewed and this showed that game meat and offal would be acceptable for sale in informal markets in the study area, if it were available and affordable. It could thus be used for alleviating poverty and job creation, as well as improving food security.

4.7 Cultural acceptability of edible game offal

As mentioned above, edible offal from sheep and cattle, forms part of the traditional food of animal origin, eaten in South Africa, and is also regarded as a delicacy. In some section of the population, there are religious and cultural prejudices against eating any part of certain livestock species, such as pigs, cattle and horses. This would extend to their offal as well. In America, for instance, the animal welfare lobby has succeeded in shutting down horse abattoirs.

It was unknown whether there were any cultural prejudices against game meat, in particular edible offal from impala. To this end a structured interview was given to a random sample of community members in the sample area (n=162).

4.7.1 Population structure - Sampling Frame

The age and gender of respondents is shown in Table 4.4 below. The sampling frame comprised of a total of one hundred and sixty two (162) respondents (from the local community) surrounding the 14 dip tanks that were chosen to participate in the study area. These dip tanks chosen were from around the State Vet Jozini and Zululand areas.

Table 4.4 Age and gender of respondents.

Variable	Female (n %)	Male (n %)	Total (n %)
Age category			
0-20	6 (3.7)	12 (7.5)	18 (11.1)
21-30	17 (10.5)	12 (7.4)	29 (17.9)
31-40	8 (4.9)	16 (9.9)	24 (14.8)
41-50	21 (13.0)	19 (11.7)	40 (24.7)
51-60	2 (1.2)	16 (9.9)	18 (11.1)
61-70	2 (1.2)	12 (7.5)	14 (8.64)
>70	0 (0)	14 (8.64)	14 (8.64)

Twelve of the dip tank respondents comprising 118 (72%) persons were from the State Vet area - Jozini whilst, two dip tank respondents consisting of 45 (28%) persons were from the State Vet -Vryheid area. Men (n=100, 62%), were more willing to be interviewed than women (n=62, 38%).The range in ages was from 17 to 83.

Table 4.5 shows the preference for offal of different species of domestic animals, stratified by gender.

Table 4.5 Preference for consumption of domestic offal. Respondents (n=162) could choose more than one offal.

Variable	Women	Men	Total
Eat offal of			
Sheep	45	86	131
Goat	37	84	121
Cattle	53	96	149
Pig	10	46	56

This preference is shown graphically below, in Fig. 4.4 as respondents could choose more than one offal type. Most respondents, preferred eating offal derived from cattle (n=149, 91.97%) sheep (n=131, 80.86%) and goats (n=121, 74.69%). Only 56 (10 females and 46 males, 34.56%) of the respondents consumed offal from pigs.

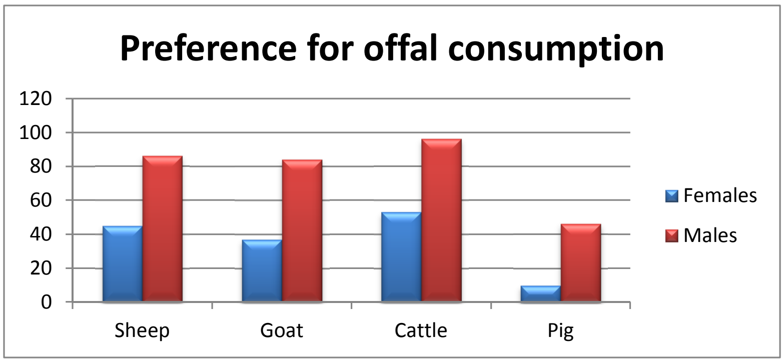

Fig 4.4 Histogram showing the preference of offal consumption stratified by sex.

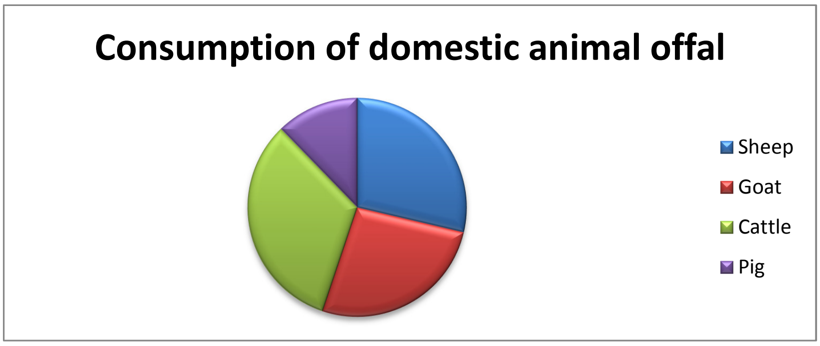

Fig 4. 5 Pie chart showing overall preferences for offal from different domestic animal species.

Table 4.6 below shows that most respondents (n=101, 62.35%) prefer eating impala offal, followed by buck (n=95, 58.64%) and kudu (n=65, 40.12%) respectively.

Table 4.6 Table showing preference for consumption for wild animal offal stratified by sex.

Variable	Female	Female%	Male	Male%	Total
Eat wild offal					
Buck*	24	25.3	71	74.7	95
Buffalo	1	10.0	9	90.0	10
Kudu	19	29.2	46	70.8	65
Impala	32	31.7	69	68.3	101
Lion	0	0.0	0	0.0	0
Zebra	0	0.0	0	0.0	0
Elephant	1	3.6	27	96.4	28
Monkey	1	11.1	8	88.9	9
Rhino	0	0.0	1	100.0	1
Warthog	3	8.3	33	91.7	36
Wilderbeest	7	17.5	33	82.5	40
Hippo	8	21.1	30	78.9	38

KEY:

"Buck" meant that the respondant described the animal as a "buck", because they did not identify what sort of species they were describing.

When the data in the table is ranked, it can be seen that impala is the most popular ~~offal ,~~offal, with n=101 (62.35%) of respondents in favour. It can be seen that game offal is definitely less popular than offal from cattle, sheep and goats. The histogram in Fig 4.6 below shows the distribution of preferences for game offal, stratified by sex. It was interesting that none of the respondents preferred to eat lion or zebra offal.

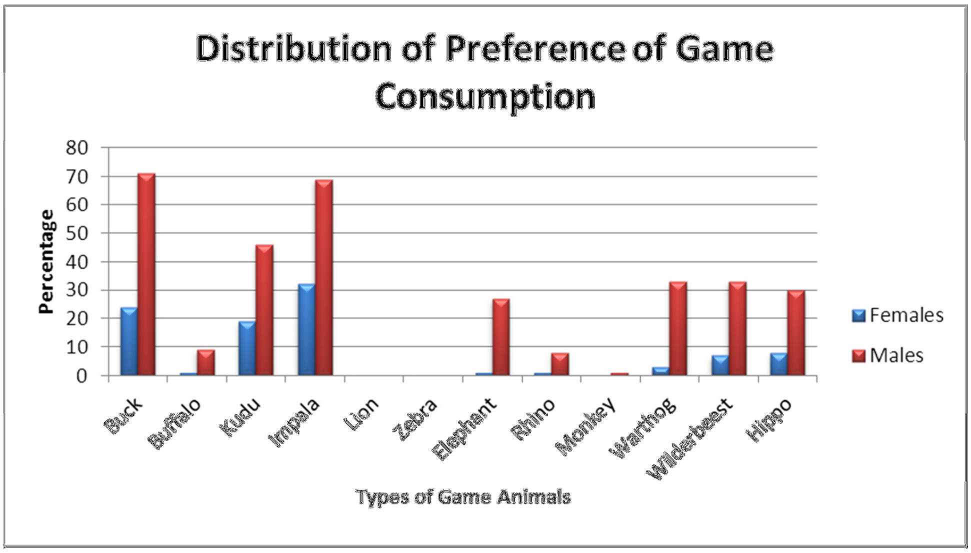

Fig 4.6 Histogram showing distribution of preference of own consumption of game offal's stratified by sex.

There was also a question as to whether parents would allow their children to eat game offal from different species, as it was planned to use stew from game offal in school feeding schemes and it was important that cultural norms and practices should be observed in the choice of offal to feed to children.

The distribution of opinions of respondents on feeding offal from domestic animals or game, by gender of respondents, is shown below (Table 4.7).

When the acceptance of offal is ranked by species, it can be seen that cattle, sheep, goat, impala, buck and kudu are the most acceptable, while offal from rhino, lion, zebra, horse, are least acceptable (n> 5, 3%, of respondents in favour).

Table 4 .7 Distribution of parents (n=162) who would allow their child to eat offal of game or domestic animal offal stratified by sex.

Variable	Female	Female%	Male	Male%	Total
Allow child to eat					
Impala	28	28.3	71	71.7	99
Buck	23	25.8	66	74.2	89
Buffalo	2	20.0	8	80.0	10
Kudu	18	29.0	44	71.0	62
Monkey	2	40.0	3	60.0	5
Lion	0	0.0	1	100.0	1
Zebra	0	0.0	2	100.0	2
Elephant	3	10.7	25	89.3	28
Wilderbeest	10	26.3	28	73.7	38
Rhino	0	0.0	0	0.0	0
Warthog	1	2.9	34	97.1	35
Hippo	5	15.2	28	84.8	33
Cattle	58	37.7	96	62.3	154
Sheep	51	35.9	91	64.1	142
Goat	48	35.3	88	64.7	136
Horse	1	33.3	2	66.7	3
Pig	10	17.2	48	82.8	58
Nyala	12	28.6	30	71.4	42

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It appears, however, that a majority of respondents (n=99, 61.11%) would allow their children to eat impala offal. As all the data in the histogram in Fig 4.7, is reflected as frequencies, rather than relative frequencies, there is an inherent bias in regard to sex as there were more men than women in the sample of respondents, which is why stratification was done by sex.

It may also be noted that there was variability in the answers between what people would eat themselves and what they would feed their children, an indication of inherent protectiveness or caution in relation to their children's health.

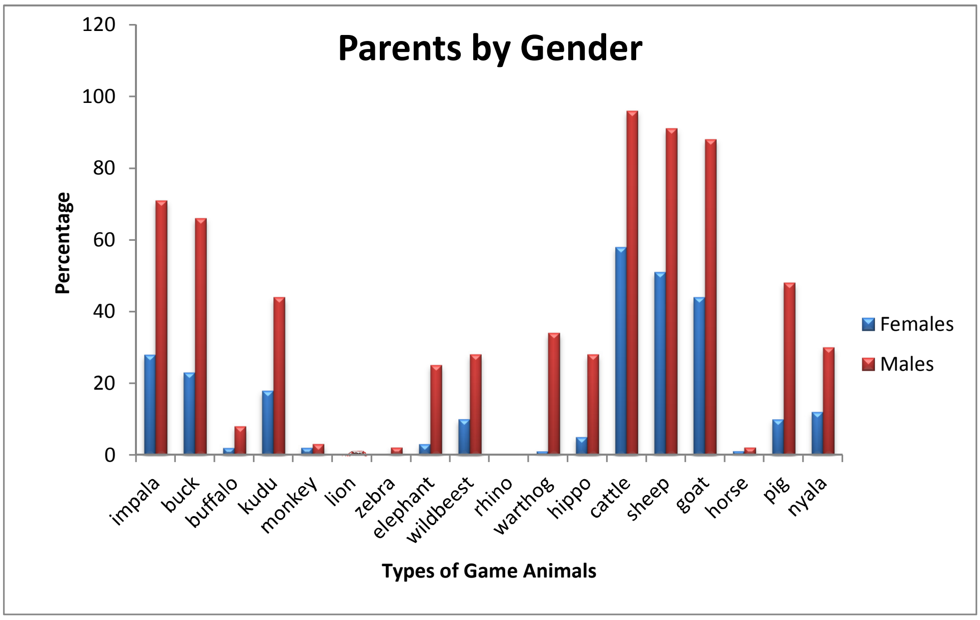

Fig. 4.7 Showing the frequency of parents by gender that would permit their children to eat offal from different game species.

Impala was the most popular game animal offal for both adults and children to consume and also the species being investigated in this study.

Table 4.8 Contingency table showing frequency of parents that would allow or not allow their children to eat impala offal.

	Parent-Gender		
Allow child to eat impala	**Female**	**Male**	
Yes	28	71	99
No	33	30	63
Total	61	101	162

As this is qualitative data, a 2X2 contingency table drawn from the sample data is shown in Table 4.8 . There was very strong evidence (p= 0.02) to show that the gender of the parent was associated with allowing the child to eat impala offal. The overall proportion of parents who would allow children to eat impala offal is 99 of 162 respondents (61.11%).This means that more than a third of the parents would object and it is important that schools should therefore obtain permission from parents before feeding impala offal to their children.

Logistic regression was used to assess for any associations between consumption of impala offal between the genders. Also an association between gender and allowing children to eat game offal was assessed, as shown in Table 4.9.

Table 4.9 Odds ratio of parents who would allow their child to eat impala offal stratified by gender and area of origin.

Variable	Odds ratio	z	p	Confidence interval
Eat impala offal				
Females ref	1			
Males	2.15	2.27	0.023	1.11-4.18
Allow child eat impala				
offal	1			
Females ref				
Males	2.79	3.05	0.002	1.44-5.39
State Vet Area				
Jozini reference				
Vryheid	0.48	-2.06	0.039	0.23-0.49

From the above, there was a significant difference between men and women (p<0.005) in their opinions on whether children should eat offal from impala, as could also be seen from the histogram in Fig 4.7.

In order to assess the acceptability of stew made from impala offal, permission was obtained from parents and cooked offal offered to schoolchildren from impoverished homes. This offal was cooked according to the recipe for “tripe” as consumed in France and Britain. Plate 4.1 below shows that children (n=175) enjoyed the taste of the cooked offal (donated by a game farmer after inspection and chilling), served with boiled rice, as part of the registered school feeding programme. Each child is allocated only R25.00 per week for food and thus animal protein is seldom affordable.

Plate 4.7 Children eating cooked impala tripe stew served with rice.

CHAPTER 5

DISCUSSION

5.1 Overview

The hypothesis in Chapter 1 stated that it will be possible to describe the value chains for game meat (impala) and formulate HACCP strategies to comply with international standards of food safety and quality for venison, while opening a market for safe, affordable and accessible protein (game offal) in low income communities, using participatory risk analysis, was proved.

In this research study, the value chains for game meat, using impala as a model, were described and HACCP strategies for primary and secondary inspection of game meat were developed. In addition, practical implementation of using affordable game offal and by-products to improve food security in vulnerable communities was described.

The new method of participatory risk analysis (Grace et al., 2008), where opinions of people who are not experts in meat inspection and abattoir management, were included in the process of estimating risk to consumers, personnel and animal welfare was found to be foremost in the process. Historically, the HACCP team is interdisciplinary, but the members are required to be experts. In this study it was found that in the informal markets and field situations, such as game harvesting, there were no experts to consult and so risk was estimated, based on observations and opinions from role players, stakeholders and end users. The lack of literature and research studies on this subject posed a major challenge during the study. It was therefore largely observational.

5.2 Meeting research objectives

With regard to the objectives of the research, the first objective, which was development of a sampling frame based on previous harvests, was complicated by the economic downturn in Europe and culling was substantially reduced as it was a good rainy season and farmers could afford to delay sales. Once impala were again being harvested it was possible to develop Standard Operating Procedures (See Fig 4.1) from data obtained in the field and observations made using Hygiene Assessment Systems (-See Table 4.2-), modified for use in the field. The SOP for secondary meat inspection was based on retrospective microbiological and condemnation data obtained from Mosstrich abattoir (Tables 4.3 to 4.7 and Figs 4.1 to 4.8). Using the field data for primary meat inspection and both retrospective and current data for secondary meat inspection, it was possible to suggest appropriate legislation for the control of game meat in South Africa (See Addendum 1). This could also be used as a model internationally where there is currently little consensus in legislation on game meat and venison.

Objective 1, 2 and 3 were met by:

- Developing a sampling frame for the game meat industry in the study area.
- Calculating sample framework size.
- Successfully describing the value chains and developing a SOP for the harvesting of impala.

Objective 4 was met

- By using participatory risk assessment to develop HACCP strategies for improved food safety and quality as well as promoting animal welfare during game harvesting, in compliance with international criteria.

It was possible to use participatory methods, mainly interviews with export abattoir staff **(n=14),** state veterinarians involved in game meat harvesting **(n=10)** hunters **(n=16),** field staff **(n=28)** and informal traders **(n=150)** to build up a flow diagram (See Figures 4.9-4.11) of the culling process for impala. Meetings and informal discussions with all these stakeholders, role players and end-users resulted in tentative critical control points being identified on the HACCP flow chart. Welfare aspects were also addressed (Table 4.8) by setting criteria for time between shooting and exsanguinations. Structured interviews with informal traders in the study area (Heeb 2009) indicated that game meat offal would be an acceptable product.

The objectives of this research, aimed at developing participatory risk analysis to facilitate HACCP in the game food value chain, as well as to facilitate a commitment for safe food to the food industry, both locally and internationally have been successfully achieved. The scientific and technological advantages and spin-offs will not only be of benefit to the wellbeing of people in low income communities, but also could improve the macro-economics of South Africa by better utilization of game meat.

Two HACCP plans have been developed for game meat using flow diagrams with prerequisites and CCP's in place. The first of these is for primary meat inspection and was put together using field observations (photographs), and participatory informal interviewing techniques. The second was based on the EU guidelines, veterinary procedural notices and literature was implemented in an export game abattoir.

The objective to identify and characterise potential hazards during production, processing and export to EU was explored and shortfalls identified.

Thermo-regulators were fitted to the transport truck's chiller with a visible monitoring device in the cabin. There was however, no built-in alarm system to indicate any deviation in temperature control. This was identified as a major challenge that could have a massive impact and result in huge financial losses to the harvesting team.

It is therefore recommended that to remedy this situation a SABS thermo-logger with a built-in alarm mechanism be designed for practical application. The calibration of such an instrument will have to be in compliance with SANAS. This CCP was thus addressed and catered for.

The study that was undertaken demonstrated that there are inadequate risk control measures such as introduction of ~~Hazard Analysis Critical Control Point (~~HACCP~~)~~ guidelines in primary and secondary meat inspection specifically for game meat not only within South Africa, but in the international arena as well. This radical innovative HACCP strategy can now bring about a whole new concept/change into the game industry that would not only be advantageous for international trade and economic development, but could be adopted by the EU for compliance in global game meat trade. The principles of HACCP as applied should be specific, measurable, attainable, realistic and time related meeting with the concept of “safe food, fair food” (Grace, 2008) and not just applied for the awarding of certification.

Consequently, this study was aimed at conducting risk analysis using a combination of traditional and participatory methods and can contribute toward improved standards for export products as well as poverty alleviation in the communities surrounding the game production areas.

Food scarcity is a contemporary challenge in rural communities in South Africa, with many child-headed households and the need for a protein rich diet for immuno-compromised individuals afflicted by either nutritional diseases or HIV/AIDS. In many parts of the world, offal items are a very popular kind of food that could be of cardinal economic interest for meat producers.

Game meat in South Africa has always been available to the select few, but this scenario has in the last decade changed due to larger tracts of land now being used as game farms. Usually, game is cropped seasonally during the winter months, when grazing is limited due to the low precipitation and for generation of income (Bothma, 2002). These carcasses are in many cases exported and thus undergo primary and secondary meat inspection. Meat by-products constitute between 50-60% of the yields of slaughtering, depending upon the species slaughtered (Subba, 2002). In the game industry, this is sometimes taken to vulture restaurants or left out for predators, after primary meat inspection (Bothma, 2002).

In addition to export, there is a market for the offal and secondary cuts resulting from the primary cuts as by-products that could be used to promote food security in low income communities on a regular seasonal basis which coincides with the winter months, a time of year when there is a scarcity of crops, due to the paucity of precipitation.

Slaughter of game therefore, provides possibilities for poverty alleviation in the area, not only due to the knock-on effects of export opportunities but also by job creation, and the possibility of informal marketing of low-cost by-products. These by-products could provide food security, improved health, for those children afflicted by kwashiorkor and for immuno compromised individuals, job creation, as well as poverty ~~alleviation.There~~alleviation. There will also be positive effects on the environment through better effluent and waste management and more efficient use of offal and by-products, a rich source of protein.

The daily dietary requirement of protein of a child is 50 grams. If an impala carcass weighs approximately 30 kg and its offal, once cleaned, weighs 3 kg
It will feed 30 learners each getting 50 grams of protein in their diet which is the daily recommended dietary requirement for a child according to the WHO.

As a result 300 kg of offal can feed 3000 learners with a diet rich in animal protein. In this way 300 kg of offal can provide 30,000 meals per week at a cost of less than R8.00 a day hence making game offal available to the communities of Northern KwaZulu-Natal.

This innovative strategy will ultimately fulfill the socio – economic and nutritional needs of the people in the study area, but it will also develop international standards of HACCP for game thus significantly boosting the economic growth and development of the area and sustaining South Africa as a global economic trading partner.

The focus globally on the quality and safety of meat for consumer placation remains a challenge in both developed and emerging countries on the international trading arena. For this reason alone it has become mandatory to adhere to international food safety management systems such as HACCP. This principle embraces the entire process from the "field to the table". The critical control points identified during this process validates the rationale for primary meat inspection which mitigates the likelihood of introducing a hazard which may adversely affect the safety of food or its suitability for consumption at later stages of the food chain. This which includes, avoiding the use of areas where the environment poses a threat to the safety of food, controlling contaminants, pests and diseases of animals and plants in a way that does not pose a threat to food safety, whilst adopting practices and measures to ensure that food is produced under appropriately hygienic conditions.

CONCLUSIONS
CHAPTER 6

6.1 Overview

The focus globally on the quality and safety of meat for consumer placation remains a challenge in both developed and emerging countries in the international trading arena. For this reason alone it has become mandatory to adhere to international food safety management systems such as HACCP. This principle embraces the entire process from the "bush to the table". The critical control points identified during this process validates the rationale for primary inspection. This mitigates the likelihood of introducing a hazard which may adversely affect the safety of food or its suitability for consumption at later stages of the food chain. The CCP's include, avoiding the use of areas where the environment poses a threat to the safety of food, controlling contaminants, pests and diseases of animals and plants in such a way as not to pose a threat to food safety. In the process practices and measures can be adopted that to ensure food is produced under appropriately hygienic conditions.

This study demonstrated that there are inadequate risk control measures such as introduction of HACCP guidelines on primary and secondary meat inspection specifically on game, not only within South Africa, but in the international arena as well. This HACCP strategy now brings about an innovative conceptual change into the game meat industry that is advantageous for international trade and economic development. It can also be adopted by the EU for improved compliance in the global game meat trade. The principles of HACCP as applied should be are specific, measurable, attainable, realistic and time related which meets with the concept of "Safe Food, Fair Food"(SFFF, 2012) and not just for the awarding of certification.

Consequently, this study was aimed at conducting risk analysis using a combination of traditional and participatory methods. It contributed toward improved standards for game meat as well as addressing poverty alleviation in the communities surrounding the game production areas.

In addition to export of game meat, there is a local market for the offal and secondary cuts resulting from the primary cuts as by-products that could be used to promote food security in low income communities. This can take place on a regular seasonal basis which coincides with the winter months, a time of year when there is a scarcity of crops, due to the lower rainfall. Slaughter of game therefore, provides possibilities for poverty alleviation in the area, not only due to the knock-on effects of export opportunities but also job creation, and the possibility of informal marketing of low-cost by-products. These by-products could provide food security, improved health for those children afflicted with kwashiorkor and immune-compromised individuals, job creation, as well as poverty alleviation. The meat obtained from trophy hunting, culling and harvesting indigenous game animals has been used in the past by biltong hunters, local butchers and for the export market. The edible by-products, currently discarded, could be used as a renewable source of protein in low income communities. These options would promote job creation for women and youth as well as improving food security in remote rural communities in close proximity to game farms and parks. This could then become a sustainable programme, although there is currently a seasonal over-supply of game meat and by-products, these could be frozen for use at a later stage providing a solution to food security from a renewable natural resource. Constraints to the utilization of such edible by-products of game meat include lack of recognized food value chains in informal markets, food safety concerns and market access to edible by-products from game harvesting operations. Therefore, this study was aimed at conducting risk analysis using a combination of traditional and participatory methods, which could contribute improved standards for export products as well as poverty alleviation in the communities surrounding game production areas.

This innovative strategy will ultimately fulfill the socio – economic and nutritional needs of the people in the study areas as well as in other game meat producing areas throughout South Africa. Simultaneously it will develop international standards of HACCP for venison. This will significantly boost the economic growth and development of the area and sustaining South Africa as a global economic trading partner. South Africa is also an integral part of NEPAD.

6.2 Conclusions

It can be concluded that the current practice of leaving the offal for predators was likely, if it continues, to cause imbalances in the predator/prey ratio on game farms. The hypothesis that stated that it would be possible to describe the value chains for game meat (impala) and formulate HACCP strategies to comply with international standards of food safety and quality for venison, while opening a market for safe, affordable and accessible protein(game offal) in low income communities, using participatory risk analysis, was proved.

If an impala carcass weighs approximately 30 kg its offal once cleaned weighs 3 kg and 3 kg can feed 300 learners, each getting 50 gm of protein in their diet. This is the daily protein dietary requirement suggested by WHO. Therefore 300 kg of offal can feed 3000 learners with a diet rich in animal protein. Thereby 300 kg can provide 30,000 meals per week at a cost of less than R8.00 a day. Hence making game offal available to the communities of northern KZN, has a considerable potential for increasing food security.

6.3 Recommendations

Recommendations suggested for further study are additional appropriate training in food safety, product handling and processing, food borne diseases, personal hygiene as well as environmental awareness enshrined in the hierarchy of reduce, recycle and reuse, together with effluent and waste management are areas that need to be addressed as a matter of extreme urgency. It must, however, provide the assurance to consumers provided by the Consumer

Protection Act 2011 that the safety of all foods including edible offal from game meat complies with legislation.

Game meat in South Africa is considered a luxury item that has historically always been available to the select few. Food security is a reality in South Africa and is a contemporary challenge in the remote rural areas. Many child-headed households are in dire need of protein rich diets especially immune-compromised individuals, vulnerable populations afflicted by either nutritional diseases, HIV/AIDS positive individuals, orphans and the elderly.

Often game farms and parks are in close proximity to the rural poor where food is scarce and comes at a premium price. These game farms harvest seasonally for either the local or export market hence there is an abundance of game offal and by products available. These products at present are left in the field or taken to the vulture restaurants, by management decisions

Harvesting of game therefore, provides possibilities for poverty alleviation in the study area, other game meat producing areas in South Africa as well as elsewhere in Africa, resulting not only on the knock-on effects of export opportunities but also job creation, and the possibility of informal marketing of low-cost by-products.

CHAPTER 7
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ADDENDUM

ADDENDUM 1: Legislation

ADDENDUM 2: Ethics consent form

ADDENDUM 3: Questionnaire

SCIENTIFIC PAPERS: PRESENTED / PRODUCED / POSTERS

1. Participatory Risk Analysis to Ensure Food Safety of Edible Offal From Game Meat. (SASVEPM)

2. ICOPHAI -International conference on Pathogens at the Human-Animal Interface

3. WVC-October, 2011. World Veterinary Conference Cape Town Convention Centre.

4. Improving food security and safety through use of edible by -products from wild game. Published in Journal -Environment, Development and Sustainability-Springer.

5.Participatory Risk Analysis: Game Meat: Food safety of Edible Offal.-poster

ANNEX A

HEATH ATTESTATION BY
ISSUING PROVINCIAL STATE VETERINARIAN

Ref. N° ____________________
(Farm Registration N° may be used)

Provincial issuing Logo **Letterhead of PSV**

Addressed To: ....

....
(Name of PSV of district where farm of destination is located)

....
Or (Name of OSV at abattoir of destination)

Address: ....
....
....

Tel. N°: ....
Fax N°: ....

ATTESTATION BY THE ISSUING PROVINCIAL STATE VETERINARIAN*

I .... hereby certify that the .... number of partially dressed game carcasses (PDGC's) as identified in the copy of the Certificate of Origin attached satisfy to the following requirements:

1. The farm must be located in the Foot and Mouth Disease Free zone (without vaccination) of South Africa as recognized by the OIE, or outside any Foot-and-Mouth Disease restricted area, as communicated from time to time by S.M.A.H. N.D.A. or as specified in the latest EU Directives in the case of export to the EU.

2. The farm from which the animals originate:

2.1 has been registered for export approval Reg N° ....

2.2 receives regular veterinary inspections;

2.2 was not under animal health restrictions in connection with any disease to which the animals concerned are susceptible;

Signed at (place) .... (date) .... *

....
(Signature of Provincial State Veterinarian)

Stamp

....
(Name in capital letters, title and qualification)

* This health attestation is valid for 10 days.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

(Logo of Controlling Authority)

ANNEX B (VPN/09/2003-05) CERTIFICATION OF ORIGIN OF PARTIALLY DRESSED GAME CARCASSES TRANSPORTED FROM THE WILD GAME FARM TO THE ABATTOIR

A. PARTICULARS OF FARM AND OWNER

Registered number of farm: ....

Name of farm: ....

Name of owner / manager: ....

B. PARTICULARS OF HUNTER

Name of hunter: ....

Registration number: ....

C. PARTICULARS OF CONSIGNMENT

Identification tag numbers of wild game carcasses:

First tag number		Last tag number	

Date of harvesting: ....

Time of harvesting:

Start of harvesting		End of harvesting	

Chiller vehicle registration number: ....

Date of departure: ....

Time at departure: ....

Name of abattoir of destination: ....

Carcass Number	Comments relating to ante- and post mortem inspection

D. DECLARATION BY AUTHORISED PERSON

I, ... hereby declare that:
(name of GME)

(i) The wild game carcasses mentioned in paragraph C of this certificate have been harvested from:

Name of Farm	Registration Number

(ii) by registered hunter:

Name	Registration Number

(iii) the partially dressed game carcasses were loaded in chiller truck:

Registration Number	Seal Number

Signed at (place) .... , (date) ....

....
Signature of game meat inspector

E. DECLARATION BY RECEIVING AUTHORISED PERSON

I hereby declare that the following partially dressed wild game carcasses arrived at

.... (name of establishment)

on (date) (time) ....

Registration Number	Seal Number

Identification tag numbers of wild game carcasses:

First Tag Number	Last Tag Number

The following temperatures were recorded on arrival:

Position in truck	Carcass identification tag number	Temperature °C
Back of truck		
Middle of truck		
Front of truck		

Signed at (place) .... , (date) ....

....
(signature of official state veterinarian)

Stamp

....
(name in capital letters, title and qualification)

(Logo of Controlling Authority)

ANNEX C (VPN/09/2003-05)
CHECKLIST FOR HARVESTING INSPECTION

Name of hunter: ____________________ Date of hunt: _______________________

Name of Official Field Game Meat Inspector: ________________________________

Signature of Official Field Game Meat Inspector: ____________________________

GENERAL	Compliance	Non-compliance	Remarks
Clean and hygienic protective clothing			
Record of Medical Certificates and ID's of hunters and assistants available			
OPERATIONAL	**Compliance**	**Non-compliance**	**Remarks**
Copy of hunter's Registration form available			
Wild game animals are killed by an approved method in accordance with animal welfare requirements, did not contaminate the wild game carcass and caused immediate death			
Only healthy wild game animals are harvested			
Animals bled within 10 minutes of killing			
Evisceration takes place before bloating			
Hygienic evisceration			
DEPOT	**Compliance**	**Non-compliance**	**Remarks**
Method of sterilisation of knives available			
Potable water available			
Clean non-corrosive hanging frame			
Sufficient light			
Area below slaughter frame hygienically maintained			
Identification of carcasses and corresponding offal			
Timeous loading of carcasses into chilling vehicle			
Clean and hygienic protective clothing			
Workers wash hands regularly, with bactericidal soap available			
Containers for condemned, inedible material and heads and feet and rough offal available			
Thermometer to measure carcass temperature available			
Containers for head and feet available			
VEHICLES	**Compliance**	**Non-compliance**	**Remarks**
Harvesting Vehicle(s) complies with requirements			
Reg. Number:			
Reg. Number:			
Reg. Number:			
Reg. Number:			
Reg. Number:			
Unregistered vehicles			
Unregistered vehicles			
Unregistered vehicles			

Chiller Vehicle(s) complies with requirements			
Reg. Number:			
Reg. Number:			

CONSENT FORM

PARTICIPATORY RISK ASSESSMENT FOR HARVESTING OF IMPALA (AEPYCEROS MELAMPUS) AND THE DISTRIBUTION OF BY-PRODUCTS.

I …………………………………………… hereby voluntarily grant my permission for participation in the project as explained to me by……………………………………………………………………………….

The nature, objective, possible safety and health implications have been explained to me and I understand them.

I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially. I am aware that the results of the investigation may be used for the purposes of publication.

Upon signature of this form, you will be provided with a copy.

Signed: ________________________ Date: ______________

Researcher: ________________________ Date: ______________

UNIVERSITEIT VAN PRETORIA
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Topic:

Participatory risk analysis to ensure food safety of edible offal from game meat

Authors:

1. Shashi, Ramrajh (University of Pretoria) shashi.ramrajh@kzndae.gov.za [Presenter]
2. McCrindle, Cheryl (University of Pretoria) Cheryl.Mccrindle@up.ac.za
3. Heeb, Alexander (University of Hohenheim) redheeb@web.de
4. Makita, Kohei (Rakuno Gakuen University) kmakita@rakuno.ac.jp
5. Grace, Delia (International Livestock Research Institute) d.grace@cgiar.org

Abstract text

The meat obtained from trophy hunting, culling and harvesting indigenous game animals has been used in the past by biltong (traditional dried meat) hunters, local butchers and for export markets. The edible by-products, currently discarded, could be used as a renewable source of protein in low income communities. Constraints to the utilization of such edible by-products of game meat include lack of recognized food value chains in informal markets, food safety concerns and limited market access to edible by-products from game harvesting operations. Participatory risk analysis was used to investigate the feasibility of using edible offal as a source of renewable protein, to address food security issues in poor communities bordering game parks in South Africa. The market outlet for the food value chain selected for investigation was informal markets in Pongola, KwaZulu Natal, South Africa. In order to promote food safety, only edible offal from impala carcasses that had been through primary meat inspection, were considered during the study.

Samples were submitted for microbiology, in line with published EU guidelines and Veterinary Procedural Notices to an accredited laboratory. Structured and informal interviews were held with stakeholders, including veterinarians, game harvesters and informal traders. Scenario planning and decision tree analysis was used to develop a practical food marketing chain and estimate critical control points for identified physical, biological and chemical hazards. In addition, environmental risks were considered and a risk mitigation strategy designed, to reduce any possible environmental impacts.

It was concluded that the food marketing chain is feasible and that the current practice of leaving the offal for predators was likely, if it continues, to cause imbalances in the predator/prey ratio on game farms

Keywords
offal, renewable protein, food security, food safety, game meat, KwaZulu Natal, South Africa

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Food Safety and Food Security aspects of Wild Game Meat Harvesting

Ramrajh, S[1]., McCrindle, C. M. E. [1]

Abstract

The demand for the control of safe food, from consumers the world over, has revolutionized the manner in which wild game meat harvesting occurs. In developed countries, food quality, food and human safety with quality controlling systems embracing environmental carbon footprint issues are constantly improving, for international harmonization at each level of production" from stable to table" "farm to fork" "field to yield" as well as from "cradle to grave".

Food industries globally have adopted the HACCP system. A system that is compatible with international trends designed not only for food safety and quality, but it also embraces other aspects of farming such as animal welfare, environmental management and Occupational Safety and Health.

Global marketing for International trade demands quality assurance from trading partners thereby promoting economic growth for developing countries. The watch dog bodies such as WTO prohibits trading for non compliances, thereby trade barriers are in place for uncertified food of animal origin, EU regulations are stringent requirements that need compliance and so too with the OIE regulations for disease control whilst Codex alimentarius maintains trade harmonization.

In South Africa **Hygiene Assessment Systems (HAS)** is a National Hygiene management system implemented at abattoirs, that promotes and facilitates Quality and Hygiene which is reflective of South African quality abroad. It is prescribed under the section, Essential National Standards in the Meat Safety Act, 2000, (Act 40 of 2000)

The objective of the Hygiene Management System (HAS) is to create a National awareness of Quality to better improve the quality of life of all South Africans, whilst at the same time it is used as an auditing tool for Veterinary Public health to effectively compare essential standards in the provinces. Currently this is only applicable to the high and low throughput Red Meat and Poultry abattoirs in South Africa and not to the Game abattoirs.

A revision of the HAS document will be needed to meet with the criteria for wild game harvesting for food safety thus enabling food security in the remote non agricultural areas in KwaZulu -Natal.

[1] Dr Shashi Ramrajh, Post graduate Student, Section VPH, Department of Paraclinical Sciences, Faculty of Veterinary Science, University of Pretoria Pvte Bag X04, Onderstepoort 0110. Tel 0125298181, Fax 012 5298311 E-mail Shashi.ramrajh@kzndae.gov.za

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