



Università degli Studi di Milano

Department of Health, Animal Science and Food Safety

PhD Course in Veterinary and Animal Science

Main domain: Economics and Management (AGR/01)

Class XXXI

THE VALORIZATION OF THE MEAT

FROM WILD UNGULATES:

Evidences from an Italian empirical analysis

Author: Maria Elena MARESCOTTI

Supervisor: Prof. Anna A. M. GAVIGLIO

Co-Supervisor: Prof. Vincenzina CAPUTO

Academic Year 2017/2018

To my family

Table of Contents

Abstract	1
Sintesi	3
List of Papers	7
CHAPTER 1	11
<i>Introduction</i>	11
1.1. Short food supply chains	11
1.2. The non-existent Italian Short Food Supply Chain of hunted wild game meat.....	13
1.3. PhD research pathway and steps	17
1.4. Aims and structure of the thesis.....	29
1.5. Summary of papers.....	31
<i>References</i>	33
CHAPTER 2	45
<i>The creation of a local supply chain for large wild ungulates meat: Opportunities and limitation from an Italian Alpine case study</i>	45
Abstract	45
2.1. Introduction.....	47
2.2. Opportunities and risks related to a supply chain for hunted large wild ungulates meat.....	49
2.2.1. Economic benefits and costs.....	50
2.2.2. Social benefits and costs	51
2.2.3. Environmental benefits and costs	52
2.3. Research Methodology	53
2.3.1. Case study.....	54
2.4. Results and discussion	57
2.5. Conclusion	72
<i>Acknowledgments</i>	74
<i>References</i>	74
CHAPTER 3	81
<i>The local value chain of hunted red deer meat: A scenario analysis based on a Northern Italian case study</i>	81
Abstract	81
3.1. Introduction.....	83
3.2. Materials and methods	86
3.3. Results and discussion.....	89
3.3.1. Flow sheet and segmentation of the game meat supply chain	89
3.3.2. The value of the meat at each step of the supply chain	90
3.3.2.1. <i>The value of the meat for the Hunter</i>	90
3.3.2.2. <i>The value of the meat for the Transformer</i>	91
3.3.2.3. <i>The value of the meat for the Restaurateurs</i>	92
3.4. Conclusions.....	104

<i>Acknowledgments</i>	108
<i>References</i>	108
CHAPTER 4	115
<i>Discovering market segments for hunted wild game meat</i>	115
Abstract	115
4.1. Introduction.....	117
4.2. Consumers' attitudes towards hunted wild game meat: background	120
4.3. Method and procedures.....	124
4.3.1. Survey framework.....	124
4.3.2. Data collection and survey instrument	126
4.3.2. Statistical Analysis	131
4.4. Results and Discussion	133
4.4.1. Descriptive analysis.....	133
4.4.1.1. <i>Consumption of wild game meat</i>	133
4.4.1.2. <i>Consumers' objective knowledge about HWGM</i>	133
4.4.1.3. <i>Consumers' general attitudes and perception of HWGM safety</i>	135
4.4.1.4. <i>Consumers' attitudes towards animal welfare, hunting activity and wildlife-related values</i>	140
4.4.2. Reliability analysis and principal component analysis..	146
4.4.3. K-means cluster analysis.....	147
4.5. Conclusions.....	158
<i>Acknowledgments</i>	161
<i>References</i>	161
APPENDIX A: <i>Overview of the Questionnaire</i>	173
APPENDIX B	178
CHAPTER 5	185
<i>Conclusions</i>	185
<i>Acknowledgments</i>	195

Abstract

In recent years, trends in the population of large wild ungulates (wild boar, red deer, chamois, mouflon) have become worrisome for Italy and many European countries. Ironically, while two decades ago these animals were listed as endangered species, they turned out to be a social cost. In fact, their population is growing with damage to ecosystems, economic losses in forestry and agriculture, increased risk of zoonotic diseases and increased frequency of vehicle collisions. Due to this overpopulation, management and containment strategies have been developed, with a cost to public institutions and an increase in culling rates, and the availability of game meat. Furthermore, according to European trade and safety regulations (Reg. EC No. 178/2002, No. 853/2004 and No. 854/2004), hunters are considered primary food producers (such as farmers and breeders) and, under certain conditions, they can sell the game they harvest.

On the consumers' side, recent years have seen a notable increase in the popularity of hunted wild game meat among consumers. In fact, large wild ungulate meat has optimal nutritional attributes, can be considered an environmentally friendly and local food and represents a sustainable alternative to intensive livestock production of beef, pork or poultry.

The growing demand and availability of these products has led to a growing number of emerging markets for hunted wild game meat in many developed countries, including Europe. However, expansion of these markets is often hampered by the lack of a structured food supply chain. This is especially the case in Italy where the hunting sector continues to have only a recreational and social connotation.

Also from a scientific point of view, despite the growing potential of the hunting sector, only a few economic studies to date discuss the case of wild game meat, and there is no research examining the Italian context.

All of these premises considered, the present thesis aims to contribute to the possible future development of the Italian local

supply chain of wild game meat and is structured as a step-by-step feasibility analysis that takes into consideration all of the involved stakeholders with the final goal of creating this new market. Specifically, the thesis is organized into three different studies, each one developing different aspects of the analysis.

The first study focuses on the primary producer of the game meat, namely, the hunter, trying to estimate the potential market availability and quality of meat of large wild ungulates produced by hunting activities in a local mountainous context.

The second study aims to assess the real economic value of the local supply chain of the hunted wild game meat by performing an exploratory analysis aimed at the quantification of the value transmission along the chain.

Finally, the third study addresses the need to broaden the knowledge of consumers' attitudes towards hunted wild game meat by profiling Italian consumers and assessing whether their attitudes and perception towards hunted wild game meat, socio-demographic characteristics and objective knowledge affect their intentions to purchase hunted wild game meat products.

The results of this research led to better understand some aspects of the current scenario of the Italian hunted wild game meat sector, with the final aim of understanding if and what types of strategies implement for the promotion of its future development.

Sintesi

Negli ultimi anni in Europa ed in Italia si è registrato un incremento preoccupante della popolazione di grandi ungulati selvatici (cinghiale, cervo, camoscio, muflone). Mentre in passato questi animali venivano classificati come specie a rischio di estinzione e quindi considerati come animali da tutelare, attualmente il loro sovrannumero è tale da determinare ingenti costi sociali. La continua crescita del numero di esemplari infatti causa danni agli ecosistemi, perdite economiche nella silvicoltura e nell'agricoltura, aumento del rischio di malattie zoonotiche e aumento della frequenza degli incidenti stradali provocati dalle collisioni con i veicoli. Per risolvere tali problematiche, sono state sviluppate strategie di gestione e contenimento, con conseguenti costi per le istituzioni pubbliche.

Tali strategie hanno determinato un aumento delle percentuali di abbattimento, che ha portato ad un incremento nella disponibilità di carne di selvaggina. Secondo le normative europee in materia di commercio e sicurezza (Reg. CE n. 178/2002, n. 853/2004 e n. 854/2004), i cacciatori sono considerati produttori alimentari primari, al pari di agricoltori e allevatori e, a determinate condizioni, possono vendere la selvaggina da loro cacciata. Allo stesso modo, dal punto di vista della domanda, negli ultimi anni si è registrato un notevole aumento della popolarità della carne di selvaggina ottenuta tramite attività di caccia. Infatti, le carni degli ungulati selvatici hanno caratteristiche nutrizionali ottimali, possono essere considerate un alimento ecologico e locale e rappresentano un'alternativa sostenibile alla produzione intensiva di carne bovina, suina o di pollame.

La crescente domanda e disponibilità di questi prodotti ha portato allo sviluppo di un numero crescente di mercati emergenti di carne di selvaggina cacciata in molti paesi sviluppati, inclusa l'Europa. Tuttavia, la diffusione del mercato per questo prodotto è spesso ostacolata dalla mancanza di una filiera di approvvigionamento alimentare strutturata. Questo è particolarmente riscontrabile in Italia, in cui al settore venatorio

continua ad essere associata solo una connotazione ricreativa e sociale.

Anche dal punto di vista scientifico, nonostante il crescente potenziale del settore venatorio, solo pochi studi economici prendono in considerazione questa tematica e, in particolare, non esistono ricerche che esaminino il contesto italiano.

Considerate queste premesse, il presente elaborato vuole fornire un contributo al possibile sviluppo della filiera locale italiana della carne di selvaggina ottenuta tramite attività di caccia. La tesi si struttura come un'analisi di fattibilità Step-by-Step che prende in considerazione tutti gli attori coinvolti in una ipotetica filiera, con l'obiettivo finale di creare un nuovo mercato.

Nello specifico la tesi è organizzata in tre diversi studi, ognuno dei quali sviluppa diversi aspetti dell'analisi.

Il primo studio si concentra sul produttore principale della carne di selvaggina, ovvero il cacciatore, stimando la potenziale disponibilità di prodotto che potrebbe essere immessa sul mercato e la qualità della carne di grandi ungulati selvatici ottenuta tramite attività venatorie in un contesto montano locale.

Il secondo studio si propone di valutare il reale valore economico della filiera locale della carne selvatica cacciata tramite la realizzazione di un'analisi esplorativa volta a quantificare la trasmissione del valore lungo la catena di approvvigionamento.

Infine, il terzo studio affronta la necessità di ampliare la conoscenza dell'atteggiamento dei consumatori nei confronti della carne ottenuta tramite attività di caccia, profilando i consumatori italiani e valutando se il loro atteggiamento e la loro percezione nei confronti della carne di selvaggina, le caratteristiche sociodemografiche e la conoscenza oggettiva influenzano il consumo di questo prodotto.

I risultati di questa ricerca contribuiscono alla comprensione di alcuni aspetti dell'attuale scenario legato al settore venatorio italiano e della filiera delle carni ottenute tramite attività di caccia, con l'obiettivo finale di capire se e quale tipo di strategie implementare per la promozione del suo sviluppo futuro.

List of Papers

This thesis is based on the following three papers:

- 1. The creation of a local supply chain for large wild ungulates meat: Opportunities and limitation from an Italian Alpine case study**

Gaviglio, A., Demartini, E., Marescotti, M.E.

Published in: *Quality – Access to Success* (2017), 18(S2)

ISSN: 1582-2559, scopus: 2-s2.0-85015941324

- 2. The local value chain of hunted red deer meat: A scenario analysis based on a Northern Italian case study**

Gaviglio, A., Marescotti, M.E., Demartini, E.

Published in: *Resources* (2018), 7(2):34

ISSN: 20799276, scopus: 2-s2.0-85048940376,

Doi: 10.3390/resources7020034

- 3. Discovering market segments for hunted wild game meat**

Marescotti, M.E., Caputo, V., Demartini E. Gaviglio, A.

Published in: *Meat Science* (2019), 149:163-176

ISSN: 03091740, scopus: 2-s2.0-85058366957,

Doi: 10.1016/j.meatsci.2018.11.019

“In view of its ecological, social and economic value, wildlife is an important renewable natural resource, with significance for areas such as rural development, land-use planning, food supply, tourism, scientific research and cultural heritage.

If sustainably managed, wildlife can provide continuous nutrition and income and contribute considerably to the alleviation of poverty as well as to safeguarding human and environmental health.”

FAO, 2005

CHAPTER 1

Introduction

1.1. Short food supply chains

Food supply chains (FSCs) have a relevant economic role: they provide safe food at reasonable prices and generally generate income by adding value to local resources, creating many economic and social benefits. FSCs bring stakeholders to work together to create competitive advantages and satisfy consumers' needs (Matopoulos et al., 2007; Mentzer et al., 2000). Several incentives motivate stakeholders involved in these institutions to cooperate, such as optimizing operational processes, improving research and development, performance, and mitigating market risks. However, decreasing transaction costs, and therefore increasing profits, is probably one of the most important factors leading actors to cooperate with each other (Banterle & Stranieri, 2008; Matopoulos et al., 2007). FSCs, because of their nature, are more complex and difficult to manage than other supply chains; for this reason, cooperation among stakeholders assumes a crucial role for their success.

Among FSCs, **short food supply chains (SFSCs)** have an even more particular organizational structure and distinctive features. SFSCs in fact provide an alternative to the globalized and agro-industrial model (Galli & Brunori, 2013) that has led to the alienation of consumers from the primary sector. For this reason, they are defined as “alternative food supply chain” or “alternative agro-food networks” (AFSCs) (Bazzani & Canavari, 2013; Renting et al., 2003). These supply chains can re-build a

connection between consumers and “place”, “enhancing an image of the farm and/or region as a source of quality foods” (Marsden et al., 2010).

In the European literature, SFSCs have been widely proposed as a new form of rural development tool (Fondse et al., 2012) and as an opportunity to revitalize rural areas (Marsden et al., 2010; Brunori & Rossi, 2007). Goodman (2004) affirms that alternative food distribution strategies can truly support long-lasting rural problems such as poverty, inequality and social exclusion. Moreover, Sims (2009), has shown that they can also play an important role in the tourism sector, because they have the potential to enhance visitor experience by connecting consumers to the region and their perceived culture and heritage. For all these positive outcomes, specific incentives have been promoted in the framework of the EU rural development strategies (CAP 2014-2020) for supporting the development of this type of supply chains (Bazzani & Canavari, 2013; Santini & Paloma, 2013), and over the past decades, they have been experiencing substantial growth all over Europe and, in particular, in the Italian agri-food context (Giampietri et al., 2018; Filippini et al., 2016). SFSCs in fact respond to the increased attention of consumers towards the quality, safety, healthiness and origin of the food they consume, as well as towards the effects that their food choices have on the environment (De Marchi et al., 2016). As highlighted by Fernández-Ferrín (2018), consumers have a growing demand for products of local or regional origin that have a traditional character, and produced with a low input systems method (Steenkamp, 1997). Local food productions incorporate a distinctive set of attributes, but generally, their most important characteristics are strictly connected to their sustainability (Seyfang, 2006) from the economic, environmental and social/ethical point of view (Giampietri et al., 2015). Moreover, consumers buy local food products because they expect them to have a higher quality, freshness and taste than other products (King, 2007; Fondse et al., 2012; Filippini et al., 2014).

1.2. The non-existent Italian Short Food Supply Chain of hunted wild game meat

Currently, while in other European countries there is already a professional supply chain for the meat of the game hunted (EC, 2014), the Italian hunting sector continues to have only a recreational and social connotation. Italian hunted game meat is mainly destined to the same hunters and to their acquaintances, with a relevant amount of wasted product. Despite this, the Italian hunting sector presents very interesting characteristics in terms of the amount of available large wild game meat. In fact, as reported by Ramanzin et al. (2010), the Italian total culling of ungulates may be estimated at more than 230,000 head/year.

Similar to other European countries, in Italy, the total number of animals of the large wild ungulates category is very high and has prompted severe concern. According to the Italian National Institute for Environmental Protection and Research (most recent data – ISPRA, 2013), the most widely diffused ungulates in Italy are:

- wild boar - *Sus scrofa*: approximately 600.000 heads;
- roe deer – *Capreolus capreolus*: approximately 426.000 heads;
- red deer – *Cervus elaphus*: approximately 63.000.

The overabundance of these species causes damage to ecosystems (Winkelmayer et al., 2011; Carpio et al., 2015; Côté et al., 2004), major economic losses in forestry (Reimoser & Putman, 2011; Motta, 2003; Gill & Beardall, 2001; Zamoral et al., 2001) and agriculture (Apollonio et al., 2010; Wildauer & Reimoser, 2007; Schley & Roper, 2003), increases the risk of zoonotic disease (Ferroglia & Vicente, 2011; Gortázar et al., 2007; Simpson, 2002) and enhances the frequency of vehicle collision (Ciabò et al., 2012; Langbein et al., 2010; Putman et al., 2004; Sielecki, 2001; Groot Bruinderink & Hazebroek, 1996). Therefore, as highlighted by Côté et al. (2004), “there has been a shift from a preoccupation with augmenting population growth (with habitat protection, hunting regulations and predator control) to serious concerns about how best to limit its densities and their impacts”. The most common approach adopted

worldwide to try to reduce ungulate impacts is by reducing regional or local ungulate densities by culling (Reimoser & Putman, 2011). Hunting activity has been used as a strategy of management and containment for regulating the ungulates density and their spatial distribution (Martínez-Jauregui et al., 2016; Andersen et al., 2014; Strand et al., 2012; Hothorn & Müller, 2010), with a consequent increase in culling rates and availability of meat (Avagnina et al., 2012; Ramanzin et al., 2010; Côté et al., 2004).

According to the European trade and safety regulation (Reg. EC No. 854/2004, No. 853/2004 and No. 178/2002), hunters are considered primary producers, such as farmers and breeders, and they can sell the game they harvest. Clearly, as food traders are responsible for the safety of their products and they have to ensure their traceability. The culled meat follows a path similar to the meat from domestic animals, although with some specific characteristics. The initial part of the process is carried out in the hunting area, where the animals are harvested and eviscerated.

Research on venison production and commercialisation in Europe is not developed as in other parts of the world, such as South Africa (Bekker et al., 2011; Hoffman et al., 2004) and New Zealand (Shaldbolt et al., 2008). Therefore, comprehensive statistics data on UE production of large game meat are not available; despite this, in the last European Commission's study about minor meats (EC, 2014), it has been reported that in some Member States, there is a well-established market: in Spain, game production comes mainly from hunting, and in France, about half of game meat processors promote a "Game from French Hunters" brand.

In terms of consumption, the meat of large wild ungulates produced by hunting activity can be considered traditional in Italy (Ramanzin et al., 2010; Avagnina et al., 2012). Indeed, local dishes containing meat from red deer, roe deer, and wild boar are often proposed in the culinary offer of the restaurants of the hilly and mountainous areas of Italy (Demartini et al., 2018). In these areas the total consumption of wild ungulates meat rises significantly, especially in the case of hunters' families (4.0 kg *per capita/year* – Ramanzin et al., 2010).

In recent years, there has been a notable increase in the popularity of hunted wild game meat (Hoffman & Wiklund, 2006; Hoffman, 2013; AC Nielsen, 2016). Indeed, wild game meat, if produced under strict and regulated hunting practices, embeds a number of quality features that may attract modern consumers when purchasing meat products. For instance:

- it is *organic* because wild animals are free-roaming by definition;
- it is a *sustainable and natural* production (low input system) that guarantees the maximum level of animal welfare compared to industrialized production of beef, pork or poultry;
- it can be considered a *local* production “from forest to fork”;
- it possesses *high nutritional quality*, low fat and cholesterol content, a favorable n3:n6 fatty acid ratio and high mineral content.

The sensorial and sanitary quality of the game meat is strictly related to hunting practices, particularly to the hunting method (which has effects on the *pre-mortem* stress experienced by the animals), the training level of the hunter (which ensure accuracy of shooting and one-shot ethical killing of the animal) and post-shot practices such as the evisceration process, carcass field dressing, transportation, storage conditions and slaughtering process. These aspects play a crucial role in the microbiological safety of the meat (Gill, 2007; Atanassova et al., 2008; Ramanzin et al., 2010). Only by following good practices at all stages of processing and the marketing chain can game meat meet international hygiene and food safety requirements and remain high quality food (Atanassova et al., 2008; Demartini et al., 2018).

Currently, the growing demand for Italian consumers is met by the relevant amount of meat imported mainly from Hungary, Austria, Poland, Slovenia, Germany, Spain, the United Kingdom and New Zealand. Most of the imported meat is sold to butchers (73%) and restaurants (22%); only 5% is sold to supermarkets (EC, 2014).

Considering the hypothetical creation of a professional Italian supply chain for the hunted large wild game meat, it can be reasonably said that its development may lead to the following incentives for each of the stakeholders involved:

- *Hunters* can profit from selling their products and thus pay back their hunting activities;
- *Transformers, butchers and restaurateurs* can diversify their production and increase their revenue;
- *Consumers* can find availability of local produced wild ungulates meat;
- *Local institutions* could mitigate the costs of management of wild ungulates' overpopulation and create more environmental and social resilience in local communities, providing a new attraction for the territory.

Considering all these premises, it can be expected that the benefits linked to the development of this type of local supply chain, are likely to overcome the costs required for its implementation and management. Despite the growing potential of this sector in Italy (but also in Europe) only a few economic studies to date discuss the case of wild game meat, and to the best of our knowledge, there is no research examining the Italian context.

1.3. PhD research pathway and steps

The Ph.D research project has been focused on the assessment of the opportunities and limitations connected to the development of a new Italian professional short food supply chain in the field of animal production, namely, the wild game meat supply chain. The results of this study led us to better understand some aspects of the current scenario of the Italian hunted wild game meat sector, with the final aim of understanding if and what types of strategies are implemented for the promotion of its future development.

The goals have been achieved by using a mixed approach that has involved the combination of a quantitative data collection method (such as paper survey, online surveys, face-to-face interviews) and qualitative methods (such as focus groups) according to the objectives, timing and case study and resources/budget constraints.

The research work followed a pathway characterized by three main research phases.

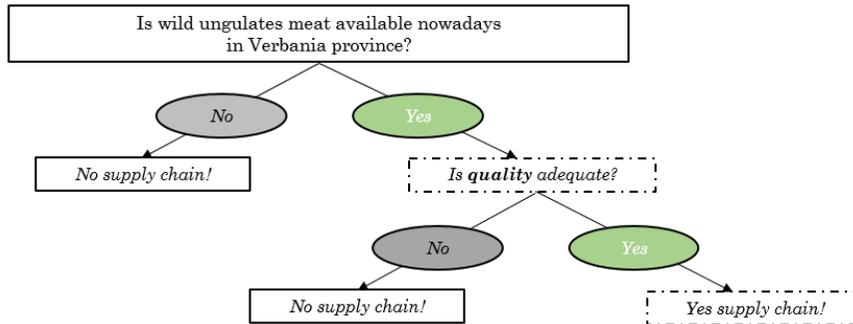
The **first research phase** focused on the implementation of a detailed analysis of a hypothetical game meat supply chain case study. After an in-depth literature review concerning short food supply chains (planning models, management, rural development strategies, market tools), hunted game meat (features, legislative context, market, consumption) and data collection strategies (surveys, focus group, in-depth interviewing), two phases were developed: an exploratory phase and an analytical phase.

The *exploratory phase* involved the analysis of the case study area and the assessment of the potential availability of salable meat and its current quality in the area under study. The identified case study area is located in Verbania-Cusio-Ossola Province (Piedmont, Italy). The province of Verbania-Cusio-Ossola is divided into three Hunting Districts (Comprensori Alpini di Caccia – CAC1), accounting for 157,589 ha of hunting

¹ CACs are local management authorities instituted and regulated by National Law 157/1992 on wildlife safeguard and hunting activity. Among other duties, the Hunting Districts define the dimension of the cull of wild ungulates according to the census, and technical evaluations and National and Regional law provided by public institutions such as Regione Piemonte and ISPRA.

area. Then, the next step focused on the verification of the potential availability of salable meat of wild game and its current quality in the area under study. In fact, it is possible to assume the development of a market only if these two conditions are met (Figure 1.1.).

Figure 1.1. The fundamental conditions for the development of a local game meat market



The information needed to verify these assumptions was collected through paper surveys and face-to-face interviews with a sample of large wild ungulates hunters. On the other hand, the quality of the meat has been estimated by indirect questions about the training level of the hunters, the sanitary attention level and the post-shot practices (treatments on wild game after shooting). The results achieved from this first phase show that the case study area has interesting potential in terms of the amount of salable product (Verbano-Cusio-Ossola's hunting activity is estimated to overcome self-consumption needs for a total volume of 38.7 tons of meat, equal to 387 thousand SINU's portions per year (SINU, 2014). Nonetheless, although Regulations (EC) No. 178/2002, No. 853/2004 and No. 854/2004 allow hunters and producers to create a supply chain and training courses are offered to hunters to improve their skills, wild game meat from Verbania Province still lacks the hygienic and quality standards required for trade. The low education level and the age of hunters surely have an effect on non-adequate behaviors, as the cultural Italian background of the hunting sector probably represents the most important resistance to change. On the other hand, a portion of the interviewees know good hunting and post-harvesting practices; it is thus possible

that hunters' conduct may evolve, and policy-makers and researchers should study the incentives to promote these changes. Positive outcomes could be reinforced by such tactics as being assured that if they apply simple rules when hunting they could enter a market or they will have a safer and better product for their families. Otherwise, the risks associated with their actual behavior could be shown in order to create awareness among hunters.

The *analytical phase* involved the study of the current scenario using group interviews that adopt the "focus group" technique with local experts in the field of hunted wild game meat. The group interview involved six experts in the field. We chose a small focus group ("mini group") mainly because:

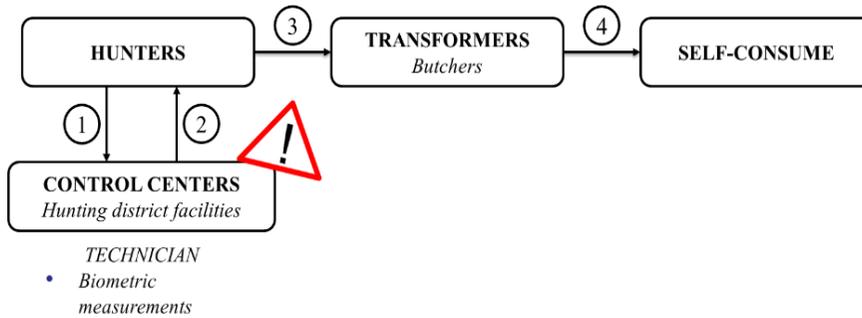
- the topic under study is particularly complex and the respondents should have in-depth knowledge;
- the high level of involvement of the respondents makes them more inclined to expose their opinions and knowledge, so more time is needed for the conversation;
- the moderator as well as the respondents need to pay attention to the discussion; with a small sample (4-6 people), they are more likely to stay focused on the conversation.

A single semi-structured mini-focus group has been used since the six people correspond to the entire target population, namely, all the major experts of the hunting sector of the Verbano Cusio Ossola Province.

During this analytical phase of the research, the stakeholders involved in the hypothetical game meat supply chain have been encouraged to participate in meetings and discussion groups so that a common path may be created for supply chain collaboration and the creation of enterprise networks.

The information collected during the group interviews allowed us to outline the route of the hunted game meat in the current scenario (Figure 1.2.).

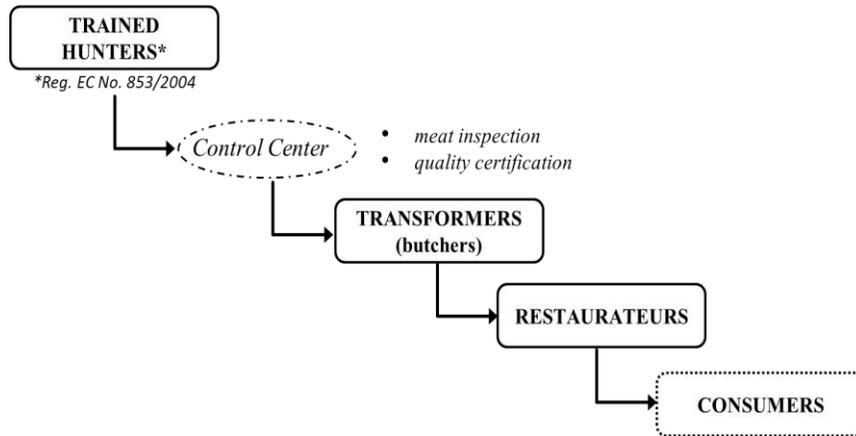
Figure 1.2. The current route of the hunted game meat



Currently, the game harvested by the hunter is brought to the control centers where a technician (not a professional veterinarian) performs a biometric measurement of the carcasses (species, age, weight, gender). There is no meat inspection, and the quality of the meat it is not guaranteed. After the biometric measurement the game is returned to the hunter, who can proceed with the slaughtering and preparation of the meat by himself or leave it to a professional butcher. Generally, the final product is destined for family consumption, with significant amounts of wasted meat. It is clear that the current system needs to be managed.

Figure 1.3. shows the ideal flow sheet of the game meat supply chain. It begins with the trained hunter (Regulation (EC) 853/2004), who by hunting gets the game. The hunter brings the carcass to the control center, where a specialized veterinarian carries out a meat inspection and certifies the quality of the product. Then, the process continues with the transformer, who has the task of working the carcasses to obtain high value-added products. The next step in the chain is the local restaurateur, who proposes local game meat dishes to the final consumer. In this hypothetical flow sheet, the control center plays a crucial role by inspecting the hunted meat and certifying its quality, and it is also important in the education of the hunters who obtain instant feed-back regarding the quality of their meat, which is strictly related to their hunting practices.

Figure 1.3. The ideal flow sheet of the game meat supply chain



Having checked the basic conditions for the development of a market of game meat and completed the phase of supply chain analysis, the **second research phase** focuses on the development of a market analysis and in particular on the estimation of the meat's value transmission in the local supply chain of large wild game meat by the application of revenue accounting analysis. Knowledge of the economic values of the meat can act as a positive lever for stakeholders, contributing to the future development of a successful professional market.

Among the large wild ungulates species that can be hunted in Italy, red deer (*Cervus elaphus*) meat has been chosen as a reference product given its representativeness among European large wild ungulates, its culinary traditional consumption and its potential availability due to population trends in the peninsula and its large size. Moreover, according to the results of the first research phase, in the case study area the species with the highest average value of available meat, accounting for 45.76% (confidence interval 33.4-58.1%), was found to be the deer.

The data needed for the analysis have been collected through in-depth interviews carried out with the stakeholders involved in the supply chain, namely, trained hunters, transformers and restaurant owners. The survey was conducted in the Italian Alpine area of Valle Ossola (Verbania Cusio Ossola province, Piedmont region). The stakeholders were chosen among the restricted number of available experts in the field of the case

study area. Due to the constraints (non-existent supply chain), the final sample consisted of eight people.

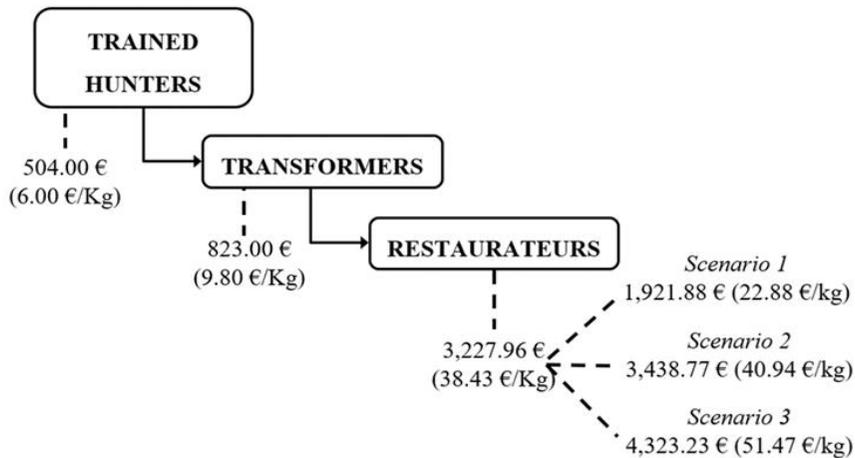
On the basis of the results from the interviews combined with the in-depth literature review concerning value chain analysis in short food supply chains and according to the constraints of the case study, a methodological framework for the economic analysis of the hypothetical wild game meat supply chain has been developed.

The value of red deer meat for each stakeholder have been calculated by considering the path, across the supply chain, of a hypothetical locally hunted red deer. According to the findings of the in-depth interviews, the identified reference product is a male red deer with an average weight of 84 kg. By assuming this, we obtain the average value per kilogram of meat at each step of the chain.

The economic flow sheet of the red deer meat has been carry out by the identification of the values of the meat in any phase of the chain. The final value of the game meat, at the end of the supply chain, corresponds to the price of different dishes of red deer meat at the restaurant. The final results of the study have been shown to the experts in the field (including the same respondents) with the aims of their validation and confirmation.

As schematically shown in Figure 1.4., the value of the deer meat changes for the stakeholders involved, from a starting value of 6.00 €/kg for the hunter, to 9.80 €/kg for the transformer, and reaching a final average value of 38.43 €/kg for the restaurateur. This last value varies considerably depending on the presence of high value-added courses such as tartare and carpaccio in the restaurant menu, ranging from 22.88 €/kg to a maximum value of 51.47 €/kg.

Figure 1.4. Current potential dynamics of the value of the red deer meat supply chain



We can reasonably assume that there will be a redistribution of value across the supply chain with increasing quality of the hunted meat and the establishment of the supply chain with the certification of products with a local brand. The estimated economic value of hunted meat could be an adequate incentive for hunters; to maximise their revenue by procuring a higher quality of meat, they will start to improve their hunting practices.

After the fulfillment of the supply chain and value chain analysis, the **third research phase** of the Ph.D. focuses on consumer-related studies; the final purpose is to explore whether consumers would support a professional supply chain of hunted wild game meat that offers more information to stakeholders to develop products and marketing strategies that effectively target individual consumer needs. More specifically, the PhD research has focused on the consumer choice behavior and demand toward novel foods and pricing decisions using the Discrete Choice experiment methodology, under the supervision of Prof. V. Caputo from the Department of Agricultural, Food and Resource Economics of Michigan State University, expert in the field of consumer behavior in food market research and choice modelling.

This phase of the research began with a learning period based on the book “Applied Choice Analysis – A primer” by

Hensher et al. (2015); with seminars and the summer school session “Discrete Choice Experiments and Data Analysis: Theory and Applications from Introductory to Advanced Models with Case Studies” at Michigan State University; and an in-depth literature review on experimental and behavioral economics.

Therefore, knowledge of consumer food purchase decisions and choice has been applied to the case study involving the novel product red deer meat from the certified Italian hunting supply chain, designing a choice experiment study.

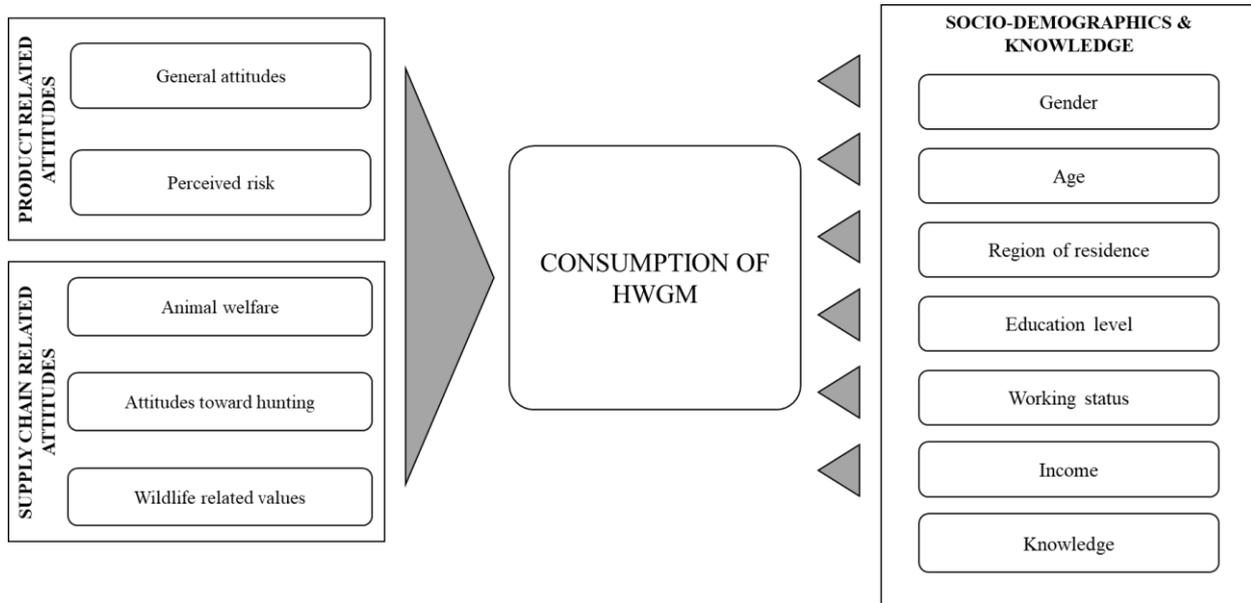
Studying consumer attitudes towards hunted wild game meat assumes an even more crucial role because the economics and marketing literature on hunted wild game meat is still limited. Until now, a comprehensive, specific consumer attitudinal study on hunted wild game meat has not been published. Most of the existing literature devoted to wild game meat consumption has a descriptive connotation and focuses on non-European countries (such as Africa and Australia). Due to the characteristics of this product, the results from these international studies cannot be extended to other geographical contexts, such as Europe.

The data for the analysis were collected through an on-line survey developed using the Qualtrics ® online survey platform. A soft launch with a representative quota sample of 100 random Italian consumers was carried out before the start of the main study. The final goal of this pre-study was to control the data generation and the correct formulation of the questions and to test if the results were suitable for the final purpose of the study. After adjustment, the survey was sent to a random sample of 1059 Italian consumers. The survey data have been reorganized in a data set and checked. After validation, a sample of 1029 respondents was obtained.

Whether a supply chain of hunted wild game meat is economically sustainable depends on whether there is a demand for these products, which in turn depends on how consumers perceive hunted wild game meat-based products. Therefore, the first analysis that has been performed on the consumer survey data has the final aim of (1) segmenting consumers based on their general attitudes towards hunted wild game meat, the perception of its safety, animal welfare, wildlife-related value

orientation, hunting activities, objective knowledge and socio-demographic factors; and (2) assessing whether these general attitudes affect consumer intentions to purchase hunted wild game meat product. Figure 1.5. shows a schematic representation of the variables taken into account in the study.

Figure 1.5. Schematic representation of the variables investigated



The investigated variables were detected with closed-ended questions. More specifically, consumer knowledge has been detected through a series of true/false questions developed based on the literature on the various empirical applications related to the Italian hunted game meat sector mentioned above. Consumer attitudes towards hunted wild game meat products (product-related attitudes and supply chain related attitudes) have been investigated by adopting adapted versions of multi-item scales (Likert scale and semantic differential scale). These implied scales have been developed taking into account previous studies focused on the determinant of the consumption of meat of different animal species.

Survey data were first submitted to a descriptive analysis to provide a synthetic description of the main characteristics of the interviewed sample. Then, after an in-depth study of the literature concerning consumer studies, a non-hierarchical *k*-means cluster analysis was performed to identify groups of consumers with similar attitudes towards hunted wild game meat.

Three different consumer segments were identified: pro-animal consumers, disoriented consumers, and hunted wild game meat eaters. Survey data were first submitted to a descriptive analysis to provide a synthetic description of the main characteristics of the interviewed sample. Through a cluster analysis, three different consumer groups were identified and classified as *pro-animal consumers*, *disoriented consumers* and *hunted wild game meat eaters*. The three groups (clusters) showed significant differences with respect to their socio-demographic characteristics

(gender, educational level and average household income), consumption of hunted wild game meat and their level of objective knowledge.

Findings from this study provide new inputs for the development of a new market for Italian hunted wild game meat, highlighting the existence of an important information asymmetry between consumers and producers (hunters and transformers) that could act as a barrier to consumption. There is a need to better inform and educate citizens about the hunted wild game meat sector, as well as about hunted wild game meat. Consumers need to be informed about European hunting regulations, the role of hunting activities in the management of large wild animal overpopulation, and the impact of the densities of these animals on ecosystems and human activities; on the other hand, consumers need to be aware of all the positive intrinsic features of hunted wild game meat. Only by improving consumers' knowledge about hunted wild game meat is it possible to increase the likelihood of its consumption.

All the results obtained until now provide important inputs for future challenges connected to the creation of a novel labelled game meat product.

The most significant and interesting results obtained from the work performed in the last three years are presented in the present thesis work.

1.4. Aims and structure of the thesis

The present thesis aims to contribute to the possible future development of the Italian local supply chain of wild game meat and is structured as a step-by-step feasibility analysis that takes into consideration all the involved stakeholders with the final goal of the creating this new market. The thesis is organized into three different studies, each developing different aspects of the analysis. The first study is focused on the primary producer of the game meat, namely, the hunter; in addition to the hunter, the second study takes into account the stakeholders involved in the transformation of the meat into the final products, while the third study regards the final consumer of hunted wild game meat.

Specifically, the research questions of each paper were as follows:

Paper 1: How can the potential wild game meat available for the market be quantified? Currently, what is the quality of hunted meat? What is the final destination of the hunted meat? Is it possible to develop a market?

Paper 2: How can the economic value of large wild game meat be estimated? What is the economic value of large wild game meat in Italy? How is this value created and distributed among private stakeholders involved in the supply chain? Is the development of a supply chain for wild game meat economically viable for the stakeholders?

Paper 3: How do consumers perceive wild game meat? Is it possible to identify different consumer segments on the basis of their general attitudes towards hunted wild game meat, knowledge and socio-demographic characteristics? Do these general attitudes and characteristics affect consumer purchase behaviour towards wild game meat products?

1.5. Summary of papers

Paper 1: *The creation of a local supply chain for large wild ungulates meat: Opportunities and limitation from an Italian Alpine case study*

This first study represents the first step in the analysis for the development of a new Italian market for the wild game meat and involve a feasibility study for the assessment of the opportunities and limitations associated with the creation of a supply chain for the meat produced by hunting activities (red deer - *Cervus elaphus*, roe deer - *Capreolus capreolus*, chamois - *Rupicapra rupicapra*, mouflon - *Ovis orientalis*, and wild boar - *Sus scrofa*). Data have been collected through self-compiled questionnaire submitted to hunters participating to the 2014 hunting season in the Italian Alpine area of Verbano and Valle Ossola (North-West Italian Alps). Results of the context analysis give us important inputs for the management of the development of a real market for this meat. Considering our findings, the hunting activity of Valle Ossola presents very interesting characteristics for large wild ungulates meat's market in term of amount. Despite this, on the other hand, wild game meat still lacks the standards required for trade.

Paper 2: *The local value chain of hunted red deer meat: A scenario analysis based on a Northern Italian case study*

The purpose of the study 2 is to assess the real economic value of the local supply chain of hunted wild game meat. In this paper an exploratory analysis that quantifies the value

transmission along the chain by the application of revenue accounting analysis is presented. The analysis has been conducted through a survey based on in-depth interviews with the stakeholders involved in an Italian local supply chain, namely hunters, transformers and restaurateurs from the Italian Alpine area of the Valle Ossola (Piedmont). Findings derived from this study represent the current potential dynamics of the value of Italian hunted game meat across the supply chain, highlighting that the development of a sustainable market of this product could be economically viable for the involved stakeholders.

Paper 3: *Discovering market segments for hunted wild game meat*

Study 3 is focused on the most important element study that each operator should take into consideration: the consumer. In particular, this paper addresses the need to broaden the knowledge on Italian consumer attitudes towards hunted wild game meat and explores whether consumers would support a professional supply chain of hunted wild game meat. In order to identify group of consumers with similar attitudes, a non-hierarchical k -means cluster analysis has been performed. Three different consumers segments have been identified: pro-animals consumers, disoriented consumers and hunted wild game meat eaters. Our findings highlighted the existence of an important information asymmetry between consumers and producers (hunters and transformers) that could act as a barrier to consumption.

References

AC Nielsen (2016) Weighing consumers' growing appetite for "Clean" meat labeling. Fresh Facts historical data, 2011-2015. Insights news, October 2016.

Andersen, O., Wam, H.K., Atle, M., Kaltenborn, B.P. (2014) Applying typology analyses to management issues: Deer harvest and declining hunter numbers. *The Journal of Wildlife Management* 78(7):1282-1292.

Apollonio, M., Andersen, R., Putman, R. (2010) *European ungulates and their management in the 21st Century*. Cambridge University Press.

Atanassova, V., Apelt, J., Reich, F., Klein, G. (2008) Microbiological quality of freshly shot game in Germany. *Meat Science* 78:414-419.

Avagnina, A., Nucera, D., Grassi, M., Ferroglio, E., Dalmasso, A., Civera, T. (2012) The microbiological conditions of carcasses from large game animals in Italy. *Meat Science* 91:266-271.

Banterle, A., Stranieri, S. (2008) The consequences of voluntary traceability system for supply chain relationships. An application of transaction cost economics. *Food Policy* 33(6):560-569.

Bazzani, C., Canavari, M. (2013) Alternative Agri-Food Networks and Short Food Supply Chains: a review of the literature. *Economia agro-alimentare* 2:11.34.

Bazzani, C., Canavari, M. (2017) Is local a matter of food miles or food traditions?. *Italian Journal of Food Science*. 3:1120-1770.

Bekker, J.L., Hoffman, L.C., Jooste, P.J. (2011). Knowledge of stakeholders in the game meat industry and its effect on compliance with food safety standards. *International Journal of Environmental Health Research*, 1-23, First published on 12 May 2011.

Brunori, G., Rossi, A. (2007) Differentiating countryside: Social representations and governance patterns in rural areas with high school density: The case of Chianti, Italy. *Journal of Rural Studies* 23(2):183-205.

Bureš, D., Bartoň, L., Kotrba, R., Hakl, J. (2014) Quality attributes and composition of meat from red deer (*Cervus elaphus*), fallow deer (*Dama dama*) and Aberdeen Angus and Holstein cattle (*Bos taurus*). *Journal of the Science of Food and Agriculture* 95:2299-2306.

Carpio, A. J., Oteros, J., Lora, A. (2015) Effects of the overabundance of wild ungulates on natural grassland in Southern Spain. *Agroforest Systems* 89(4):637-644.

Ciabò, S., Fabrizio, M., & Ecoview Studio Associato (2012). *Linee guida per la prevenzione di incidenti stradali causati da fauna selvatica nella Provincia di Pescara*. Provincia di Pescara.

Côté, S.D., Rooney, T.P., Tremblay, J.P., Dussault, C., Waller, D.M. (2004) Ecological impacts of deer overabundance. *Annual Review of Ecology, Evolution, and Systematics* 35:113-47.

De Marchi, E., Caputo, V., Nayga, R.M., Banterle, A. (2016) Time preferences and food choices: Evidence from a choice experiment. *Food Policy* 62:99-109.

Demartini, E., Vecchiato, D., Tempesta, T., Gaviglio, A., Viganò, R. (2018) Consumer preferences for red deer meat: a

discrete choice analysis considering attitudes towards wild game meat and hunting. *Meat Science* 146:168-179.

European Commission – Directorate General for Agriculture and Rural Development (2014) Study on mandatory origin labelling for milk, milk used as an ingredient in dairy products, and unprocessed meat other than beef, pig, poultry, and sheep and goat meat. Study Report. Part B – Minor Meats. September 2014. LEI Wageningen UR.

Fernández-Ferrín, P., Calvo-Turrientes, A., Bande, B., Artaraz-Miñón, M., Galán-Ladero, M. (2018) The valuation and purchase of food products that combine local, regional and traditional features: the influence of consumer ethnocentrism. *Food Quality and Preferences* 64:138-147.

Ferroglio, E. & Vicente, J. (2011) Wild ungulate diseases and the risk for livestock and public health. *Ungulate Management in Europe: Problems and Practices*. Cambridge University Press, Cambridge, 192-214.

Filippini, R., Marracini, E., Houdart, M., Bonari, E., Lardon, S. (2016) Food production for the city: hybridization of farmers' strategies between alternative and conventional food chains. *Agroecology and Sustainable Food Systems* 40(10):1058-1084.

Filippini, R., Marraccini, E., Lardon, S., Bonari (2014) Assessing food production capacity of farms in periurban areas. *Italian Journal of Agronomy* 9 (2), 63-70.

Fondse, M., Wubben, E., Korstee, H., Pascucci, S. (2012) The economic organization of Short Supply Chains. Paper prepared for the 126th EAAE Seminar “New challenges for

EU agricultural sector and rural areas. Which role for public policy?" Capri (Italy), June 27-29, 2012.

Galli, F., Brunori, G. (2013) Short Food Supply Chains as drivers of sustainable development. Evidence Document. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287). Laboratorio di studi rurali Sismondi.

Giampietri, E., Finco, A., Del Giudice, T. (2015) Exploring consumers' attitude towards purchasing in short food supply chains. *Quality – Access to Success* 16(S1):135-141.

Giampietri, E., Verneau, F., Del Giudice, T., Carfora, V., Finco, A. (2018) A theory of planned behaviour perspective for investigating the role of trust in consumer purchasing decision related to short food supply chains. *Food Quality and Preference* 64:160-166.

Gill, R. M. A., Beardall, V. (2001) The impact of deer on woodlands: the effects of browsing and seed dispersal on vegetation structure and composition. *Forestry* 74(3):209-218.

Gill, C.O. (2007) Microbiological conditions of meat from large game animals and birds. *Meat Science* 77:149-160.

Goodman, D. (2004) Rural Europe Redux? Reflections on alternative agro-food networks and paradigm change. *Sociologia ruralis* 44(1):3-16.

Gortázar, C., Ferroglio, E., Höffle, U., Frölich, K., Vicente, J. (2007) Diseases shared between wildlife and livestock: a European perspective. *European Journal of Wildlife Research* 53:241.

Groot Bruinderink, G.W.T.A., Hazebroek, E. (1996) Ungulate traffic collisions in Europe. *Conservation Biology* 4(10):1059-1067.

Hensher, D.A.; Rose, J.M.; Greene, W.H. (2015) *Applied Choice Analysis – Second Edition*.

Hoffman, L.C., Muller, M., Schutte, D.W., Crafford, K. (2004). The retail of South African game meat: current trade and marketing trends. *South African Journal of Wildlife Research* 34(2):123-134.

Hoffman, L.C., Wiklund, E. (2006) Game and venison: meat for the modern consumer. *Meat Science* 74:197-208.

Hoffman, L.C. (2013) Producing game meat to meet the International hygiene and food safety requirements in the bush. American Meat Science Association, 66th Annual Reciprocal Meat Conference (RMC) Auburn University, Auburn, ALA.

Hothorn, T., Müller, J. (2010) Large-scale reduction of ungulate browsing by managed sport hunting. *Forest Ecology and Management* 260(9):1416–1423.

ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) Italian National Institute for Environmental Protection and Research (2013) *Linee Guida per la gestione degli Ungulati*. ISPRA, 91/2013, 1-225.

King, L. (2007) Consumer attitudes about local foods. Home Grown Economy: Food from local farms as an economic development tool conference, University of Minnesota, Morris, Apr. 2007.

Langbein, J., Putman, R., Pokorny, B. (2010) Traffic collisions involving deer and other ungulates in Europe and available measures for mitigation. *Ungulate management in*

Europe: problems and practices. Cambridge University Press 215-259.

Marsden, T., Banks, J., Bristow, G. (2000) Food Supply Chain Approaches: exploring their role in rural development. *Sociologia Ruralis* 40(4):424-438.

Martínez-Jauregui, M., Herruzo, A.C., Campos, P., Soliño, M. (2016) Shedding light on the self-consumption value of recreational hunting in European Mediterranean forests. *Forest Policy and Economics* 69:83-89.

Matopoulos, A., Vlachopoulou, M., Manthou, V., Manos, B. (2007) A conceptual framework for supply chain collaboration: empirical evidence from the agri-food industry. *Supply Chain Management: An International Journal* 12:177-186.

Mentzer, J.T., Min, S., Zacharia, Z.G. (2000) The nature of interfirm partnering in supply chain management. *Journal Of Retailing* 76:549-568.

Motta, R. (2003) Ungulate impact on rowan (*Sorbus aucuparia* L.) and Norway spruce (*Picea abies* (L.) Karst.) height structure in mountain forests in the eastern Italian Alps. *Forest Ecology and Management* 181:139-150.

Putman, R.J, Langbein, J. and Staines, B.W (2004) Deer and Road Traffic Accidents: A review of Mitigation Measures: Costs and Cost-effectiveness. Contract report RP23A. Inverness, UK: Deer Commission, Inverness, Scotland.

Ramanzin, M., Amici, A., Casoli, C., Esposito, L., Lupi, P., Marsico, G., Mattiello, S., Olivieri, O., Ponzetta, M.P., Russo, C., Trabalza Marinucci, M. (2010) Meat from wild

ungulates: ensuring quality and hygiene of an increasing resource. *Italian Journal of Animal Science* 9(61):318–331.

Reimoser, F., Putman, R. (2011) Impacts of wild ungulates on vegetation: costs and benefits. *Ungulate Management in Europe: problems and Practices*, eds. Rory Putman, Marco Apollonio and Reidar Andersen. Published by Cambridge University Press, 2011.

Renting, H., Marsden, T., Banks, J. (2003) Understanding alternative food networks: exploring the role of short supply chains in rural development. *Environment and Planning* 35(3):393–411.

Santini, F., Paloma, S.G. (2013) *Short Food Supply Chains and Local Food Systems in the EU: a state of play of their socio-economic characteristics*. Publications Office.

Schley, L. and Roper, T.J. (2003) Diet of wild boar *Sus scrofa* in Western Europe, with particular reference to consumption of agricultural crops. *Mammal Review* 33:43–56.

Seyfang, G. (2006) Ecological citizenship and sustainable consumption: Examining local organic food networks. *Journal of rural studies* 22(4):383-395.

Shaldbolt, N.M., McDermott, A., Williams, C., Payne, T., Walters, D., Xu, Y. (2008) The key elements of success and failure in the New Zealand venison industry. Research Report No. 312. Lincoln University, Christchurch New Zealand.

Sielecki, L. E. (2001) Evaluating the effectiveness of wildlife accident mitigation installations with the Wildlife Accident Reporting System (WARS) in British Columbia. Road Ecology Center.

Simpson, V.R. (2002) Wild animals as reservoirs of infectious diseases in the UK. *Veterinary Journal* 163:128–146.

Sims, R. (2009) Food, place and authenticity: local food and the sustainable tourism experience. *Journal of Sustainable tourism* 17(3):321-336.

SINU (2014) Standard quantitative delle porzioni. LARN - Livelli di Assunzione di Riferimento di Nutrienti ed energia per la popolazione italiana, IV Revisione. SICS Editore, Roma.

Steenkamp, J.E.M. (1997) Dynamics in consumer behaviour with respect to agricultural and food products. In: Wierenga, B., Van Tilburg, A., Grunert, K., Steenkamp, J.E.M., Wedel, M. (Eds.) *Agricultural marketing and consumer behaviour in a changing world* (pp. 143-188). Boston: Kluwer Academic Publishers.

Strand, O., Nilsen, E.B., Solberg, E.J., Linnell, J.D.C. (2012) Can management regulate the population size of wild reindeer (*Rangifer tarandus*) through harvest?. *Canadian Journal of Zoology* 90:163-171.

Wildauer, L. & Reimoser, F. (2007) Wild boar (*Sus scrofa*) damage in agriculture: relation between farmers and hunters in past and present. XXVIIIth International Union of Game Biologists Congress, Uppsala, Sweden, 225.

Winkelmayer, R., Stangl, P. V., & Paulsen, P. (2011) Assurance of food safety along the game meat production chain: inspection of meat from wild game and education of official veterinarians and 'trained persons' in Austria. *Game meat hygiene in focus: Microbiology, epidemiology, risk*

analysis and quality assurance, 245-258. Wageningen Academic Publishers - Wageningen.

Zamoral, R., Gomez, J. M., Hodar, J. A., Castro, J., Garcia, D. (2001). Effect of browsing by ungulates on sapling growth of Scots pine in a Mediterranean environment: consequences for forest regeneration. *Forest Ecology and Management* 144(1-3):33-42.

“Everything in excess is opposed to nature”

Hippocrates

CHAPTER 2

The creation of a local supply chain for large wild ungulates meat: Opportunities and limitation from an Italian Alpine case study

Gaviglio, A.¹, Demartini, E.¹, Marescotti, M.E.¹

Quality – Access to Success (2017), 18(S2)

¹ Department of Health, Animal Science and Food Safety - University of Milan

Abstract

In the last decades Italian populations of large wild ungulates increased. Management and containment strategies aimed at preventing overpopulation have been proposed, with a consequent increase of culling and availability of game meat. The present research focuses on

the opportunities and limitations associated with the creation of a supply chain for the meat produced by hunting activities of red deer - *Cervus elaphus*, roe deer - *Capreolus capreolus*, chamois - *Rupicapra rupicapra*, mouflon - *Ovis orientalis*, and wild boar - *Sus scrofa*. Data have been collected through self-compiled questionnaire submitted to hunters participating to the 2014 hunting season in the Italian Alpine area of Verbano and Val D'Ossola North-West Italian Alps. Results suggest that Italian large wild ungulates lacks the requirements for trade, nonetheless some adjustments are proposed in order to promote and support a local supply chain for this type of product.

Keywords: Large wild ungulates, game meat, short food supply chain, mountainous food products, hunting, local food

2.1. Introduction

Despite the rapid growth in the population of large wild ungulates (Ramanzin et al, 2010) such as red deer - *Cervus elaphus*, roe deer - *Capreolus capreolus*, chamois - *Rupicapra rupicapra*, wild boar - *Sus scrofa* and (in some cases) mouflon - *Ovis orientalis* and the Italian predisposition for high quality and local food production, there is no food supply chain for hunted game in Italian mountainous areas. Numerous economic, social and environmental factors (see review in the next paragraph) suggest that selling this product would therefore be recommended in certain cases, and the presence of an established market for hunted meat in the French, Austrian and Slovenian Alps confirms that such a practice could be imported to Italy. Nonetheless, proposing and supporting a new food supply chain is not easy by definition. It involves the committed participation of multiple stakeholders in the creation of an economic activity, which may be profitable but assuming a certain degree of risk.

Firstly, hunting activity cannot be compared with conventional food production in terms of standardization of processes; in this sense it is objectively difficult for hunters to comply with hygienic requirements for the food trade unless strong incentives are introduced for their training (or strong disincentives for those who do not participate in training activities). Therefore, on the producers' side, until hunters can prove the safety of the meat they produce, it is to be expected that food manufacturers will not participate

in the supply chain because of the reputational risks they would have to assume when buying unconventional meat.

Secondly, animal rights activists (Daigle et al, 2002) and, perhaps, some groups of consumers, could consider hunting activity unacceptable. Consequently, because of a lack of social desirability, policy-makers could discourage the development of this food supply chain, and hunters and producers could be dissuaded from participating in it. Finally, the legal environment has to be considered.

With regard to the Italian context, the European Regulations (EC) No. 178/2002, No. 853/2004 and No. 854/2004 establish that hunters, producers, sellers and public or private authorities are responsible for wild game meat traceability and safety for human consumption (Bertolini et al, 2005; Scari et al, 2009), but a national/regional clear and applicable juridical framework is yet to be proposed.

Building on these premises, the present article contributes to the literature by presenting the results of a survey based on a self-compiled questionnaire regarding the hunting habits of a sample of Italian hunters practising their activity in an Alpine area. The results cannot be considered representative for the all Italian mountainous regions, nonetheless they represent the first attempt to assess the opportunities and risks for a short food supply chain at local community level for wild ungulate meat. The findings will be helpful for researchers in the field of economics and food hygiene topics related to wild game and for those stakeholders interested in managing hunting activity. Thus, the research seems to be relevant at both scientific and

practical level, proposing a new interpretive and operative option for the economic and environmentally sustainable development of Italian (and other) mountain areas.

2.2. Opportunities and risks related to a supply chain for hunted large wild ungulates meat

The scientific literature is still lacking in research studies focused on the supply chain of large wild ungulate meat. While some papers discuss this issue (Wiklund et al., 2003; Piasentier et al, 2005; Hoffman and Wiklund, 2009), a strictly economic study has not been developed yet, although in the last decade this product showed interesting characteristics in terms of market performance (Ramanzin et al, 2010). In this sense, the Italian situation is particularly interesting; in fact, the local hunting activity does not satisfy domestic demand in terms of both product quality and quantity even if the populations of wild ungulates are growing especially in the Alpine and Apennine areas. As a result, the demand of Italian consumers' is met by a corresponding amount of meat imported mainly from Poland, Austria, Hungary and Slovenia, among the European manufacturers, or New Zealand, USA and Australia among non-EU Countries (Bertolini et al, 2005). Despite the Italian large wild ungulate harvesting having evolved towards a sport activity rather than a professional food supply chain, some factors suggest that stakeholders' efforts to develop it would be justified. In fact, the predictable economic, social and environmental benefits are likely to overcome the costs of organizing such a market structure. Indeed, according to

classical economic theory, the market is the best tool for the allocation of resources. Profit- and utility-driven choices are most of the time efficient in terms of organizing multiple and complex networks between producers and consumers of goods. Nonetheless, the presence of possible market failures must be considered, and are worth being discussed. The following points focus on these dimensions and provide a brief thematic review.

2.2.1. Economic benefits and costs

The economics benefits of a large wild ungulates meat supply chain are represented by the foreseeable profit deriving from selling these products to consumers. Due to the request of wild ungulates meat, its optimal nutritional characteristics (Ramanzin et al., 2010) and the feasibility of a microbiologically safe production (Membré et al., 2011; Laaksonen and Paulsen, 2015), is undeniable that consumers would accept to pay for game meat. Thus, the real opportunity of paying back their hunting activity and diversifying the production can be rationally considered positive levers for hunters and producers to entry this market, respecting the legal framework at the lowest costs for society.

If the direct economic benefit for primary stakeholders are straightforward (i.e. availability of local produced meat for consumers and income growth for hunters and producers), the assessment of indirect economic benefits and costs of this market is difficult. Researchers state that as game harvesting increases, the costs of conflicts between

wild animal and traditional mountain economic activities decrease (Hester et al., 1998; Lavina, 2010). Moreover, as wild ungulates meat is processed as domesticated species meat (Hoffman and Wiklund, 2006) and the harvest activity directed to produce meat for a food supply chain does not seem different from normal one, private investments for specific industrial plants or new hunting apparels can be considered irrelevant. On the contrary, fixed costs for hunters and producers activity training must be contemplated in order to guarantee high standard quality products and public costs for specific sanitary monitoring plans, too.

2.2.2. Social benefits and costs

Considering the development of a local supply chain for wild ungulates meat, the social benefits and costs are probably the most interesting issues. On one hand, the growth of a profitable activity should be accounted as positive for any territory, especially in mountainous areas for the potential of economic recovery. On the other hand, as markets are attractive, new players could try to participate in hunting activity, generating conflicts between stakeholders and risks for consumers if not fully controlled (Willebrand, 2009).

The literature suggests that communities would benefit a wild ungulate supply chain by the increase of touristic activity (Hoffman et al., 2005; Willebrand 2009) and the reduction of the overpopulation of wild animal which cause car accidents (Langbein et al., 2010; Malo et al., 2004;

Sielecki, 2001) and domesticated animal health problems, due to the spreading of eradicated diseases and zoonoses (Gortázar et al., 2007). However, Institutions need to invest in order to manage a fair development of the hunting activity. Possible conflicts between animal rightists and hunters (Daigle et al., 2002) must be prevented; in this sense, the opportunity of local-sounding labelling should be carefully evaluated. In fact, as local production is likely to be preferred by consumers (Gaviglio and Demartini, 2009; Vianelli et al., 2012; Gaviglio et al., 2014) the risks connected to adverse political ideologies represents a relevant potential social cost.

2.2.3. Environmental benefits and costs

The discussion on the environmental benefits and costs of wild ungulates hunting is awkward. Even if wildlife must be protected, the overpopulation of some species represents a threat for ecosystems (Winkelmayer et al., 2011; ISPRA, 2013) which justifies harvesting practices. As part of the apparent paradox, the solution lies on controlled and planned hunting seasons aimed at preserving the ecologic value of wild animals (Willebrand, 2009), limiting the problems they can cause in the area they live. This specific issue, which may appear irrelevant for some species, can achieve an important dimension in some cases. For example, in the Italian territory wild boar (*Sus scrofa* – Monaco et al., 2007) and Coypu or nutria (*Myocastor coypus* – Cocchi and Riga, 2008) can be considered wild invasive species that cause environmental damage and need to be contained at

economic costs for society. For this reason, an organized marketing activity for wild game meat has been considered a tool for managing environmental conflicts (Thogmartin, 2006; Tisdell, 2013).

All these premises considered, the research focuses on the opportunities and limitations associated with the creation of a supply chain for the meat of large wild ungulates produced by hunting activities in a local mountainous context.

2.3. Research Methodology

The survey was conducted in Verbania province (Piedmont, Italy), collecting information about 145 hunters during three meetings of the Hunting District's members. Data have been collected through self-compiled questionnaire that had been previously explained in a 30-minute training session led by a specialized researcher. Some of the hunters refused to respond or did not conclude the questionnaire; thus, the final sample is a sum of 113 questionnaires, with a ratio of 77.9% of acceptable questionnaires over the 145 totally distributed.

Questionnaire was organized into three sections regarding: (i) socio-demographic profiles of hunters; (ii) quantity and typologies of large wild ungulates shot during last hunting season; (iii) amount of self-consumed and sold game meat; (iv) self-declared post-shot hygienic procedures applied on carcasses, used as estimator of meat quality; (v) hunters' training level; and, (vi) types of culinary meat preparation used by hunters. These six sections allow

measuring the maximum and minimum quantity of wild ungulates meat that could possibly reach the market and estimating different aspects of its quality. Furthermore, the questions about hunters' training and preparation of meat help respectively to assess the required efforts to improve hunting activity, meat processing skill of Hunting District's members, and the consciousness they have about the intrinsic value of wild ungulates meat.

Primary data have been firstly organized and commented by means of descriptive statistics in order to provide a context analysis. Secondly, information about amount and market value of shot game has been elaborated along with carcass mean weight and harvesting season's statistics in order to define strengths and opportunities of the supply chain for local wild meat.

2.3.1. Case study

The study area is located in Verbania province (North-West Italian Alps - 445 Km E, 5,107 Km N) that has an extent of 2,260.91 km² and a population of about 160,883 inhabitants (Istat 2015) with a density of 71.16 inhabitants/km². The area presents a typical Alpine and Prealpine environment; the minimum altitude is 196 m MSL (at Maggiore Lake level) and the maximum altitude is 4.634 m MSL (Monte Rosa). The utilized agricultural area amounts to 165,108.51 ha.

Verbania province is divided into three alpine Hunting Districts (Comprensori Alpini di Caccia – CAC): CAC VCO1 Verbano-Cusio, CAC VCO2 Ossola Nord and CAC VCO3

Ossola Sud (Figure 2.1.) accounting for 157,589 ha of hunting devoted area.

Figure 2.1. Case study: the Verbania province (North-West of Italian Alps)



CACs are local management authorities instituted and regulated by National Law 157/1992 on wildlife safeguard and hunting activity. Among other duties, the Hunting Districts define the dimension of the cull of wild ungulates according to the census, and technical evaluations and National and Regional law provided by public institutions such as Regione Piemonte and the Italian National Institute for Environmental Protection and Research (Istituto Superiore per la Protezione e la Ricerca Ambientale - ISPRA).

In the three Hunting Districts the presence of at least 4,500 chamois, 2,500 roe deer, 2,000 red deer and 100 mouflons is estimated (an estimation of wild boar population is not provided as it is considered widespread in the south-central territories). Considering the season 2014, hunting activity began on 3rd of September and ended on 31st of December with closing periods for some species and/or age classes according to ISPRA instructions (Raganella Pelliccioni et al., 2013) and the Regional hunting calendar. Bovids and cervids hunting is based on the selective cull method which provides the assignment of determined species, age class and sex to each hunter based on previous census. Wild boar is hunted with either selective cull method or hound method. Each hunter can shoot a maximum of six large wild ruminants and five wild boars per year.

As shown in Table 2.1., during 2014 hunting season overall 1,670 hunters shot 3,449 wild ungulates, including 425 red deer, 352 roe deer, 625 chamois, 30 mouflons and 585 wild boars. Furthermore, 1,432 wild boars have been shot during the 2014 cropping plan in order to reduce the population, for a total amount of 2,017 heads.

Table 2.1. Hunting Districts' characteristics and head harvested during the hunting season 2014

Season 2014	VCO1	VCO2	VCO3	Total
	<i>Verbano-Cusio</i>	<i>Ossola Nord</i>	<i>Ossola Sud</i>	
<i>Hunting area - ha</i>	47,288	49,275	61,026	157,589
<i>Hunters - n.</i>	560	440	670	1,670
<i>Heads harvested - n.</i>				
Red deer	30	152	243	425
Roe deer	86	104	162	352
Chamois	108	191	326	625
Mouflon	30	0	0	30
Wild boar	445	25	115	585
Wild boar (cropped)				1,432

2.4. Results and discussion

The elaboration of the socio-demographic characteristics of the sample (Table 2.2.) show that the interviewed hunters are all male, except for three women. The 46.9% of them is more than 51 years old and the average education seems to be low; in fact, the 38.1% of the sample has the Middle School, the 31.9% has an High School and the just the 6.2% has a Bachelor Degree.

Table 2.2. Socio-demographic characteristics of the respondents

Socio-demographic variable	n.	%
<i>Gender</i>		
Male	110	97.35
Female	3	2.65
<i>Age</i>		
< 30	12	10.62
31-40	15	13.27
41-50	24	21.24
51-60	28	24.78
61-70	19	16.81
> 70	6	5.31
Not Declared	9	7.96
<i>Education</i>		
Elementary	8	7.08
Middle School	43	38.05
High School	36	31.86
University Degree	7	6.19
Not Declared	19	16.81
<i>Household size</i>		
1	8	7.08
2	27	23.89
3	28	24.78
4	33	29.20
5+	3	2.65
Not Declared	14	12.39
<i>Number of respondents= 113</i>		

Most of the hunters join the VCO1 – Verbanco-Cusio (39.8%) and VCO2 – Ossola Nord (31.0%), then a residual 13.3% pertains are VCO3 – Ossola Sud members; the 15.9% of the respondents subscribed to two of the three hunting districts (Table 2.3.).

Table 2.3. Respondents hunting district memberships

<i>Hunting District membership</i>	<i>n.</i>	<i>%</i>
VCO1	45	39.82
VCO2	35	30.97
VCO3	15	13.27
VCO1 - VCO2	10	8.85
VCO1 - VCO3	6	5.31
VCO2 - VCO3	2	1.77
<i>Number of respondents= 113</i>		

Then the number of heads harvested during the 2014 hunting season organized by species and hunters has been calculated. Results are presented in Table 2.4..

Table 2.4. Heads harvested by respondents

Large wild ungulates	Calf	Fully-grown	Total	Number of hunters	Heads per hunter	Total heads harvested¹	Representativeness of the sample²
	<i>n.</i>	<i>n.</i>	<i>n.</i>	<i>n.</i>	<i>n.</i>	<i>n.</i>	<i>%</i>
Red deer	13	32	45	29	1.55	425	0.11
Roe deer	15	45	60	38	1.58	352	0.17
Chamois	28	35	63	40	1.58	625	0.10
Mouflon	4	8	12	7	1.71	30	0.40
Wild boar	39	45	84	22	3.82	2,017	0.04
Total (mean)	99	165	264	(27.2)	(2.05)	3,449	0.08

¹See section 2.1; ²The representativeness has been calculated considering the ratio between the harvested heads as declared by respondents over the total heads harvested in VCO1, VCO2 and VCO3.

On the average, every hunter shot at least two heads. The value varies between species; wild boar represents the first species by volume (84 heads, 3.82 heads per hunter), chamois (63 heads, 1.58 heads per hunter), roe deer (60, 1.58 heads per hunter) and red deer (45, 1.55 heads per hunter) follow. Finally, respondents have shot only 12 mouflons (1.71 heads per hunter). In order to evaluate the representativeness of the presented results, these quantities must be compared with the total number of heads harvested in the three hunting districts during the hunting season 2014. Considering the whole, the 12 mouflons represent the 40% and the 60 roe deer represent the 17% of the total; red deer and chamois are less representative and cover the 11% and the 10% respectively of the entire population. The 4% calculated for wild boars is likely to be due to a response bias; in fact, it can be supposed that hunters did not account for wild boars shot during containment plans out of the hunting season, that are included in the number of total harvested heads in 2014.

Table 2.5. shows data related to destination of local large wild ungulates meat.

Table 2.5. Destination of local large wild ungulates meat

Large wild ungulates	Number of hunters	Self-consumed		Donated to relatives/friends		Discarded		Sold to restaurants	
	<i>n.</i>	<i>mean</i>	<i>CI 95%</i>	<i>mean</i>	<i>CI 95%</i>	<i>mean</i>	<i>CI 95%</i>	<i>mean</i>	<i>CI 95%</i>
Red deer	29	54.24	41.9-66.6	32.41	22.8-42.0	6.10	2.2-10.0	7.24	0.7-13.8
Roe deer	38	67.43	57.0-77.9	27.86	18.3-37.5	4.14	0.2-8.1	0.57	0.0-1.7
Chamois	40	70.08	59.7-80.4	22.05	13.6-30.5	5.31	1.3-9.3	2.56	0.0-6.5
Mouflon	7	78.00	49.7-100.0	22.00	0.0-50.3	0.00	-	0.00	-
Wild boar	22	61.71	51.8-71.6	30.29	20.9-39.7	6.03	1.4-10.7	1.97	0.0-6.0
Mean	27.20	66.29	-	26.92	-	4.32	-	2.47	-

Hunters mostly self-consume the meat they produce; indeed, on average the 66.29% of the product is destined for family consumption. The mouflon is the species with the highest average value of meat self-consumed, equal to 78.00%, followed by chamois, with 70.08% of self-consumed meat, roe deer, with 67.43% and wild boar, with 61.71%. The species with the lowest average value of self-consumed meat, accounting for 54.24%, was found to be the deer, probably due to the fact that the deer is the wild ungulate with the greatest mole. Finally, on the average 26.92% of the meat is donated to relatives or friends, the 4.32% discarded, thus indicating a local over-production of product that could enter the market, in front of a small quota of 2.47% of the meat that is actually sold to local restaurants. These data clearly indicate that hunters do not participate into large wild ungulates meat markets even if it would be possible. The behavioral context cannot be fully explained because of the survey design and its main objective, nonetheless at least two explanations may be proposed. Firstly, local hunters may not consider themselves as producers/sellers, thus neglecting the idea that wild ungulates meat is a food product that can enter the market. Secondly, they may be not considered as producers/sellers by buyers (butchers and restaurants), because of the risks connected to selling non-standardized products in terms of hygiene, quality and provision logistic. Probably, both these hypothesis are true and are worth being examined by further studies.

In Table 2.6. the unsold meat and the carcass weight per species (Ramanzin et al., 2010) are used in order to estimate the market availability of local large wild ungulates meat.

The calculated values seem to be economically interesting; the VCO's hunting activity is estimated to overcome self-consumption needs for a total volume of 38.7 tons, equals to 387.3 thousand portions per year (according to SINU recommended portion size, 2014), which could reasonably cover local and touristic demand for wild ungulates meat and, probably, may reach national food market.

Table 2.5. Estimated market availability of local large wild ungulates meat

Large wild ungulates	Estimation parameter		Quantity of meat out-of-the-market						Market availability		
	Total heads harvested ¹	Average carcass weight ²	Donated to friends/relative			Discarded			Volume		
	<i>n.</i>	<i>kg/head</i>	<i>Average %</i>	<i>CI 95% lower</i>	<i>CI 95% upper</i>	<i>Average %</i>	<i>CI 95% lower</i>	<i>CI 95% upper</i>	<i>Average %</i>	<i>CI 95% lower</i>	<i>CI 95% upper</i>
Red deer	425	60.0	32.41	22.8	42.0	6.10	2.2	10.0	9,821.9	6,375.0	13,260.0
Roe deer	352	12.5	27.86	18.3	37.5	4.14	0.2	8.1	1,408.0	814.0	2,006.4
Chamois	625	14.5	22.05	13.6	30.5	5.31	1.3	9.3	2,479.4	1,350.3	3,606.9
Mouflon	30	17.0	22.00	0.0	50.3	0.00	0.0	0.0	112.2	0.0	256.5
Wild boar	2,017	34.0	30.29	20.9	39.7	6.03	1.4	10.7	24,909.9	15,292.9	34,563.3
Total (mean)	3,449	-	(26.92)	-	-	(4.32)	-	-	38,731.4	23,832.2	53,693.1

¹ See Table 1; ²As suggested in Ramazin et al., (2010).

This information needs to be compared with the estimation of meat quality, given by indirect questions about hunters' training level (Figure 2.2.), sanitary attention level (Figure 2.3.) and treatments on wild game after shooting (Table 2.7.).

Figure 2.2. Training level of interviewed hunters

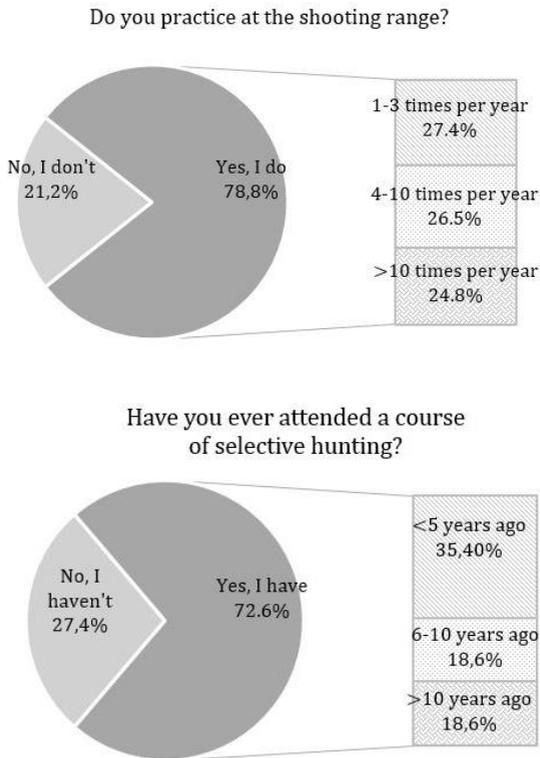
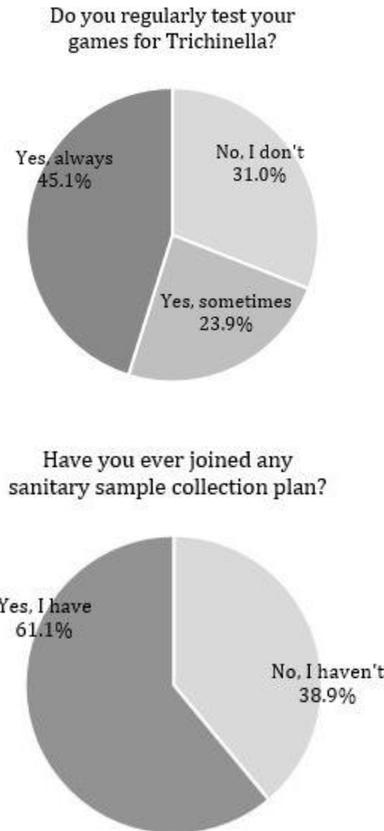


Figure 2.3. Sanitary attention level of interviewed hunters



Probably due to the (low) average education level, the interviewed sample seems to include some untrained hunters. The 21.2% and the 27.4% of the sample do not practice at the shooting range or have never attended a course of selective hunting respectively, and a relevant quota attended the course more than 5 years ago or practice less

than 4 times per year. Not practicing at the shooting range implies the increasing in the probability of imprecise shots admitting the increase of risk for other hunters, and decreasing the chance of one-shot ethical killing of the animal, which would assure a certain quality of the meat (Hoffman and Wiklund, 2006).

Unfortunately, the attention paid to sanitary issues shows even worse statistics: in fact, more than an half of the interviewees do not regularly test their game for *Trichinella* and the 38.9% have never participated to sanitary sample collection plans.

Furthermore, Table 2.7. indicates that treatments of game meat after shooting are incorrect for a relevant part of the sample. The 21.24% and 25.66% of the sample do not bleed or do not disembowel the animal just after shooting respectively. Also maturation practices are sometimes conducted in the wrong way; in fact, 20 hunters declare that they mature the meat less than two days, while 14 of them use cellar or even the garage for maturation. These wrong practices on hunted games, which cause high hygiene hazards (Membré et al., 2011), make the supply chain for wild game meat quite difficult to be created, because of the risks for consumers.

Table 2.7. Wild game treatment after shooting

Treatments after shooting	n.	%
<i>Do you bleed the game just after shooting</i>		
No, I don't	24	21.24
Yes, I do.	89	78.76
<i>When do you disembowel the game?</i>		
Within an hour after shooting	29	25.66
Just after shooting	84	74.34
<i>How long do you mature the game for?</i>		
< 2 days	20	17.70
3-4 days	35	30.97
5-7 days	34	30.09
> 7 days	8	7.08
Not declared	16	14.16
<i>Where does the game mature?</i>		
Cellar	13	11.50
Private refrigerating room	18	15.93
Refrigerating room at a slaughterhouse	54	47.79
Refrigerator	23	20.35
Garage	1	0.88
Not declared	2	1.77
<i>How do you mature the game?</i>		
Skinned (whole or half carcass)	49	43.36
Sectioned carcass	19	16.81
Coated	45	39.82
Number of respondents= 113		

Finally, data on consumption habits of interviewees are presented in Table 2.8. in order to approximate hunters' level of awareness of culinary opportunities offered by local large wild ungulates meat. Elaborations show that most of the hunters consume well-done dishes, while just a little part of them consume raw preparations, such as tartare or

carpaccio. Among cuts, liver and heart of the games can be considered well penetrated in hunters' habits, while kidney is consumed by a third of respondents. On the other hand, the lung, the tongue and the tripe are rarely considered for eating. These findings suggest that hunters ignore the potentiality of their product which goes on the opposite direction of what researchers found on positive consumers' perception of wild game meat (Hoffman and Wiklund, 2006; Ljung et al., 2015) and predisposition to try particular culinary preparation (Cosmina et al., 2012).

Table 2.8. Consumption habits of interviewed hunters

Type of consumption	n.	%
<i>What recipe do you make with wild ungulates meat?</i>		
<u>Well-done</u>		
Gulash	87	76.99
Ragout	78	69.03
Roast	72	63.72
Pot roast	67	59.29
Stew	63	55.75
<u>Medium</u>		
Steak	56	49.56
Roast-beef	30	26.55
<u>Very rare</u>		
Carpaccio	22	19.47
Tartare	13	11.50
<i>Which cuts of wild ungulates do you eat a part of meat's ones?</i>		
Liver	81	71.68
Heart	72	63.72
Kindeg	35	30.97
Lung	19	16.81
Tongue	13	11.50
Tripe	12	10.62
Number of respondents= 113		

2.5. Conclusion

Considering our findings, the hunting activity of Valle Ossola presents very interesting characteristics for large wild ungulates meat's market in term of amount. Nonetheless, despite the Regulations (EC) No. 178/2002, No. 853/2004 and No. 854/2004 allow hunters and producers to create a supply chain and training courses are offered to hunters in order to improve their skills, wild game meat still lacks the standards required for trade. The low education level and the age of hunters surely have an effect on non-adequate behaviors, as the cultural Italian background of hunting sector, probably represents the most important resistance to change. On the other hand, a part of the interviewees knows the good hunting and post-harvesting practices on carcasses; the evolution of hunters' conduct is thus possible and policy-makers and researchers should study the incentives to promote these changes. Levers could act on positive outcomes such as being assured that if they apply simple rules when hunting they could entry a market or they will have a safer and better product to eat for them and their families. Otherwise, the risks associated to their actual behavior could be showed in order to create awareness among hunters.

In a bio-economic sense, an external intervention could act in order to facilitate the transformation of large wild ungulates hunting from a traditional sport activity to a standardized and professional short food supply chain. That could mitigate the costs of mismanaged wild animal

population in mountainous areas, and create more environmental and social resilience in local communities, providing a new attraction for the territory.

Finally, by an analytical point of view, the questionnaire used for the survey showed good capacity of market and context investigation; it allowed to collect information about hunters and their behaviors in performing their activity. The results, which aim to be a first attempt to describe the characteristics of the wild game meat supply chain at local level, give us important inputs for the management of the development of a real market for this meat. On the other hand, some limitations of the study worth being discussed. Firstly, for a correct estimation of shot game meat's quality from actual market needs, a demand analysis (of both transformers and consumers) is essential. Secondly, as stated experiences collect indirect and partly biased measurements of what researchers are interested in, a multidisciplinary approach, introducing microbiological and sanitary data harvested species during the hunting seasons would enhance the survey's reliability and informative capacity.

Acknowledgments

The paper was carried out within the research project “*La Filiera Eco-alimentare. Progetto per la valorizzazione delle carni di selvaggina: la gestione di prodotto sostenibile come strumento di stimolo al miglioramento ambientale dei territori alpini*”. This project has been financed by Fondazione Cariplo, “Bandi Ambiente 2014”. The authors acknowledge the anonymous referees for their comments and suggestions.

References

Avagnina, A., Nucera, D., Grassi, M., Ferroglio, E., Dalmaso, A., Civera, T. (2012) The microbiological conditions of carcasses from large game animals in Italy. *Meat Science* 91:266-271.

Bertolini, R., Zgrablic, G., Cuffolo, E. (2005) Wild game meat: products, market, legislation and processing controls. *Veterinary research communications* 29:97-100.

Cocchi, R., Riga, F. (2008) Control of a coypu *Myocastor coypus* population in northern Italy and management implications. *Italian Journal of Zoology* 75(1):37-42.

Cosmina, M., Demartini, E., Gaviglio, A., Mauracher, C., Prestamburgo, S., Trevisan, G. (2012) Italian consumers' attitudes towards small pelagic fish. *New Medit* 11(1):52-57.

Côté, S. D., Rooney, T. P., Tremblay, J. P., Dussault, C., Waller, D. M. (2004) Ecological impacts of deer overabundance. *Annual Review of Ecology, Evolution, and Systematics* 35:113-47.

Daigle, J. J., Hrubes, D., Ajzen, I. (2002) A comparative study of beliefs, attitudes, and values among hunters, wildlife viewers, and other outdoor recreationists. *Human Dimensions of Wildlife* 7(1):1-19.

Gaviglio, A., Demartini, E. (2009) Consumer attitudes towards farm-raised and wild-caught fish: variables of product perception. *New Medit* 8(3):34-40.

Gaviglio, A., Demartini, E., Mauracher, C., Pirani, A. (2014) Consumer perception of different species and presentation forms of fish: An empirical analysis in Italy. *Food Quality and Preference* 36:33-49.

Gortázar, C., Ferroglio, E., Höffle, U., Frölich, K., Vicente, J. (2007) Diseases shared between wildlife and livestock: a European perspective. *European Journal of Wildlife Research* 53:241.

Hester, A. J., & Baillie, G. J. (1998) Spatial and temporal patterns of heather use by sheep and red deer within natural heather/grass mosaics. *Journal of Applied Ecology* 35(5):772-784.

Hoffman, L.C., Muller, M., Schutte, D. W., Calitz, F. J., Crafford, K. (2005) Consumer expectations, perceptions and purchasing of South African game meat. *South African Journal of Wildlife Research* 35(1):33-42.

Hoffman, L. C., Wiklund, E. (2006) Game and venison – meat for the modern consumer. *Meat Science* 74(1):197-208.

ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) Italian National Institute for Environmental Protection and Research (2013) *Linee Guida per la gestione degli Ungulati*. ISPRA, 91/2013:1-225.

Laaksonen, S., & Paulsen, P. (2015) Hunting hygiene. Wageningen Pers, Wageningen.

Langbein, J., Putman, R., Pokorny, B. (2010) Traffic collisions involving deer and other ungulates in Europe and available measures for mitigation. Ungulate management in Europe: problems and practices. Cambridge University Press, pp 215-259.

Lavina, E. (2010) Rinnovazione forestale e danni da cervidi nella riserva biogenetica "Campo di Mezzo-Pian Parrocchia" (Foresta del Cansiglio). Dissertation, Università degli Studi di Padova.

Ljung, P. E., Riley, S. J., Ericsson, G. (2015) Game meat consumption feeds urban support of traditional use of natural resources. *Society & Natural Resources* 28(6):657-669.

Malo, J. E., Suarez, F., Diez, A. (2004) Can we mitigate animal-vehicle accidents using predictive models?. *Journal of Applied Ecology* 41(4):701-710.

Membré, J. M., Laroche, M., Magras, C. (2011) Assessment of levels of bacterial contamination of large wild game meat in Europe. *Food microbiology* 28(5):1072-1079.

Monaco, A., Carnevali, L., Riga, F., Toso, S. (2007) Il cinghiale sull'arco alpino: status e gestione delle popolazioni. In: Hauffe HC, Crestanello B, Monaco A (Eds.) Il cinghiale sull'arco alpino: status e gestione. Report N. 38, Centro di Ecologia Alpina.

Piasentier, E., Bovolenta, S., Viliani, M. (2005) Wild ungulate farming systems and product quality. *Veterinary research communications* 29:65-70.

Raganella Pelliccioni, E., Riga F, Toso S (2013) Linee guida per la gestione degli ungulati. Cervidi e Bovidi. Italian National Institute for Environmental Protection and Research - ISPRA, Manuali e Linee Guida 91/2013:1-225.

Ramanzin, M., Amici, A., Casoli, C., Esposito, L., Lupi, P., Marsico, G., Mattiello, S., Olivieri, O., Ponzetta, M.P., Russo, C., Trabalza Marinucci, M. (2010) Meat from wild ungulates: ensuring quality and hygiene of an increasing resource. *Italian Journal of Animal Science* 9(61):318–331.

Scari, A., Pelliccioli, L., Fraquelli, C., Viganò, R., Lanfranchi, P. (2009) What possibility of placing on the market wild-game meat? Atti III° Convegno Nazionale di ecopatologia della Fauna Selvatica (SIEF), Torino, 15-17 ottobre 2009.

Sielecki, L. E. (2001) Evaluating the effectiveness of wildlife accident mitigation installations with the Wildlife Accident Reporting System (WARS) in British Columbia. Proceedings of the international conference on ecology and transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, USA.

SINU (2014) Standard quantitative delle porzioni. LARN - Livelli di Assunzione di Riferimento di Nutrienti ed energia per la popolazione italiana, IV Revisione. SICS Editore, Roma.

Thogmartin, W. (2006) Why Not Consider the Commercialization of Deer Harvests?. *Bioscience* 56(12):957-957.

Tisdell, C. A. (2013). Wild pigs: environmental pest or economic resource?. Elsevier Science.

Vianelli, D., De Luca, P., Bortoluzzi, G. (2012) Distribution channel governance and value of 'Made in Italy' products in the Chinese market. In: Bertoli G, Resciniti R (Ed.) International marketing and the country of origin effect, Edward Elgar Publishing Limited, Cheltenham, UK, pp 133-153.

Willebrand, T. (2009) Promoting hunting tourism in north Sweden: opinions of local hunters. *European Journal of Wild-life Research* 55:209-216.

Winkelmayer, R., Stangl, P. V., Paulsen, P. (2011) Assurance of food safety along the game meat production chain: inspection of meat from wild game and education of official veterinarians and 'trained persons' in Austria. *Game meat hygiene in focus*. Wageningen Academic Publishers, Wageningen, pp. 245-258.

CHAPTER 3

The local value chain of hunted red deer meat: A scenario analysis based on a Northern Italian case study

Gaviglio, A.¹, Marescotti, M.E.¹, Demartini, E.¹

Resources (2018), 7(2):34

¹ Department of Health, Animal Science and Food Safety - University of Milan

Abstract

Although in recent decades, meat from hunted wild ungulates has shown interesting results in terms of market opportunities, the scientific literature is still lacking in economic studies concerning the estimation of the meat's value for involved stakeholders. We present an analysis of the evolution of price in the local red deer meat supply chain.

This analysis has been conducted through a survey based on in-depth interviews with the stakeholders involved in an Italian local supply chain.

Findings derived from this study describe a case study, however, they also represent the potential dynamics of the value of Italian game meat, highlighting that the development of a sustainable local supply chain of this product may represent an economic resource for involved stakeholders.

Keywords: Hunting, game meat, wildlife management, supply chain analysis, wildlife values

3.1. Introduction

In recent years, the trends of the population of large wild ungulates (wild boar, red deer, chamois, mouflon) became worrisome for Italy and many European countries. Ironically, while two decades ago these animals were listed as endangered species, they turned out to be a social cost. In fact, their population is growing with damage to ecosystems (Gerhardt et al., 2013; Winkelmayr et al., 2011), economic losses in forestry and agriculture (Apollonio et al., 2010; Zamora et al., 2001), increased risk of zoonotic diseases (Ferroglio & Vicente, 2011) and increased frequency of vehicle collisions (Malo et al., 2004). Due to this overpopulation, management and containment strategies have been developed, with a cost for public institutions and an increase in culling rates, as well as availability of game meat (Avagnina et al., 2012; Ramanzin et al., 2010). Furthermore, according to European trade and safety regulations (Reg. EC No. 178/2002, No. 853/2004 and No. 854/2004), hunters are considered primary food producers (such as farmers and breeders) and, under certain conditions, they can sell the game they harvest. Consumers' willingness to pay for this product is also likely to be positive (Hoffman & Wiklund, 2006). In fact, large wild ungulate meat has optimal nutritional attributes (Bureš et al., 2014) and can be considered an environmentally friendly and local food (Hoffman & Wiklund, 2006).

Given the availability of meat, the legal framework and consumers' preferences, a professional supply chain for hunted game meat has been developed in some European

countries, such as France, Slovenia, Austria, and Scotland (Winkelmayer & Paulsen, 2008). On the other end, despite favourable market environment conditions, the Italian hunting sector continues to have only a recreational and social purpose and the growing demand of Italian consumers is met by a significant amount of imported meat (Bertolini et al., 2005). As reported in research by Gaviglio et al. (2017), Italian hunted meat is mainly consumed by hunters and their acquaintances. Put simply, the empirical evidence suggests that most Italian hunters do not consider themselves as food producers and neglect the idea that game meat can enter the market.

Building on basic microeconomics principles, it is evident that the Italian hunting sector would highly benefit from the creation of a professional supply chain for wild game meat. Indeed, profit and utility-driven choices are mostly efficient in terms of organising multiple and complex networks between producers and consumers of goods. In this sense, the creation of a market for hunted game meat is expected to generate the following positive outcomes by means of the respective economic incentives:

- *Hunters* can gain revenue from selling their game; therefore, to maximise their revenue, they will be interested in achieving a higher quality of meat, which will be possible only by following good hunting practices.
- *Transformers and restaurateurs* can diversify their production and increase their revenue by selling a local product with high value added; therefore, to protect their reputation and obtain a price premium from consumers, they will search for high-quality meat from hunters.

On the other hand, the creation of this new market involves the participation of multiple private and public stakeholders. Studies aimed at estimating the real economic value of this local supply chain (i.e., the expected value of the economic incentives) would greatly contribute to the debate by providing grounded evidence for supporting (or not) this project. Although in recent decades, meat from hunted wild ungulates has shown interesting results in terms of market opportunities and economic benefits (Gaviglio et al., 2017; Bureš et al., 2014), scientific literature is still lacking in research concerning the estimation of revenue for the Italian stakeholders involved in this kind of supply chain. To fill this gap, this paper answers the following research questions:

- What is the economic value of large wild game meat in Italy?
- How is this value created and distributed among the private stakeholders involved in the supply chain?

To answer these questions, we present the results of an exploratory analysis that quantifies the value transmission along a local supply chain of large wild game meat by the application of revenue accounting analysis (Vavra & Goodwin, 2005; Drury, 1992). The research has been carried out through in-depth interviews with the stakeholders involved. The case study discussed in the paper is represented by hunters, transformers, and restaurateurs from the Italian Alpine area of the Valle Ossola (Piedmont, Verbano-Cusio-Ossola, Italy). The results derived from this study allow us to understand the ideal flow sheet and the current potential dynamics of the value of game meat. They

also highlight that the development of a sustainable local supply chain of hunted game meat could be economically interesting for all involved stakeholders as well as their territories.

The remainder of the text is organised into four sections. Section 3.2 presents materials and methods used in the study. Section 3.3 presents the results of the analysis and their discussion, organised into two subsections. Section 3.3.1 shows the flow sheet of the supply chain, while Section 3.3.2 reports the results concerning the value of the meat for each involved stakeholder, namely, hunter (Section 3.3.2.1), transformer (Section 3.3.2.2), and restaurateur (Section 3.3.2.3). Finally, a concluding section offers a summary of the research and discusses its implications under the light of some limitations.

3.2. Materials and methods

The data needed for the analysis of the price transmission were collected in 2016 through in-depth interviews carried out with the stakeholders involved in the supply chain.

In-depth interviews are a useful qualitative and quantitative data collection method that allows the interviewer to deeply explore specific aspects and collect data (Guion et al., 2001). This technique consists of a face-to-face conversation, during which the researcher tries to obtain detailed information on the topic under study. The conversation is led by the interviewer on the basis of a flexible and non-standardised questionnaire scheme

(Corbetta, 1999). The task of the researcher is to ensure that the conversation is focused on the topic and deeply examines important aspects for the object of research (Pani & Sagliaschi, 2006). Therefore, it is clear that the final purpose of this method is not to reach a generalisation of results, but to collect accurate information; for this reason, the number of respondents is not a crucial factor (Guion et al., 2001).

The stakeholders identified for in-depth interviews belong to these groups:

- **Trained hunters**, which are considered by European Regulation (EC) 853/2004 to be primary producers;
- **Transformers**, including the local butchers, which have the skills to process game carcasses;
- **Restaurateurs** that offer game meat dishes.

In some cases, the same respondent belonged to multiple categories of stakeholders. In fact, currently, the supply chain of game meat is frequently represented by a single specialised operator who embodies the roles of all the different stakeholders (i.e., a restaurateur who practises hunting, personally transforms the carcasses, uses them for the preparation of dishes, and then offers the dishes to the consumer). However, it is not a professional supply chain, and there are not well-defined quality standards and parameters.

The stakeholders were chosen among the restricted number of available experts in the field of the area under study (see below). Each in-depth interview lasted about an hour.

Due to the constraints (non-existent supply chain), the final sample consisted of eight people concurrently categorised as three hunters, three local butchers, and five restaurateurs.

A pre-interview questionnaire (differentiated for each of the three groups of stakeholders involved) with the key questions, was sent to each respondent by e-mail few days before the actual interview. During the interviews, data were reported and afterwards analysed systematically to identify any deficiencies or other aspects to be further investigated (Foglia & Vanzago, 2011).

Following Vavra and Goodwin (2005) and Drury (1992), a methodology based on revenue accounting analysis was adopted for the identification of the price transmission along the value chain. This analysis accumulates, classifies, summarises, and reports information that will assist managers in their decision-making (Drury, 1992). According to the methodology, we have identified the stakeholder's revenue at each step of the supply chain's flow sheet. The costs were not taken into account.

Information collected during the interviews allowed us to carry out the **economic flow sheet** of the red deer meat by the identification of the **values of the meat** in any phase of the chain. The final value of the game meat, at the end of the supply chain, corresponds to the price of different dishes of red deer meat at the restaurant.

The survey was conducted in the Italian Alpine area of Valle Ossola, which is located in Piedmont region, in the province of Verbania Cusio Ossola (VCO). The VCO province is divided into three alpine hunting districts (Comprensori

Alpini di Caccia—CAC). The interviewed hunters belonged to the CAC VCO2 Ossola Nord. Among the large wild ungulate species that can be hunted in Italy, red deer (*Cervus elaphus*) meat has been chosen as the reference product for the category in consideration of its representativeness among European large wild ungulates, its traditional culinary consumption, and its potential availability due to their populations' trend in the peninsula and its large size.

In this study, the value of red deer meat for each stakeholder was calculated by considering the path, across the supply chain, of a hypothetical locally-hunted red deer. According to the findings of the in-depth interviews, the identified reference product is a male red deer with an average weight of 84 kg. By assuming this, we obtain the average value per kilogram of meat at each step of the chain.

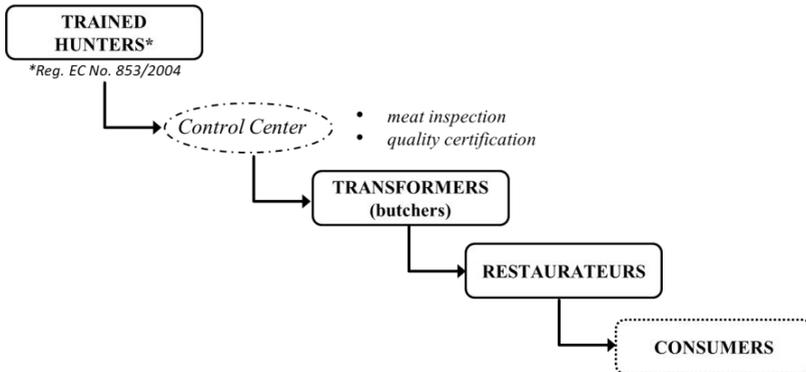
3.3. Results and discussion

3.3.1. Flow sheet and segmentation of the game meat supply chain

As reported in Figure 3.1., the ideal flow sheet of the red deer meat supply chain begins with the trained hunter (Regulation (EC) 853/2004), which through hunting gets the game. The hunter brings the carcass to the control centre, where a veterinarian carries out a meat inspection and certifies the quality of the product. Then, the route of the game continues with the transformer, who will have the task of working the carcasses in order to obtain high value-added

products. The next step in the chain is the local restaurateur, who proposes local game meat dishes to the final consumer.

Figure 3.1. Flow sheet of the red deer meat supply chain.



3.3.2. The value of the meat at each step of the supply chain

3.3.2.1. The value of the meat for the Hunter

Data collection during the in-depth interviews allowed us to identify the value of the red deer meat for the trained hunter.

From the male red deer of reference with the hypothetical weight of 84 kg, the hunter can obtain a total value of 504.00 €. This means that the price at which hunters sell the game meat (and the purchase cost for the transformer) is, on average, 6.00 €/kg. This final value has been confirmed by experts in the field.

The in-depth interviews conducted with hunters highlighted that the costs related to their hunting activity are mainly fixed cost connected to the fee payment (hunting license, regional hunting card, liability insurance, and hunting district registration), equipment purchase (rifle, clothing), and firearms practice activities at shooting ranges. Variable costs change in relation with the number and characteristics of the animals harvested (species, age, gender).

3.3.2.2. The value of the meat for the Transformer

In the revenue accounting analysis of the meat's value for the transformer, we have assumed an ideal meat yield that can be reached only through a maximum enhancement of the red deer carcass, worked in order to obtain high-quality products and without any waste.

Table 3.1 reports meat cuts and their values resulting from the ideal processing of the carcass of the same male red deer with the hypothetical weight of 84 kg considered in the previous section. Data have been identified through examining the information collected during the interviews and wholesale market lists (which are related to imported meat). The quantity of each cut of meat has been specified with its respective value €/kg in order to obtain the total value of each cut.

Through the recovery and reuse of the scraps, the red deer (84 kg) can reach a total value of 823.00 €. This equates to a hypothetical average price of 9.80 €/kg. It is worth noting that these scraps are not currently present on the

wholesalers' lists and, thus, are not available on the market. Therefore, it is an ideal value.

Table 3.1. Meat cuts resulting from the processing of a male red deer (84 kg) and their values.

Meat Cut	Quantity	Value	Cut Value
	(kg)	(€/kg)	(€)
Loin (filets)	2.00	26.00	52.00
Backstrap (chops, roast)	5.00	15.20	76.00
Back leg (bone-in, x 2)	32.00	10.00	320.00
Shoulders (boneless)	6.00	15.00	90.00
Shoulder stew	6.00	7.70	46.20
Shoulder's scrap *	4.00	6.00	24.00
Neck (boneless)	9.00	7.70	69.30
Neck's scrap *	5.00	6.00	30.00
Ribs and scraps	15.00	7.70	115.50
Total	84.00		823.00

** Not currently on the market, hypothetical value*

On the costs side, as large wild ungulate meat is processed as domesticated species meat (Hoffman & Wiklund, 2006), therefore, no additional costs might be considered for transformers except for the attendance of a specific training course focused on wild game meat safety. This training is often free offered by the Local Health Centre (Azienda Sanitaria Locale, "ASL").

3.3.2.3. The value of the meat for the Restaurateurs

Through the in-depth interviews with the restaurateurs, we have found the main game meat dishes offered, the

average portion weight of each dish and the average menu prices.

To identify the value of the red deer for the restaurateur, we have calculated the revenue of each game dish by using the portion weight, the menu prices, and the cost of the cut of meat. The obtained results are schematically shown in Table 3.2.

Table 3.2. Value of the red deer meat for the restaurateur by type of dish.

Dish	Meat Cut	Weight	Gross Revenue (Menu Prices)	Meat Cut Cost	Net Revenue
		(kg/Portion)		(€/Portion)	
Tartare	<i>Stew, scraps (from shoulder and back leg)</i>	0.15	15.00	1.03	13.97
Carpaccio	<i>Shoulder and back leg</i>	0.12	13.00	1.50	11.50
Roast/ Goulash	<i>Shoulder and back leg</i>	0.25	12.00	3.13	8.88
Steak	<i>Backstrap</i>	0.20	16.00	4.12	11.88
Pot roast and polenta	<i>Stew, scraps (from shoulder and back leg)</i>	0.25	12.50	1.76	10.75

It is important to highlight that some dishes are prepared with the same cuts of meat. This is the case of stew and scraps; they can be used to prepare both tartare and pot roast. However, this latter dish has a substantially lower net revenue if compared with the tartare (10.75 €/portion vs. 13.97 €/portion of the tartare). This also occurs for shoulder and back leg, which can be used for the carpaccio (11.50 €/portion) and for roast/goulash (8.88 €/portion).

After this preliminary analysis, the value of the meat has been calculated through the definition of three different selling combination scenarios, outlined by considering the red deer (84 kg) previously used for reference in the other phases. In fact, as previously mentioned, some dishes are prepared with the same cuts. Therefore, the final total hypothetical value of the carcass will change according to the destination of the meat cuts in the courses proposed and then sold to the consumer.

The three identified selling combination scenarios are:

- 1) *Mountain lodge***
- 2) *Mountain restaurant***
- 3) *Innovative restaurant***

In all three scenarios we have assumed an ideal meat yield, therefore, we do not consider the possible presence of meat wasted or discarded.

Scenario 1

The first selling combination scenario is the **mountain lodge**. In this context, the consumer's preference is oriented towards the most popular and traditional courses; thus, the raw meat dishes (tartare and carpaccio) are excluded from the culinary offerings. Therefore, in this case, the shoulder and back leg will be fully destined to the preparation of roast/goulash, and the stew meat and scraps will be fully destined to the preparation pot roast.

As shown in Table 3.3., the final value of the red deer under study at the mountain lodge is **1921.88 €**, equal to **22.88 €/kg**.

Table 3.3. Deer's final value estimation – Mountain lodge

Dish	Meat Cut	Weight	Gross Revenue	Meat Cut Cost	Net Revenue	Portions/ Deer	Net Revenue/ Deer
		(kg/Portion)		(€/Portion)		(n)	(€)
Roast/ Goulash	<i>Shoulder and back leg</i>	0.25	12.00	3.13	8.88	68	603.50
Steak	<i>Backstrap</i>	0.20	16.00	4.12	11.88	35	415.80
Pot roast and polenta	<i>Stew, scraps (from shoulder and back leg)</i>	0.25	12.50	1.76	10.75	84	902.58
Total						187	1921.88

Scenario 2

The second scenario involves a situation typically found in a **mountain restaurant**. In this hypothetical scenario, both traditional and sophisticated courses are offered to the consumer, but the sales of these last dishes (such as tartare and carpaccio) will be less than the sale of roast/goulash and pot roast. This is because the customers are not yet familiar with these raw courses. Therefore, we have assumed that the stew meat and scraps are used for the preparation of both the tartare, as well as pot roast and polenta, with a hypothetical sales ratio between these courses of 1:2 weighted in favour of the pot roast. The same also occurs for the shoulder and back leg, which are utilised for both the carpaccio and roast/goulash (sales ratio 1:2, weighted in favour of the roast/goulash).

Accordingly, to these assumptions, the final value of the carcass at the mountain restaurant is **3438.77 €**, equal to **40.94 €/kg** (Table 3.4).

Table 3.4. Deer's final value estimation – Mountain restaurant.

Dish	Meat Cut	Weight	Gross Revenue	Meat Cut Cost	Net Revenue	Portions/ Deer	Net Revenue/ Deer
		(kg/ Portion)		(€/Portion)		(n)	(€)
Tartare	<i>Stew, scraps</i>	0.15	15.00	1.03	13.97	53	745.20
Carpaccio	<i>Shoulder and back leg</i>	0.12	13.00	1.50	11.50	47	543.06
Roast/ Goulash	<i>Shoulder and back leg</i>	0.25	12.00	3.13	8.88	45	402.33
Steak	<i>Backstrap</i>	0.20	16.00	4.12	11.88	35	415.80
Pot roast and polenta	<i>Stew, scraps</i>	0.25	12.50	1.76	10.75	124	1332.38
Total						305	3438.77

Scenario 3

The third scenario (**innovative restaurant**) involves a situation in which the consumer preferences are oriented towards more sophisticated and expensive gourmet meals, such as tartare and carpaccio. Therefore, in this case, for the estimation of the red deer's final value, it is assumed that the stew meat and scraps will equally be used for both the preparation of tartare and pot roast. Therefore, we have considered equal sales to both of these dishes (sales ratio pot roast vs. tartare 1:1).

As reported in Table 3.5., it is assumed that the final value of the red deer at the innovative restaurant is **4323.23 €**, which equates to **51.47 €/kg**.

It is worth mentioning that these raw dishes can be prepared only from meat of high and guaranteed quality.

Table 3.5. Deer’s final value estimation – Innovative restaurant.

Dish	Meat Cut	Weight	Gross Revenue	Meat Cut Cost	Net Revenue	Portions/ Deer	Net Revenue/ Deer
		(kg/ Portion)		(€/Portion)		(n)	(€)
Tartare	<i>Stew, scraps</i>	0.15	15.00	1.03	13.97	80	1117.80
Carpaccio	<i>Shoulder and back leg</i>	0.12	13.00	1.50	11.50	142	1629.17
Steak	<i>Backstrap</i>	0.20	16.00	4.12	11.88	35	415.80
Pot roast and polenta	<i>Stew, scraps</i>	0.25	12.50	1.76	10.75	108	1160.46
Total						365	4323.23

Thus, the final hypothetical value of the locally hunted male red deer weighing of 84 kg varies considerably according to the dishes proposed in the restaurant menu, ranging from 1921.88 € (22.88 €/kg) of the mountain lodge in Scenario 1, increasing to 3438.77 € (40.94 €/kg) of the mountain restaurant in Scenario 2, up to a maximum value of 4323.23 € (51.47 €/kg) of the innovative restaurant in Scenario 3. Therefore, on average, the value of the red deer for the restaurateur is **3227.96 €**, equal to **38.43 €/kg** (Table 3.6.).

Table 3.6. Value of the red deer meat for the restaurateur in the three hypothetical selling combination scenario.

Dish	Meat Cut	Mountain Lodge (1)	Mountain Restaurant (2)	Innovative Restaurant (3)
		HYPOTHETICAL Net Revenue/Deer		
(€)				
Tartare	<i>Stew, scraps (from shoulder and back leg)</i>	-	745.20	1117.80
Carpaccio	<i>Shoulder and back leg</i>	-	543.06	1629.17
Roast/ Goulash	<i>Shoulder and back leg</i>	603.50	402.33	-
Steak	<i>Backstrap</i>	415.80	415.80	415.80
Pot roast and polenta	<i>Stew, scraps (from shoulder and back leg)</i>	902.58	1332.38	1160.46
Total (€)		1921.88	3438.77	4323.23
(€/kg)		22.88	40.94	51.47

3.4. Conclusions

Although in recent decades, hunted game meat has shown interesting results in terms of economic potential, scientific literature is still lacking in research concerning the estimation of the revenue for Italian stakeholders involved in this kind of supply chain. To fill the present gap, this paper aimed at estimating the price distribution among the private stakeholders involved in a local supply chain of hunted red deer meat. The presented case study is represented by hunters, transformers, and restaurateurs from the Italian Alpine area of the Valle Ossola (Piedmont, Verbano-Cusio-Ossola, Italy).

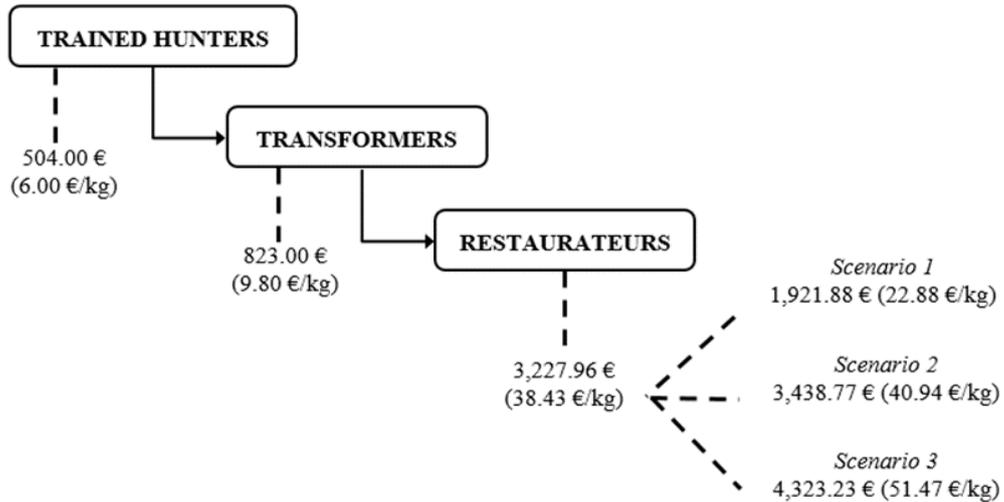
Following the revenue accounting analysis theory (Vavra & Goodwin, 2005; Drury, 1992), we have identified:

- the flow sheet of the supply chain with the involved stakeholders; and
- the stakeholders' revenue at each step of the supply chain.

3.4.1. What is the economic value of the large wild game meat in Italy?

As schematically shown in Figure 3.2., the value of the deer meat changes for the stakeholders involved, from a starting value of 6.00 €/kg for the hunter, to 9.80 €/kg for the transformer, and reaching a final average value of 38.43 €/kg for the restaurateur. This last value varies considerably depending on the presence of high value-added courses, such as tartare and carpaccio, in the restaurant menu.

Figure 3.2. Current potential dynamics of the value of the red deer meat supply chain.



3.4.2. How this value is created and distributed among the private stakeholders involved in the supply chain?

The elaborations of the data collected from experts in the field show that the value of the red deer meat is considerably increasing across the supply chain (Figure 3.2.), from 6.00 €/kg for the hunter to a maximum of 51.47 €/kg for the restaurateurs. We can reasonably assume that there will be a redistribution of the value across the supply chain with an increasing quality of the hunted meat and the establishment of the supply chain with the certification of the products with a local brand.

The present results assume relevance in relation to the current condition of the Italian hunting sector, which faces a lack of a professional supply chain of hunted game meat mainly due to hunters, who do not consider themselves as food producers and neglect the idea that game meat can enter the market (Gaviglio et al., 2017). The estimated economic value of hunted meat could be an adequate incentive for the hunters which, in order to maximise their revenue by the achievement of a higher quality of the meat, will start to follow good hunting practices.

Despite the findings described in this paper were derived from a single case study, the present research constitutes the only available benchmark for Italian hunted game meat and suggests that the development of a sustainable local supply chain of this product may represent an economic resource for the involved private and public stakeholders.

From the environmental and ethical points of view, the present paper promotes a sustainable management of large wild ungulates, which means that hunting activity must be conducted under well-defined culling plans, which guarantees the respect of the environment, assures control over wild ungulate populations, and the respect of wild animals.

Finally, the study limitations are worth mentioning. While the research provides original estimates of the value of large wild ungulate game meat, the costs have not been taken into consideration; consequently, it is not possible to calculate the expected profit for each stakeholder. In this sense, the differences in prices seen from hunters to restaurateurs may be perceived as higher than the actual differences in profit. Unfortunately, there is no information on the cost side of this supply chain, which might be considered a shortcoming of this paper. However, a reliable cost analysis would have required analytical accountancy tools different from in-depth interviewees. Due to budget constraints, we had to restrict the analysis to revenues only. Underlining that no strong, neither final, results can be inferred from the available data, we still consider our contribution relevant for Italian hunting sector management because the market prices are always important for private stakeholders when deciding whether to enter the market, as well as for public institutions when planning policy interventions.

Acknowledgments

The paper was carried out within the research project “*La Filiera Eco-alimentare. Progetto per la valorizzazione delle carni di selvaggina: la gestione di prodotto sostenibile come strumento di stimolo al miglioramento ambientale dei territori alpini*”. This project has been financed by Fondazione Cariplo, “Bandi Ambiente 2014”. The authors acknowledge the two anonymous referees and the Editor for their constructive comments and helpful suggestions.

References

Apollonio, M., Andersen, R., Putman, R. (2010) European ungulates and their management in the 21st century. First edition. Cambridge University Press, New York. New York, USA.

Avagnina, A., Nucera, D., Grassi, M., Ferroglio, E., Dalmaso, A., Civera, T. (2012) The microbiological conditions of carcasses from large game animals in Italy. *Meat Science* 91:266-271.

Bertolini, R., Zgrablic, G., Cuffolo, E. (2005) Wild game meat: products, market, legislation and processing controls. *Veterinary research communications* 29:97-100.

Bureš, D., Bartoň, L., Kotrba, R., Hakl, J. (2014) Quality attributes and composition of meat from red deer (*Cervus elaphus*), fallow deer (*Dama dama*) and Aberdeen Angus and Holstein cattle (*Bos taurus*). *Journal of the Science of Food and Agriculture* 95:2299-2306.

Corbetta, P. (1999) *Metodologia e tecniche della ricerca sociale*; Il Mulino: Bologna, Italy.

Côté, S.D., Rooney, T.P., Tremblay, J.P., Dussault, C., Waller, D.M. (2004) Ecological impacts of deer overabundance. *Annual Review of Ecology, Evolution, and Systematics* 35:113-47.

Drury, C. (1992) *Management and Cost Accounting*. Third Edition. The Chapman & Hall: London, UK.

Ferroglio, E., & Vicente, J. (2011) Wild ungulate diseases and the risk for livestock and public health. *Ungulate Management in Europe: Problems and Practices*. Cambridge University Press, New York, 192-214. New York, USA.

Foglia, E. & Vanzago, A. (2011) *Metodologia e metodi della Ricerca Qualitativa*. Centro di Ricerca in Economia e Management in Sanità e nel Sociale; Università Carlo Cattaneo – LIUC: Castellanza (VA), Italy.

Gaviglio, A., Demartini, E., Marescotti, M.E. (2017) The creation of a local supply chain for large wild ungulates meat: Opportunities and limitation from an Italian alpine case study. *Calitatea – Access la Succes* 18(2):215-222.

Gerhardt, P., Arnold, J.M., Hackländer, K., Hochbichler, E. (2013) Determinants of deer impact in European forests – a systematic literature analysis. *Ecol Manag* 310:173-186.

Giampietri, E., Verneau, F., Del Giudice, T., Carfora, V., Finco, A. (2018) A Theory of Planned behaviour perspective for investigating the role of trust in consumer purchasing decision related to short food supply chains. *Food Quality and Preferences* 64:160-166.

Gill, R.M.A., & Beardall, V. (2001) The impact of deer on woodlands: the effect of browsing and seed dispersal on

vegetation structure and composition. *Forestry* 74(3):209-218.

Gortázar, C., Ferroglio, E., Höffle, U., Frölich, K., Vicente, J. (2007) Diseases shared between wildlife and livestock: a European perspective. *European Journal of Wildlife Research* 53:241.

Guion, L.A., Diehl, D.C., McDonald, D. (2001) *Conducting an In-depth Interview*. IFAS (Institute of Food and Agricultural Sciences) Extension; University of Florida: Gainesville, FL, USA.

Hoffman, L.C., & Wiklund, E. (2006) Game and venison: meat for the modern consumer. *Meat Science* 74:197-208.

ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale (Italian National Institute for Environmental Protection and Research). (2013) *Linee guida per la gestione degli ungulati*. *ISPRA* 91:1-225.

Langbein, J., Putman, R., Pokorny, B. (2010) *Traffic collisions involving deer and other ungulates in Europe and available measures for mitigation*. *Ungulate management in Europe: problems and practices*. Cambridge University Press, New York. New York, USA.

Malo, J.E., Suarez, F., Diez, A. (2004) Can we mitigate animal-vehicle accidents using predictive models?. *Journal of Applied Ecology* 41(4):701-710.

Pani, R., & Sagliaschi, S. (2006) *Dinamiche e strategie del colloquio clinico*. Carocci, Roma.

Ramanzin, M., Amici, A., Casoli, C., Esposito, L., Lupi, P., Marsico, G., Mattiello, S., Olivieri, O., Ponzetta, M.P., Russo, C., Trabalza Marinucci, M. (2010) *Meat from wild ungulates*:

ensuring quality and hygiene of an increasing resource. *Italian Journal of Animal Science* 9(61):318–331.

Schley, L., & Roper, T.J. (2003) Diet of wild boar *Sus scrofa* in western Europe, with particular reference to consumption of agricultural crops. *Mammal Review* 33:43-56.

Sielecki, L.E. (2001) Evaluating the effectiveness of wildlife accident mitigation installations with the Wildlife Accident Reporting System (WARS) in British Columbia. Proceedings of the international conference on ecology and transportation, Keystone, CO, USA, 24-28 September 2001; Center for Transportation and the Environment, North Carolina State University: Raleigh, NC, USA.

Vavra, P., Goodwin, B. (2005) Analysis of price transmission along the food chain. OECD Food, Agriculture and Fisheries Papers, No. 3, OECD Publishing: Paris, France.

Winkelmayer, R., & Paulsen, P. (2008) Direct marketing of meat from wild game in Austria: A guide to good practice according to Regulations (ECC) 852 and 853/2004. *Fleischwirtschaft*, 88:122-125.

Winkelmayer R., Stangl P.V., Paulsen P. (2011) Assurance of food safety along the game meat production chain: inspection of meat from wild game and education of official veterinarians and 'trained person' in Austria. Game meat hygiene in focus. Wageningen Academic Publishers, Wageningen, 245-258. Wageningen, Holland.

Zamora, R., Gomez, J.M., Hódar, J.A., Castro, J., García, D. (2001) Effect of browsing by ungulates on sampling growth of Scots pine in a Mediterranean environment.

Consequences for forest regeneration. *Forest Ecology and Management* 144:33-42.

CHAPTER 4

Discovering market segments for hunted wild game meat

Marescotti, M.E.¹, Caputo, V.², Demartini, E.¹, Gaviglio,
A.¹

Meat Science (2019), 149:163-176

¹ Department of Health, Animal Science and Food Safety -
University of Milan

² Department of Agricultural, Food and Resource Economics
– Michigan State University

Abstract

Recent years have seen a notable increase in the popularity of hunted wild game meat (HWGM) among consumers. This has led to a growing number of emerging markets for HWGM in many developed countries, including Europe. However, expansion of these markets is often hampered by the lack of a professional supply chain. The

profitability of a supply chain would depend on consumer willingness to purchase HWGM products. This paper aims to (1) segment consumers based on their general attitudes towards HWGM, their perceptions of its safety, animal welfare, orientation concerning wildlife-related values, hunting activities, objective knowledge and socio-demographic factors and (2) assess whether these general attitudes affect consumer intentions to purchase HWGM products. To achieve our objective, a random sample of Italian consumers was recruited. Three different consumer segments were identified: pro-animal consumers, disoriented consumers, and hunted wild game meat eaters. Our findings highlighted an important lack of knowledge amongst consumers.

Keywords: Hunted wild game meat, hunting, cluster analysis, Italian consumer, consumer segmentation

4.1. Introduction

In recent years, there has been a notable increase in the popularity of hunted wild game meat² (HWGM) among consumers (Hoffman & Wiklund, 2006; Atanassova *et al.*, 2008; FAO, 2007; Goguen *et al.*, 2018). This has led to a growing number of emerging markets for HWGM in many developed countries, including Europe. To illustrate this, although there are no data available concerning the HWGM sector in Europe, the last European Commission study on minor meats (EC, 2014) reported that, in some member states, there is a well-established market for this type of product. For example, in France, about half of the game meat processors promote a “Game from French Hunters” brand (*Gibier de Chasse – Chasseurs de France*³). Similarly, in Spain, the Interprofessional Association for Hunted Game “Asiccaza” (Asociación Interprofesional de la Carne de Caza⁴) promotes wild game products that mainly come from hunting. However, the expansion of HWGM markets is often hampered by the lack of a structured food supply chain. This is especially the case in Italy where, despite flourishing populations of wild animals (Ramanzin *et al.*, 2010), there is still a limited market for HWGM products (Gaviglio *et al.*, 2017; Giacomelli & Gibbert, 2018).

² In this paper the term “hunted wild game meat” refers to meat from large wild ungulates (e.g. wild boar – *Sus scrofa*, red deer – *Cervus elaphus*, roe deer – *Capreolus capreolus*, chamois – *Rupicapra rupicapra*, mouflon – *Ovis orientalis*) obtained through hunting activities.

³ <http://chasseurdefrance.com/charte-gibier-de-chasse-chasseurs-de-france/>

⁴ <http://www.asiccaza.org/>

Nonetheless, the creation of an Italian food supply chain for HWGM would generate market incentives that are expected to improve hunting practices and the management of wildlife overpopulation at no cost to the public. In addition, it would also generate new sources of income for populations living in marginal and rural mountain areas (Gaviglio *et al.*, 2018). However, whether a supply chain for HWGM is economically sustainable depends on whether there is a demand for these products, which in turn depends on how consumers perceive them. In this regard, if obtained under strict and regulated hunting practices, HWGM embeds a number of quality features that may appeal to modern consumers when purchasing meat products (Hoffman & Wiklund, 2006; Ljung *et al.*, 2012; Hoffman, 2013; AC Nielsen, 2016). For instance, HWGM may be considered organic and grass-fed meat because wild animals are, by definition, free roaming (Hoffman & Wiklund, 2006). In relation to free roaming, HWGM production may be considered an environmentally friendly livestock system (Thogmartin, 2006; Wiklund *et al.*, 2014), representing a sustainable alternative to intensive livestock production for beef, pork or poultry (Ahl *et al.*, 2002; Bureš *et al.*, 2014; Thulin *et al.*, 2015). Additionally, as wild animals follow their natural grazing behaviour, hunting guarantees the maximum level of animal welfare. Moreover, HWGM retains high nutritional values, with a low fat and cholesterol content, favourable n3:n6 fatty acid ratios and a high mineral content (Higgs, 2000; Rule, 2002; Webb, 2003; Hoffman & Wiklund, 2006; Bureš *et al.*, 2014). Finally, if consumed in the area within which it has been hunted,

HWGM embeds quality features associated with local food products (e.g., produced and consumed “from forest to fork”) (Cerulli, 2012). However, despite these benefits, consumer valuation of HWGM can be hampered by other factors, such as environmental and ethical concerns regarding hunting practices (Ljung *et al.*, 2012; Byrd *et al.*, 2017). For instance, certain consumers with pro-environmental and pro-animal attitudes may perceive hunting practices as risky for the maintenance of wild animal species, or as a cruel activity committed against vulnerable living creatures (Kellert & Berry, 1987). Hence, consumers’ perceptions of HWGM products may also be affected by concerns arising from individual attitudes towards hunting, animal welfare, and wildlife value.

To date, several studies have focused on the determinants for the consumption of meat from different animal species (Verbeke & Viaene, 1999; Grunert *et al.*, 2004; Verbeke & Vackier, 2004; Angulo & Gill, 2007; Bonne *et al.*, 2007; Pieniak *et al.*, 2008; Verbeke *et al.*, 2010; Pieniak *et al.*, 2010b; Van Loo *et al.*, 2010; Sepúlveda *et al.*, 2011; Font-i-Furnols & Guerrero, 2014; Lusk & Tonsor, 2016, among others). However, the economics and marketing literature on HWGM is still limited. This study aims to (1) segment consumers based on their general attitudes towards HWGM, their perceptions of its safety, animal welfare, orientation concerning wildlife-related values, hunting activities, objective knowledge and socio-demographic factors and (2) assess whether these general attitudes affect consumer consumption of HWGM products.

Our study addresses the need to broaden knowledge of consumers' attitudes towards HWGM and explores whether consumers would support a professional supply chain for HWGM, offering more information to stakeholders (i.e., hunters, processors, and retailers) to develop products and marketing strategies that effectively target individual consumer needs. Findings from this study can help policy makers to design new strategic interventions for the management of wild ungulate populations and the organization of professional supply chains for local HWGM products.

The remainder of the text is organized into four sections. Section 4.2. presents a literature review focused on consumers' attitudes towards HWGM. Section 4.3. presents the method and procedures adopted, including the survey framework (4.3.1), data collection and survey instrument (4.3.2) and statistical analysis (4.3.3.). Section 4.4. provides and discusses the results, while section 4.5. provides a summary of the research and some conclusions.

4.2. Consumers' attitudes towards hunted wild game meat: background

Most of the existing literature devoted to wild game meat consumption is primarily descriptive and focuses on non-European countries, such as Africa and Australia. With regard to the African context, a number of studies have focused on African consumers' perceptions and purchase behaviour for products derived from local species, such as springbok (*Antidorcas marsupialis*), blesbok (*Damaliscus*

pygargus phillipsi), kudu (*Tragelaphus strepsiceros*), zebra (*Equus burchelli*), blue wildebeest (*Connochaetes taurinus*), impala (*Aepyceros melampus*) and gemsbok (*Oryx gazelle*) (Hoffman *et al.*, 2003; Hoffman *et al.*, 2004; Hoffman *et al.*, 2005; Hoffman & Wiklund, 2006; Swanepoel *et al.*, 2016). The results from these studies generally indicate that, despite the potential of wild game meat, African consumers and tourists are ill-informed regarding the positive attributes of game meat. This may be because producers and marketers are not doing enough to promote this meat. In Australia, Hutchinson *et al.* (2010) performed a sensory analysis to investigate consumers' evaluation of farmed red deer (*Cervus elaphus*) and fallow deer (*Dama dama*). The results from this study suggest that Australian consumers prefer red deer meat compared to fallow deer meat and that their perception of venison quality is mainly influenced by the method of carcass suspension, which can enhance the meat's tenderness and succulence. However, due to the characteristics of HWGM products, the results from these international studies cannot be extended to other geographical contexts, such as Europe (Tomasevic *et al.*, 2018), for a number of reasons. First, game meat consumption is strictly related to the local available species and to their population size. Unlike Africa and Australia, in Europe the most representative large wild ungulate species are wild boar (*Sus scrofa*) and red deer (*Cervus elaphus*) (Hoffman & Wiklund, 2006; Hofbauer *et al.*, 2010; Tomasevic *et al.*, 2018). Second, some cultural differences across countries must also be considered. The acceptance of hunting practices, in fact, is strictly connected to socio-cultural

heritage, and depending on this factor, harvesting and culling wild animals may or may not be ethically accepted (Mayfield *et al.*, 2007; Willebrand, 2009; Ljung *et al.*, 2012; Byrd *et al.*, 2017; Gamborg & Jensen, 2017; Goguen *et al.*, 2018).

Therefore the question arises, what do we know about European consumers' perceptions of HWGM? To date, there are only five studies assessing European consumer attitudes and purchase behaviour towards HWGM products. Tomasevic *et al.* (2018) have recently published the most exhaustive study on European consumers of hunted game meat. By using a cluster analysis, the authors investigated consumers' perceptions, attitudes and perceived quality of game meat in ten European countries (e.g., Czech Republic, Poland, Slovakia, Croatia, Albania, Bosnia and Herzegovina, Bulgaria, Former Yugoslav Republic of Macedonia, Montenegro and Serbia). The results from this study indicate that the consumption rate for game meat in the ten European countries is influenced by a number of factors, such as location, age, and gender. For example, the authors found that the consumption of HWGM is higher in South East European countries, and more popular among men and older consumers.

Within the remaining literature, studies have just focused on consumers from one country. Ljung *et al.* (2012) investigated the association between frequency of game meat consumption and attitudes towards hunting through an online survey sent to a random sample of Swedish residents. Their findings suggest that game meat consumption and social relationships (i.e., having friends or parents who hunt)

were the key factors associated with positive attitudes towards hunting. Bodnar *et al.* (2010) researched Hungarian consumers' demand for meat from game animals (red deer, fallow deer, roe deer, wild boar, hare, pheasant and mallard duck) and found differences between a sample of respondents living in cities and those living in rural areas. Moreover, authors report that people with negative attitudes towards game meat are vegetarian or refuse its consumption for emotional reasons. With reference to the Polish context, Kwiecinska *et al.* (2017), using a model based on a logistic regression for predicting the consumption of wild game, demonstrated that purchase intention increases with greater availability and the provision of higher quality. The results also showed a higher propensity to change eating habits towards the consumption of game in men, city dwellers and those who evaluated their own knowledge on nutrition and diet higher than others. Finally, the most recent literature on European consumers' attitudes and purchase behavior for HWGM analyzes consumer preferences for different types of preparation of red deer meat and beef in a northern Italian population sample (Demartini *et al.*, 2018). The authors conclude that considering consumers' attitudes towards wild game meat and hunting in their model significantly improved the interpretation of their results and allowed them to identify a niche market for red deer carpaccio (i.e. sliced fresh raw meat). Although Demartini *et al.* (2018) found interesting results in relation to consumer attitudes, the authors only included two of the multiple attitudinal dimensions relating to meat consumption and were restricted in generalizing their results to the entire Italian

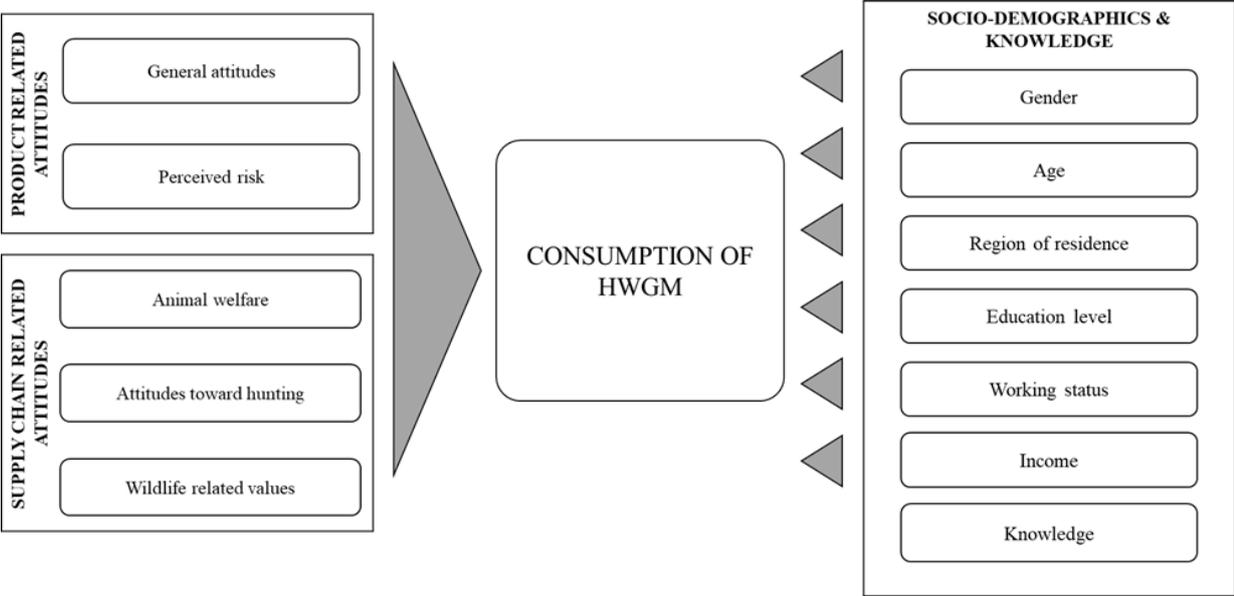
population due to a limited, non-representative sample. Thus, collectively, these prior studies suggest that consumer attitudes impact on consumption of HWGM, yet there is more to be learned from a comprehensive study specifically designed to assess the relationship between an array of consumer attitudes and HWGM purchase behavior.

4.3. Method and procedures

4.3.1. Survey framework

To segment consumers of HWGM, we identified the attitudes and perceived risks that may influence consumer consumption of this type of meat and divided these attitudinal constructs into two groups. The first attitude group directly relates to the HWGM product and explores (1) consumers' general attitudes towards the product and (2) perceptions of HWGM safety. On the other hand, the second group gathers consumers' attitudes towards the supply chain for HWGM, such as (3) animal welfare, (4) attitudes towards hunting and (5) consumer wildlife-related values. Furthermore, to describe the segments, socio-demographic characteristics and consumers' objective knowledge about HWGM are considered in the analysis. Figure 4.1. shows a schematic representation of the variables under study.

Figure 4.1. Schematic representation of the variables investigated



4.3.2. Data collection and survey instrument

Data were collected using an online survey (Appendix A) sent to a random sample of Italian consumers during February and March 2018. The data collection was carried out using the Qualtrics® online survey platform. Qualtrics is a leading world provider of survey samples⁵. Consumers were excluded from the survey if they did not buy meat during the three months preceding the survey and if they were aged under 18. The total sample comprised 1,029 respondents.

The survey consisted of a questionnaire containing closed-ended questions organized into four sections following the framework presented in Figure 1. The first section aimed at detecting consumption habits and objective knowledge about HWGM. To detect consumption habits, respondents were asked whether they had consumed wild game meat in the last year (yes/no). To measure objective knowledge, we developed a series of true/false questions based on the literature on the various empirical applications mentioned above. The following three items, out of the five, were correct: “In Italy, populations of wild ungulates (red deer, wild boar,

⁵ Qualtrics is a world leading provider of survey samples. The sampling procedures are certified for the transparency of the online process by the Qualtrics Esomar28 and through a variety of quality systems certifications, such as ISO 20252 management systems standards, Media Ratings Council, among others. Although online surveys are increasingly used in consumer food choice studies, they may be subject to selection bias issues (Canavari *et al.*, 2005; Windle & Rolfe, 2011; Guimarães *et al.*, 2015; Ripoll *et al.*, 2015) due to the exclusion of individuals who do not use the internet. This might induce slight differences between the general population and the sampled population.

roe deer, chamois) are growing rapidly”; “Consuming game meat (red deer, wild boar, roe deer, chamois) is an ethical choice, sustainable and with a very low environmental impact”; “Currently in Italy, hunting is ‘controlled’, in fact it is subject to well defined rules concerning culling, species, times and places”. The remaining two were false, and they were as follows: “Hunters are not considered producers by Italian law; therefore they cannot sell the meat they hunt” and “Game meat (red deer, wild boar, roe deer, and chamois) has a lower protein content and higher fat and cholesterol content than beef”.

The second section of the questionnaire included questions aimed at capturing the consumers’ general attitudes towards HWGM products and their perceptions of HWGM safety. Consumers’ general attitudes towards game meat (**ATT**) were assessed by asking respondents to describe their overall feelings when thinking about the consumption of HWGM products. More specifically, we adapted the version of the “general attitudes scale” proposed by Olsen *et al.* (2007) (scored on five-point semantic differential scales), which has been widely used in the literature to assess consumers’ attitudes towards food in general (Olsen, 2001, Honkanen *et al.*, 2006; Pieniak *et al.*, 2010b; Pérez-Cueto *et al.*, 2011; Van Loo *et al.*, 2013), and meat in particular (Berndsen & Van der Pligt, 2004; Almli *et al.*, 2013). To capture consumers’ perceptions towards wild game meat safety (**SAF**), we used the five-point semantic differential scale proposed by Almli *et al.* (2013) and considered six bipolar adjectives.

The third section of the questionnaire sought to highlight the typical factors that are expected to influence attitudes towards meat, in general, and HWGM in particular. To illustrate, previous studies have shown that attitude towards animal welfare (**AW**) is an important factor affecting consumer purchase intention for meat in general (Wong & Aini, 2017; Van Wezemael *et al.*, 2010). Accordingly, we included the eight-item scale proposed by Kendall *et al.* (2006), which takes into account the general ethical issues linked to animal production, as well as questions relating to the different uses of animals. For each item, a 5-point interval scale ranging from “*strongly disagree*” to “*strongly agree*” was used. Additionally, we captured consumers’ attitudes towards hunting (**AH**) by using the Likert scale proposed by Ljung *et al.* (2012). This scale is based on 9 items concerning hunting activity and hunters’ behaviour. For each item, respondents were asked to express their agreement using a scale ranging from 1= *strongly disagree* to 5= *strongly agree*. Finally, since HWGM is obtained from wild animals, consumers’ attitudes to this type of meat can be influenced by their attitudes towards wildlife. Accordingly, the 8-item Likert scale proposed by Hrubes *et al.* (2001) was used to measure consumer wildlife-related values (**WV**). For each item, a 5-point scale ranging from 1= *strongly disagree* to 5= *strongly agree* was used.

Finally, the fourth section of the questionnaire collected the socio-demographic characteristics of the sample, including gender, age, region of residence, education level and income. Table 4.1. provides an overview of the socio-demographic characteristics of the sampled population and

the actual Italian population (Italian National Institute of Statistics data, 2018).

*Table 4.1. Socio demographic characteristics of the sample
(Sample size n= 1,029)*

	Total sample	Italian population*
	(%)	(%)
<i>Gender</i>		
Male	49.08	49.82
Female	50.92	50.18
<i>Age group</i>		
18-22 yr	7.58	7.81
23-35 yr	25.27	22.75
36-55 yr	51.31	48.59
56-65 yr	15.84	20.84
<i>Geographical region of residence</i>		
Northeast Italy	26.34	19.05
Northwest Italy	18.46	26.22
Southern Italy and Islands	37.50	34.48
Central Italy	17.69	19.85
<i>Education Level completed</i>		
Elementary School	0.10	5.74
Middle School	8.07	31.95
High School	55.00	44.48
University and Postgraduate	36.05	17.83
Other	0.78	
<i>Average household income</i>		
Low	51.99	n/a
Medium	43.63	n/a
High	4.37	n/a

* Source: Italian National Institute of Statistics data (ISTAT 2018). Percentages are calculated for the population aged between 18 and 65 years.

Of the 1,029 respondents in the study, according to the national population, females were slightly over-represented (50.9%). In the sample, 51.3% were aged between 36 and 55; 44.8% of the interviewed sample live in the northern part of Italy, while 37.5% of the respondents were from southern Italy (islands included), and 17.7% were from the central part of Italy. Concerning education level, the sample was slightly biased towards better-educated participants, which may be due to the use of the online survey method. In fact, 55.0% of the respondents had completed college and 36.0% had obtained a degree or a master's degree. Finally, most interviewees (51.99%) had self-reported low financial status.

4.3.2. Statistical Analysis

The data were analysed using IBM SPSS Statistics (SPSS Inc., Chicago, IL). Survey data were first subjected to a descriptive analysis to provide a synthetic description of the main characteristics of the sample interviewed.

In addition, following the previous literature concerning consumer attitude studies (Roininen *et al.*, 1999; Verbeke & Vackier, 2004; Vanhonacker *et al.*, 2007; Van Wezemael *et al.*, 2010; Vanhonacker *et al.*, 2013; De Graaf *et al.*, 2016), we also explored the internal reliability of the five multi-item attitudinal scales used in our survey instrument (e.g. ATT, SAF, AW, AH, WV). We did so by using the Cronbach's α (Cronbach, 1951; Peterson, 1994) and considering 0.6 as the threshold value for a satisfactory scale (Verbeke & Vackier, 2004). Further, we expanded our analysis on the relationship underlying the set of variables for the five multi-item

attitudinal scales through the execution of a principal component analysis (PCA) with varimax rotation (Malhotra, 1999).

Next, we performed a cluster analysis (CA) to identify groups of consumers with similar attitudes towards HWGM. Two steps were followed. In the first step, we applied the Hierarchical Clustering (Verbeke & Vackier, 2004; Dimech *et al.*, 2011; Aprile *et al.*, 2015) and the TwoStep Cluster procedure (Bacher *et al.*, 2004) to determine the optimal number of clusters. In the second step, we used the optimal number of clusters derived from the first step to perform a non-hierarchical *k*-means cluster analysis (CA). Moreover, bivariate analyses were performed to explore whether the identified clusters differ in terms of socio-demographics, consumption habits and knowledge about HWGM. These analyses were performed using the one-way ANOVA with Dunnett's T3 post hoc comparison of means, and cross-tabulation with χ^2 and Kruskal-Wallis statistics. Finally, we adopted the approach suggested by Dimech *et al.* (2011) and estimated a probit model to explore whether belonging to a particular consumer segment identified by the CA relates to different HWGM consumption patterns.

4.4. Results and Discussion

4.4.1. Descriptive analysis

4.4.1.1. Consumption of wild game meat

The results of the analysis revealed that the majority (61.1%) of the respondents had consumed wild game meat at least once in the last year (termed “wild game meat eaters”). In contrast, 38.9% of the interviewees claimed that they had not consumed it in the last year (termed “wild game meat non-eaters”).

4.4.1.2. Consumers’ objective knowledge about HWGM

Descriptive statistics for the objective knowledge variables are shown in Table 4.2.. The table reports the total score for objective knowledge, which was created by summing the number of correct answers to the five true/false questions. The average number of correct answers was 2.66 on a five-point scale, indicating that, on average, respondents answered about half of the questions correctly. Of the sample, only 5% of the respondents answered all five true/false questions correctly, whereas 30% and 27% answered three and two correctly, respectively. More specifically, the majority of the sample interviewed (74%) answered correctly to the false statement “Game meat (red deer, wild boar, roe deer, chamois) has a lower protein content and higher fat and cholesterol content than beef”,

whereas most of the respondents (73.3%) failed to provide a correct answer to the false statement “Hunters are not considered producers by the Italian law; therefore they cannot sell the meat they hunt”. These results highlight the need to increase consumers’ awareness about HWGM. Overall, about 53% of the answers to all the implied statements were correct.

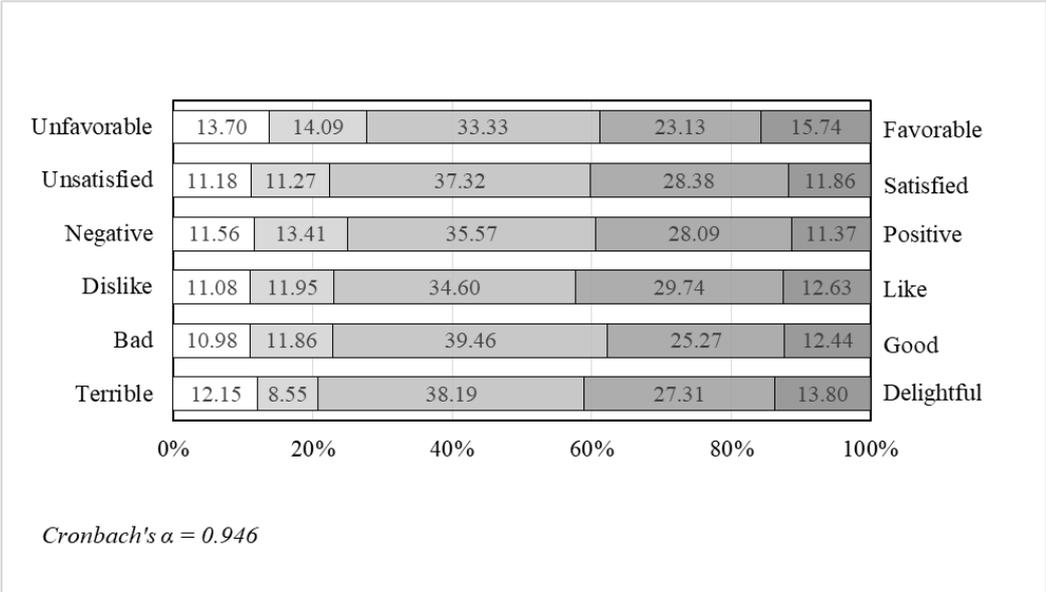
Table 4.2. Objective knowledge related to HWGM: number of correct answers to 5 statements

Statements	Correct (%)
<i>Statement 1</i>	55.49
<i>Statement 2</i>	26.72
<i>Statement 3</i>	74.05
<i>Statement 4</i>	60.64
<i>Statement 5</i>	70.26
Total number of correct answers	53.18
Respondents’ number of correct answers to 5 statements	
0	2.92
1	14.29
2	27.11
3	30.42
4	20.21
5	5.05

4.4.1.3. Consumers' general attitudes and perception of HWGM safety

The general attitudes construct (**ATT**) was calculated as the average score across the six items. Respondents showed a general positive tendency towards the consumption of HWGM products (mean value= 3.18 on a 5-point scale; SD= 1.03). The results of the general attitudes scale are reported in Figure 4.2..

Figure 4.2. Consumers' general attitudes (ATT)



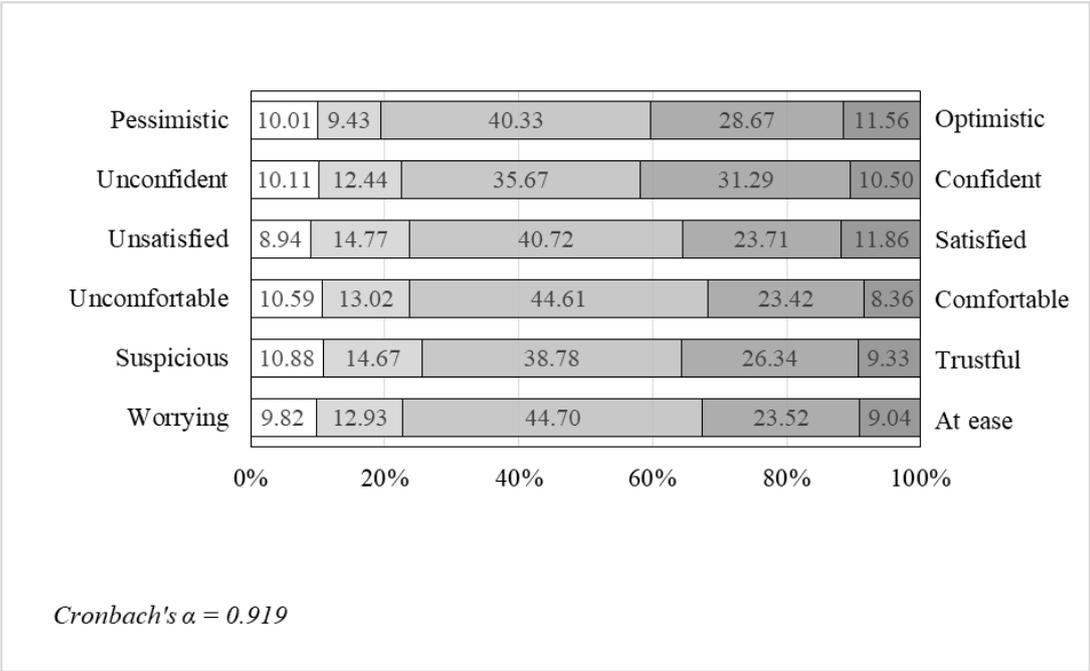
As shown in Figure 4.2., the semantic differential item unfavourable/favourable showed the highest percentage of strongly positive and strongly negative feelings, with 15.7% of respondents favourable and 13.7% unfavourable. The analysis of the results shows that the group of consumers with the lowest attitudes towards HWGM, who indicated a dislike of the product, consider it terrible and feel bad when thinking about it; and the consumer group with the highest attitudes, who like HWGM and consider it good and delightful, have a similar sample size.

The perception of the HWGM safety (**SAF**) construct was computed as the average across the six items in the scale. As seen in Figure 4.3., respondents generally showed slightly positive feelings towards HWGM safety (mean value= 3.13, SD= 0.91). Across all the semantic items on the scale, between 35.7% and 44.7% of the respondents identified as uncertain; this result can be expected considering respondents' low level of objective knowledge. Similar to the general attitudes towards HWGM, the analysis of safety perceptions revealed the presence of two groups of respondents who have strongly negative ("suspicious", "uncomfortable", "unconfident") and/or strongly positive feelings ("satisfied", "optimistic", "confident") towards HWGM.

Considering the limited body of literature concerning HWGM, consumers' general attitudes and perceptions of HWGM safety are not strictly comparable with other previous studies on this topic. However, the sample mean values relating to consumers' general attitudes and perceptions of HWGM safety are similar to the mean values

reported by Van Wezemael *et al.* (2010) and by Almli *et al.* (2013) in a study concerning beef consumers in different European countries (respectively, Germany, Spain, France, and the UK in the first study, and Belgium and Norway in the second).

Figure 4.3. Consumers' perception of HWGM safety (SAF)



4.4.1.4. Consumers' attitudes towards animal welfare, hunting activity and wildlife-related values

The third section of the questionnaire relates to factors that show a reasonable direct correlation with HWGM consumption, such as attitudes towards animal welfare, attitudes towards hunting and the perceived importance of wildlife.

Concerning attitudes towards animal welfare (**AW**), the construct was calculated as the average of the answers to the eight statements. Table 4.3. shows an overview of the results of the AW Likert scale.

Table 4.3. Consumers' attitudes towards animal welfare (AW)

Items	Strongly disagree (%)	Disagree (%)	Neither disagree nor agree (%)	Agree (%)	Strongly agree (%)	Mean	SD
It is important that the food I normally eat has been produced in a way that animals have not experienced pain	1.94	4.66	25.85	39.84	27.70	3.87	0.94
It is important that the food I normally eat has been produced in a way that animals' rights have been respected	0.87	4.57	21.48	42.47	30.61	3.97	0.88
In general humans have too little respect for the quality of life of animals	1.55	5.05	23.62	40.33	29.45	3.91	0.93
Increased regulation of the treatment of animals in farming is needed	1.75	3.50	22.25	39.26	33.24	3.99	0.92
Animal agriculture raises serious ethical questions about the treatment of animals	2.14	4.66	25.17	41.01	27.02	3.86	0.94
As long as animals suffer pain, humans should not be able to use them for any purpose (R)	12.34	18.56	37.51	24.78	6.80	3.05	1.09
It is acceptable to use animals to test consumer products such as soaps, cosmetics and household cleaners (R)	35.47	22.06	25.56	14.19	2.72	3.73	1.16
Hunting animals for sport is an acceptable form of recreation (R)	42.08	18.85	23.13	13.41	2.53	3.85	1.18

Cronbach's $\alpha = 0.696$

Note: R indicates items that have been reversely scaled in the analysis of the results; SD= Standard Deviation

Sample results were quite high (mean value= 3.73, SD= 0.70), indicating that respondents have strong attitudes towards animal welfare. Of the sample, 73.08% declared that it is important that the food they normally eat has been produced in a way that respects animals' rights (mean value= 3.97), while 72.5% agreed that increased regulation of the treatment of animals in farming is needed (mean value= 3.99). This finding is consistent with several consumer studies reporting consumers' concerns about animal welfare (Frewer *et al.*, 2005; Mayfield *et al.*, 2007, Vanhonacker *et al.*, 2007; Vecchio & Annunziata, 2012; Cembalo *et al.*, 2016). Moreover, a substantial proportion of respondents (42.1%, mean value= 3.85) believe that hunting animals for sport is unacceptable, while only 15.9% of them believe that recreational hunting is acceptable. These results are in line with previous studies on Italian consumers in relation to animal welfare issues (Harper & Henson, 2001; Mayfield *et al.*, 2007; Vecchio & Annunziata, 2012).

Table 4.4. reports the results for attitudes towards hunting using a Likert scale (**AH**).

Table 4.4. Consumers' attitudes towards hunting (AH)

Items	Strongly disagree (%)	Disagree (%)	Neither disagree nor agree (%)	Agree (%)	Strongly agree (%)	Mean	SD
Hunting helps keep nature in balance	15.06	23.52	39.94	18.85	2.62	2.70	1.02
Most hunters are well-prepared when they go hunting	16.03	26.63	32.26	21.87	3.21	2.70	1.08
I see little wrong with harvesting animals for their meat as long as the animal is not endangered	12.73	14.48	31.58	33.92	7.29	3.09	1.13
Hunters are properly trained and follow hunting regulations	19.53	25.75	36.83	15.26	2.62	2.56	1.05
Hunting is an important rural tradition	14.19	16.72	36.73	27.31	5.05	2.92	1.10
I regard any kind of sport and recreational hunting as cruel to animals (R)	4.37	8.16	25.66	30.81	31.00	2.24	1.11
Hunters often ignore safety rules (R)	2.92	6.61	26.63	38.39	25.46	2.23	1.00
Hunters often harm animals, which then dies a slow and painful death (R)	2.53	5.25	32.94	33.82	25.46	2.26	0.98
I do not like people who hunt (R)	6.03	10.98	38.87	22.16	21.96	2.57	1.13

Cronbach's $\alpha = 0.866$

Note: R indicates items that have been reversely scaled in the analysis of the results; SD= Standard Deviation

Attitudes towards hunting were notably quite low, with a mean value of 2.56 (SD= 0.74). Overall, 61.8% of respondents regarded sport or recreational hunting as cruel to animals (mean value= 2.24), corroborating the results of the AW scale item regarding hunting animals for sport. On the other hand, 41.2% of them (mean value= 3.09) agreed with the acceptability of hunting game animals for food, as long they are not endangered, revealing that hunting is more acceptable to the public if it has some kind of utility (Gamborg & Jensen, 2017). Respondents generally expressed negative feelings and concern towards hunters, stating that hunters often ignore safety rules (63.8%; mean value= 2.23), often harm animals (59.3%; mean value= 2.26), are not properly trained and do not follow hunting regulations (45.3%; mean value= 2.56). Finally, approximately 44% of the respondents report disliking people who hunt (mean value= 2.57). Our findings are consistent with the findings of a previous study on Italian consumers' behaviour (Mayfield *et al.*, 2007) and differ from the results for other European countries, such as Sweden (Mayfield *et al.*, 2007; Ljung *et al.*, 2012), where consumers were shown to be strongly in favour of hunting. This result may be because, in Sweden, hunting is not only a sport but also essential for food acquisition purposes (Mayfield *et al.*, 2007), highlighting that consumers' attitudes towards hunting are strongly influenced by the socio-cultural context and, in particular, the final purpose of the hunting activities (hunting for sport, hunting for meat, hunting for wildlife population control, hunting for a trophy). Table 4.5. shows consumers' wildlife-related value orientations (WV).

Table 4.5. Consumers' attitudes towards wildlife (WV)

Items	Strongly disagree (%)	Disagree (%)	Neither disagree nor agree (%)	Agree (%)	Strongly agree (%)	Mean	SD
It is important to manage the populations of wildlife for benefit of humans (R)	5.73	12.24	34.01	35.37	12.63	2.63	1.04
I enjoy watching wildlife when I take a trip	1.17	4.18	19.53	47.81	27.31	3.96	0.86
It is important to protect wildlife for future generations	0.68	2.04	14.38	42.76	40.14	4.20	0.81
Hunting and fishing are cruel and inhumane to the animals	7.39	16.13	42.27	22.06	12.15	3.15	1.07
I notice birds and wildlife around me every day	3.89	11.47	31.97	38.19	14.48	3.48	1.00
People should not cause pain and suffering to wildlife, regardless of how much we may benefit	3.21	7.58	27.31	31.88	30.03	3.78	1.06
It is important that we learn all we can about wildlife	0.68	3.98	23.91	43.93	27.50	3.94	0.86
Animals should have rights similar to the rights of humans	0.25	12.54	36.93	28.86	16.42	3.39	1.06

Cronbach's $\alpha = 0.830$

Note: R indicates items that have been reversely scaled in the analysis of the results; SD= Standard Deviation

Reported wildlife-related value orientations, computed as the average score across the items, were generally positive (mean value= 3.16; SD= 0.60), indicating that wildlife enjoyment and animal rights/management are important for the interviewees (Fulton *et al.*, 1996). The majority of the respondents stated that they enjoy watching wildlife (75.1%; mean value= 3.96) and that it is important to learn all we can from wildlife (71.4%; mean value= 3.94). Moreover, almost 40.1% of the interviewees strongly agreed and 42.8% agreed that it is important to protect wildlife for future generations (mean value= 4.20). On the other hand, approximately half of the sample stated that it is important to manage populations of wildlife for the benefit of humans. From these results, a relevant proportion of respondents have a “mutualist value orientation”, believing that humans and wildlife are meant to coexist or live in harmony and, thus, that wild animals deserve rights similar to the rights of humans (Charles M. Russell National Wildlife Refuge & UL Bend National Wildlife Refuge, 2010; Gamborg & Jensen, 2016). In contrast, only a limited part of the sample had a “utilitarian value orientation” and thus believed that wild animals should be used for the benefit of humans and that hunting is acceptable (Gamborg & Jensen, 2016).

4.4.2. Reliability analysis and principal component analysis

The internal reliability consistency of the AW, ATT, SAF, AH, and WV scales was analyzed using the Cronbach’s α test. The results were all higher than the 0.6 threshold value for

a satisfactory scale, indicating that all the adopted scales are valid instruments to measure the proposed constructs. The lowest values were obtained for the animal welfare scale ($AW\alpha= 0.696$), while the other scales had Cronbach's α -values higher than 0.8 ($ATT\alpha= 0.946$; $SAF\alpha= 0.919$; $AH\alpha= 0.866$; $WV\alpha= 0.830$).

To further investigate the structure and relevance of these scales in explaining consumer attitudes towards HWGM, we also performed a principal component analysis (PCA) using the varimax rotation (see Appendix B, Table B1). The PCA revealed eight components, whose internal reliability values (measured using the Cronbach's α test) are lower than the values calculated on the original attitudinal scales. This suggests that the constructs from the PCA are less consistent than the original scales, and indicates that techniques applied to factor scores (as, for example, CA) may perform worse than on original variables (Fiedler & McDonald, 1993). Moreover, removing the items that loaded on different factors, as suggested by De Graaf *et al.* (2016) and Verbeke & Vackier (2004), has not improved the internal reliability values of the constructs (see Appendix B, Table B2).

4.4.3. K-means cluster analysis

The cluster analysis was performed using the k -means method and the index of the items/constructs from the five original scales (e.g., ATT scale, SAF scale, AW scale, AH scale, WV scale). Prior to applying the k -means method, we determined the optimal number of classes using the

Hierarchical Clustering and Two-Step Cluster procedures. A total of three optimal clusters were identified⁶.

To verify the existence of significant differences between clusters, one-way analysis of variance (ANOVA) was performed to compare factor means. Considering their respective reported factor mean scores, clusters have been classified as pro-animal, disoriented, and HWGM eaters. The results of the cluster and of the one-way ANOVA analyses are summarized in Table 4.6..

Table 4.6. Final cluster average scores

	Cluster 1 (n= 168; 16.33%)	Cluster 2 (n= 574; 55.78%)	Cluster 3 (n= 287; 27.89%)	F statistics (F-test)	
General attitudes	1.532 ^a	3.116 ^b	4.257 ^c	1348.02	***
Perception of HWGM safety	1.793 ^a	3.075 ^b	4.035 ^c	855.54	***
Animal welfare	4.253 ^a	3.753 ^b	3.382 ^c	98.75	***
Attitudes towards hunting	1.861 ^a	2.489 ^b	3.107 ^c	223.81	***
Wildlife related value	3.605 ^a	3.197 ^b	2.842 ^c	105.64	***
Cluster's classification	<i>Pro-animals</i>	<i>Disoriented</i>	<i>HWGM eaters</i>		

Significance Levels ***p< 0.001; **p< 0.010; *p< 0.050

^{a,b,c} indicate significantly different means using one-way ANOVA and post hoc Dunnett T3 multiple comparison test (equal variances not assumed)

The ANOVA proved that all segments significantly differ for all the factors under study (p< 0.001). The highest

⁶ The results of the Hierarchical Clustering and Two-Step Cluster procedures are available upon request.

differences among consumer groups were related to the factor “general attitudes”. Figure 4.4. reports a graphical representation of the profiles for each cluster, while Figure 4.5. graphically reports the results for each construct.

Figure 4.4. Final clusters profiles

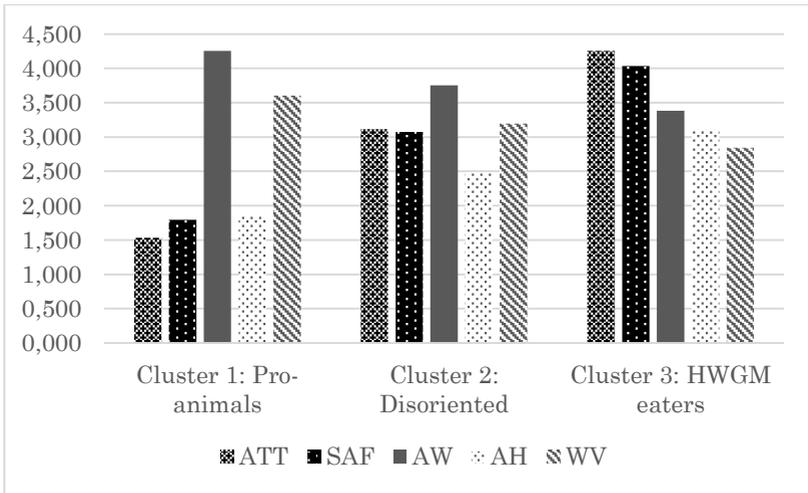
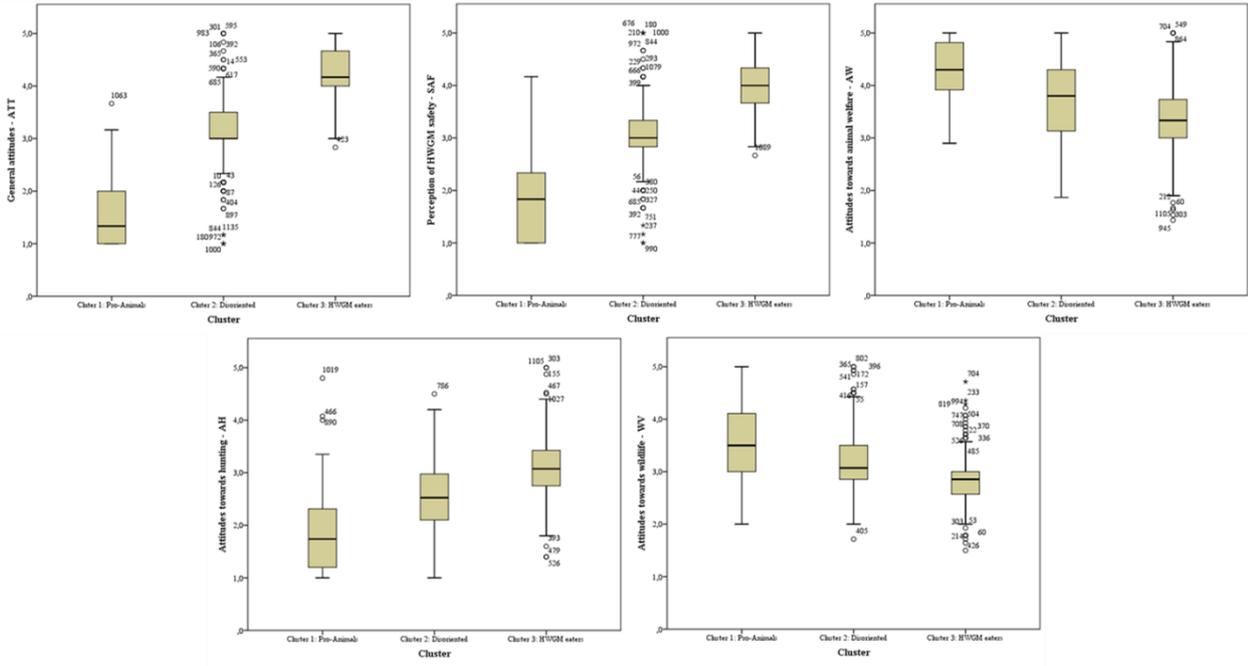


Figure 4.5. Construct results differences between clusters



To better describe the characteristics of the individuals in each class, we also designed post-clustering profiles in relation to the most meaningful variables used in the survey, such as demographic characteristics, consumption habits, and consumer knowledge.

To profile each of the segments identified in terms of socio-demographic characteristics, we performed a cross-tabulation analysis. Table 4.7. summarizes the socio-demographic profile of the three identified clusters, as well as the statistically significant differences found between groups. Differences across segments were measured using the chi-square test or Kruskal-Wallis test, depending on the characteristics of the variables.

Table 4.7. Socio-demographic profiles of the three clusters

Item	Cluster 1	Cluster 2	Cluster 3	p-value		
	<i>Pro-animal</i> (%; n= 168)	<i>Disoriented</i> (%; n= 574)	<i>HWGM eaters</i> (%; n= 287)	(χ^2 -test)	(Kruskal-Wallis test)	
<i>Gender</i>						
Male	28.57	47.74	63.76	0.000	***	
Female	71.43	52.26	36.24			
<i>Age group</i>						
18-22 yr	8.33	9.41	3.48	0	*	0.106
23-35 yr	22.02	26.66	24.39			
36-55 yr	55.36	47.74	56.10			
56-65 yr	14.29	16.20	16.03			
<i>Geographical region of residence</i>						
Northeast Italy	14.88	17.77	21.95	0.090		
Northwest Italy	21.43	26.83	28.22			
Southern Italy and Islands	45.83	37.98	31.71			
Central Italy	17.86	17.42	18.12			
<i>Educational Level completed</i>						
Elementary School	0.00	0.17	0.00	0	0.029	*
Middle School	10.71	8.01	6.62			
High School	57.14	56.62	50.52			
University and Postgraduate	31.55	34.15	42.51			
Other	0.60	1.05	0.35			
<i>Average household income</i>						
Low	62.50	54.18	41.46	0	*	0.000 ***
Medium	33.93	41.99	52.61			
High	3.57	3.83	5.92			

Significance Levels: ***p< 0.001; **p< 0.010; *p< 0.050

Chi-square and Kruskal-Wallis statistics results showed statistically significant differences between the three consumer groups in terms of gender ($p= 0.000$), education level completed ($p= 0.029$) and average household income ($p= 0.000$).

The first cluster included 16.3% of the respondents ($n= 168$). These consumers were particularly concerned about animal welfare and gave a high value to wildlife (Table 4.7. and Figure 4.4.). Moreover, they had very low attitudes towards HWGM, as well as towards hunting, and revealed strongly negative feelings regarding HWGM safety. Thus, this group was classified as *pro-animal consumers*. The results reported in Table 8 revealed that the members of this group were more likely to be female (71.4% of the total sample), with a middle school or high school diploma (67.85%), and with a low income (62.5%). Furthermore, there was a tendency ($p= 0.090$) for the respondents in this cluster to come from southern Italy and the Islands (45.8%).

The second cluster, classified as *disoriented consumers*, was the largest, accounting for 55.8% of the sample ($n= 574$). Respondents in this group, even if they revealed concerns about animal welfare and placed importance on wildlife enjoyment and animal rights, had positive attitudes towards HWGM and its safety. On the other hand, they had relatively low attitudes towards hunting (Table 4.7. and Figure 4.4.). From a socio-demographic viewpoint, as shown in Table 4.6., consumers belonging to this cluster had a better financial status (54.2% had low and 42.0% medium financial status), and they mainly came from southern Italy and the Islands (38.0%). In contrast to the first cluster, this group contained

better-educated participants (34.15% of them had obtained a degree or a master's degree). With a proportion of 47.7% males and 52.3% females, this cluster was the most balanced of the three. Finally, the third cluster (27.9% of the sample, $n= 287$) contained consumers with strongly positive attitudes towards the consumption of HWGM products and strongly positive feelings concerning its safety. Thus, this cluster was defined as *HWGM eaters*. These consumers reported the highest attitudes towards hunting and the lowest score related to animal welfare issues and wildlife value orientation. In contrast with the other groups, HWGM eaters were mainly males (63.7%) with a medium or high financial status (58.5%). This cluster had the highest percentage of consumers with the highest education level; in fact, 42.5% of them reported having a university or postgraduate degree. Moreover, although not statistically significantly different, consumers in this group seemed to be more likely to come from northern (50.2%) and central Italy (18.1%) and to be aged over 36 years (72.0%).

In relation to consumer objective knowledge concerning hunted wild game meat (Table 4.8.), statistically significant differences were found between the three consumer clusters ($p= 0.000$). Pro-animal consumers showed the lowest degree of knowledge (mean value= 1.90 correct answers out of the five statements), followed by disoriented consumers (mean value= 2.59). HWGM eaters demonstrated the highest degree of knowledge about HWGM (mean value= 3.24). These findings suggest that a poor level of consumer knowledge regarding HWGM could act as a barrier to its consumption. Consumers, in fact, are often not aware that

hunting can be practised ethically and that it is subject to strict and well-defined regulations. Our results are consistent with previous studies (Pieniak *et al.*, 2010a; Van Loo *et al.*, 2013) reporting that higher consumer knowledge about certain food products has a positive influence on their consumption.

Table 4.8. Objective knowledge related to hunted wild game meat among different clusters

Item	Total sample (n= 1.029)	Cluster 1 <i>Pro-animals</i> (n= 168)	Cluster 2 <i>Disoriented</i> (n= 574)	Cluster 3 <i>HWGM eaters</i> (n= 287)	F statistics (F-test)
Objective Knowledge (no. of correct answers to 5 statements)	2.66	1.90 ^a	2.59 ^b	3.24 ^c	0.000 ^{***}

^{a-b-c} Indicate significantly different means using Scheffé post hoc test (equal variances assumed)

Finally, we followed Dimech *et al.*, (2011) to explore whether consumers belonging to a specific segment or cluster, and with certain socio-demographic characteristics, are more or less likely to consume HWGM. More specifically, we estimated a probit model using the self-reported consumption of HWGM in the last year as a dependent variable, and the consumers' socio-demographic characteristics as covariates. The variables are defined in table 4.9., while the probit estimates are reported in table 4.10..

Table 4.9. Probit model variables

Variable	Description
<i>Dependent variable</i>	
HWGM Cons	Equals 1 if the respondent has consumed HWGM in the last year; 0 otherwise
<i>Categorical Covariates (factors)</i>	
Cluster	
Cluster 1	Equals 1 if the respondent belongs to the <i>Pro-animal</i> cluster, 0 otherwise (baseline)
Cluster 2	Equals 1 if the respondent belongs to the <i>Disoriented</i> cluster, 0 otherwise
Cluster 3	Equals 1 if the respondent belongs to the <i>HWGM eaters</i> cluster, 0 otherwise
Gender	
Male	Equals 1 if the respondent is a male, 0 otherwise (baseline)
Female	Equals 1 if the respondent is a female, 0 otherwise
Area	
NEItaly	Equals 1 if the respondent lives in Northeast Italy, 0 otherwise (baseline)
NWItaly	Equals 1 if the respondent lives in Northwest Italy, 0 otherwise
SItaly	Equals 1 if the respondent lives in Southern Italy and Islands, 0 otherwise
CItaly	Equals 1 if the respondent lives in Central Italy, 0 otherwise
<i>Covariates</i>	
Age	Respondent age. Equals 1 if the respondent is aged between 18 and 22 yrs, 2 if between 23-35 yrs, 3 if 36-55 yrs, 4 if 56-65 yrs.
Edu	Respondent education level. Equals 1 if completed middle school, 2 high school, 3 University/Postgraduate, 4 other kind of school.
Inc	Respondent average household income. Equals 1 if low, 2 if medium, 3 if high.

Table 4.10. Probit estimates results

Variables	Coeff.	Std. Error	Significance	
			<i>z</i>	<i>P</i> > <i>z</i>
Cluster 2 - Disoriented	0,846	0,120	7,059	0,000 ***
Cluster 3 - HWGM eaters	1,506	0,142	10,604	0,000 ***
Female	0,041	0,088	0,469	0,639
Northwest Italy	0,194	0,131	1,479	0,139
Southern Italy and Islands	-0,022	0,110	0,205	0,838
Central Italy	0,136	0,133	1,025	0,305
Age	-0,127	0,053	2,423	0,015 *
Edu	0,246	0,072	3,414	0,001 ***
Income	0,374	0,080	4,687	0,000 ***
Constant	-1,539	0,355	4,336	0,000 ***
Log Likelihood	-306,135			
Pseudo R-squared	0,148			

Note: Significance Levels: *** $p < 0.001$; ** $p < 0.010$; * $p < 0.050$; for the categorical covariates baselines refer to the Table 4.9.

As expected, probit estimates show that the proportion of wild game meat eaters increases across consumer segments ($p < 0.001$) from Cluster 1 (*pro-animal*) to Cluster 3 (*HWGM eaters*), and that individuals are more likely to consume HWGM if they are younger ($p < 0.050$). Moreover, the probability of HWGM consumption increases with the individual's education level and household income ($p < 0.001$). Gender and geographical region of residence seem to have no effect on HWGM consumption. Finally, the statistical significance of the coefficients for clusters 2 and 3 indicate differences in consumption patterns for HWGM across the

three clusters or segments. According to the Wald Chi-Squared Test (reported in table 4.10.) the null hypothesis of equality between classes can be rejected, indicating that the probability of consuming HWGM varies across consumer segments.

Table 4.10. Wald Tests across clusters

Hypothesis	Wald Chi-square	<i>p</i>-value
Ho: Cluster 1 = Cluster 2	49,834	0,000 ***
Ho: Cluster 1 = Cluster 3	112,443	0,000 ***
Ho: Cluster 2 = Cluster 3	38,883	0,000 ***

Significance Levels: *** $p < 0.001$; ** $p < 0.010$; * $p < 0.050$

4.5. Conclusions

This study profiles Italian consumers according to their attitudes and perceptions towards HWGM, socio-demographic characteristics and objective knowledge, and it assesses whether these factors affect consumer consumption of HWGM products. Through a cluster analysis, three different consumer groups were identified and classified as pro-animal consumers, disoriented consumers and HWGM eaters. The three groups (clusters) showed significant differences with respect to their socio-demographic characteristics (gender, education level and average household income), consumption of HWGM and their level of objective knowledge. Cluster one, termed pro-animal consumers, was the smallest (16.3%) and included significantly more females, those who are less educated, and those with a low income who are particularly concerned

about animal welfare and give high value to wildlife. This cluster showed very low attitudes towards HWGM, hunting, and HWGM safety, as well as the lowest degree of knowledge about HWGM. This group seemed the least interesting for future marketing strategies. The second and largest cluster (55.8%) was the intermediate group of disoriented consumers that mainly comprised consumers who were more educated, with a good financial status, who revealed concern about animal welfare and gave importance to wildlife enjoyment and animal rights, but had positive attitudes towards HWGM and its safety. On the other hand, these consumers had relatively low attitudes towards hunting. Moreover, the majority of the disoriented consumers (60.1%) reported having eaten HWGM in the last year, but showed a low degree of knowledge about HWGM. Considering all these factors, this consumer group is the most interesting for future targeted marketing strategies aimed at increasing HWGM consumption. Finally, the cluster of HWGM eaters (27.9% of the sample) contained mainly male consumers, consumers with the highest education level, and those with a medium or high financial status, with strong positive attitudes towards the consumption of HWGM products and strong positive feelings concerning its safety. These consumers reported the highest attitudes towards hunting and the lowest scores related to animal welfare issues and wildlife value orientation. Moreover, the majority of them (83.0) reported having eaten wild game meat in the last year, and they had the highest degree of knowledge about HWGM.

Our findings provide new insight for the development of a new market for Italian HWGM, highlighting the existence

of an important lack of consumer knowledge that could act as a barrier to consumption. Several studies, in fact, have reported that higher consumer knowledge about certain food products has a positive influence on purchase and consumption (Brucks, 1985; Pieniak et al., 2010a; Van Loo et al., 2013; Prestamburgo & Sgroi, 2018). There is a need to better inform and educate citizens about the hunted wild game meat sector, as well as about HWGM. Consumers need to be informed about European hunting regulations, the role of hunting activities in the management of large wild animal overpopulation, and the impact of the high densities of these animals on ecosystems and human activities. On the other hand, consumers need to be aware of all the positive intrinsic features of HWGM. Only by improving consumers' knowledge about HWGM is it possible to increase the likelihood of its consumption. Further research is needed to provide new insights into the existence of consumer segmentation towards HWGM in different geographical areas and cultural contexts. Future studies on this topic should focus on the analysis of consumer preferences and willingness to pay for Italian hunted wild game meat products by adopting the discrete choice experiment (DCE) method.

Acknowledgments

This research work has been funded by University of Milan – Department of Health, Animal Science and Food Safety (VESPA) “Piano di Sostegno alla Ricerca 2017 - Linea 2 Azione A”; and Fondazione Cariplo “Bandi Ambiente 2016” – Progetto “Processi di Filiera Eco-Alimentare – La gestione di prodotto sostenibile per lo sviluppo dei territori alpini”. The authors acknowledge the anonymous referees for their comments and suggestions.

References

AC Nielsen (2016) Weighing consumers’ growing appetite for “Clean” meat labeling. Fresh Facts historical data, 2011-2015. Insights news, October 2016.

Ahl, A., Nganwa, D., Wilson, S. (2002) Public health considerations in human consumption of wild game. *Annals of the New York Academy of Sciences* 969:48-50.

Almli, V.L., Van Wezemael, L., Verbeke, W. (2013) One technology does not fit all: Profiling consumers of tender and tenderised beef steaks. *Meat Science* 93:361-370.

Angulo, A.M.; Gil, J.M. (2007) Risk perception and consumer willingness to pay for certified beef in Spain. *Food Quality and Preference* 18(8):1106-1117.

Aprile, M.C., Caputo, V., Nayga, R.M. (2015) Consumers’ preferences and attitudes toward local food products. *Journal of Food Products and Marketing* 22(1):1-26.

Atanassova, V., Apelt, J., Reich, F., Klein, G. (2008) Microbiological quality of freshly shot game in Germany. *Meat Science* 78:414-419.

Bacher, J., Wenzig, K. & Vogler, M. (2004). SPSS twostep cluster: A first evaluation. (Arbeits- und Diskussionspapiere. 2, 2) Erlange—Nurnberg, University of Friedrich—Alexander, Chair of Sociology (retrieved August 25, 2007).

Berndsen, M., Van der Pligt, J. (2004) Ambivalence towards meat. *Appetite* 42:71-78.

Byrd, E., Lee, J.G., Widmar, N.J.O. (2017) Perceptions of hunting and hunters by U.S. respondents. *Animals (Basel)* 7(11):83.

Bodnar, K., Benak, A., Bodnarne Skobrak, E. (2010) Analysis of consumers preferences and attitudes on Hungarian game meat market (preliminary report). *Lucrări Științifice* 53(1):9-12.

Bonne, K., Vermeir, I., Bergeaud-Blackler, Verbeke, W. (2007) Determinants of halal meat consumption in France. *British Food Journal* 109(5):367-386.

Brucks, M. (1985) The effects of product class knowledge on information search behavior. *Journal of Consumer Research* 12(1):1-16.

Bureš, D., Bartoň, L., Kotrba, R., Hakl, J. (2014) Quality attributes and composition of meat from red deer (*Cervus elaphus*), fallow deer (*Dama dama*) and Aberdeen Angus and Holstein cattle (*Bos taurus*). *Journal of the Science of Food and Agriculture* 95:2299-2306.

Canavari, M., Nocella, G., Scarpa, R. (2005) Stated willingness-to-pay for organic fruit and pesticide ban: an evaluation using both web-based and face-to-face

interviewing. *Journal of Food Products Marketing*, 11(3):107-134.

Cembalo, L., Caracciolo, F., Lombardi, A., Del Giudice, T., Grunert, K.G., Cicia, G. (2016) Determinants of individual attitudes toward animal welfare-friendly food products. *Journal of Agricultural and Environmental Ethics*, 29(2):237-254.

Cerulli, T. (2012) *The mindful carnivore: a vegetarian's hunt for sustenance*. New York, NY: Pegasus Books.

Charles M. Russell National Wildlife Refuge, UL Bend National Wildlife Refuge (2010) *Comprehensive Conservation Plan: Environmental Impact Statement*. U.S. Fish and Wildlife Service. Northwestern University – Montana.

Cronbach, L. J. (1951) Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3):297–334.

Dimech, M., Caputo, V., Canavari, M. (2011) Attitudes of Maltese consumers towards quality in fruit and vegetables in relation to their food-related lifestyles. *International Food and Agribusiness Management Review*, 14(4):21-36.

De Graaf, S., Vanhonacker, F., Van Loo, E.J., Bijttebier, L.L., Tuytens, F.A.M, Verbeke, W. (2016) Market opportunities for animal-friendly milk in different consumer segments. *Sustainability*, 8(12):1302.

Demartini, E., Vecchiato, D., Gaviglio, A., Tempesta, T., Viganò, R. (2018) Consumer preferences for red deer meat: A discrete choice analysis considering attitudes towards wild game meat and hunting. *Meat Science* 146:168-179

European Commission – Directorate General for Agriculture and Rural Development (2014) Study Report – Minor Meats. September 2014. LEI Wageningen UR.

FAO (2007) FAOSTAT. <http://faostat.fao.org/>.

Fiedler, J., & McDonald, J. J. (1993) Market figmentation: Clustering on factor scores versus individual variables. AMA Advanced Research Techniques Forum.

Font-i-Furnols, M., Guerrero, L. (2014) Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Science* 98:361-371.

Frewer, L.J., Kole, A., Van De Kroon, S.M.A., De Lauwere, C. (2005) Consumer attitudes towards the development of animal-friendly husbandry systems. *Journal of Agricultural and Environmental Ethics* 18:345-367.

Fulton, D.C., Manfredi, M.J., Lipscomb, J. (1996) Wildlife value orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife* 1(2):24-47.

Gamborg, C., Jensen, F.S. (2016) Wildlife value orientations among hunters, landowners and the general public: A Danish comparative quantitative study. *Human dimensions of wildlife* 21(4):328-344.

Gamborg, C., Jensen, F.S. (2017) Attitudes towards recreational hunting: A quantitative survey of the general public in Denmark. *Journal of Outdoor Recreation and Tourism* 17:20-28.

Gaviglio, A., Demartini, E., Marescotti, M.E. (2017) Opportunities and limitation from an Italian alpine case study. *Calitatea – Access la Succes* 18(2):215-222.

Gaviglio, A., Marescotti, M.E., Demartini E. (2018) The local value chain of hunted red deer meat: A scenario

analysis based on a northern Italian case study. *Resources* 7(2):34.

Giacomelli, S., Gibbert, M. (2018) “He likes playing the hero – I let her have fun shooting”. Gender games in the Italian forest during the hunting season. *Journal of Rural Studies* 62:164-173.

Goguen, A.D., Riley, S.J., Organ, J.F., Rudolph, B.A. (2018) Wild-harvested venison yields and sharing by Michigan deer hunters. *Human Dimension of Wildlife* 23(3):197-212.

Grunert, K.G., Bredahl, L., Brunsø, K. (2004) Consumer perception of meat quality and implications for product development in the meat sector – a review. *Meat Science* 66:259-272.

Guimarães, M.H., Nunes, L.C., Madureira, L., Santos, J.L., Boski, T., Dentinho, T. (2015) Measuring birdwatchers preferences: a case of using online networks and mixed-mode surveys. *Tourism Management* 46:102-113.

Harper, G., Henson, S. (2001) Consumer concerns about animal welfare and the impact on food choice. EU FAIR CT98-3678 Final Report, 38 pp. http://europa.eu.int/comm/food/animal/welfare/eu_fair_project_en.pdf.

Higgs, J.D. (2000) The changing nature of red meat: 20 years of improving nutritional quality. *Trends in Food Science & Technology* 11:85-95.

Hofbauer, P., Smulders, F.J.M, Vodnansky, M., Paulsen, P. (2010) A note on meat quality traits of pheasants (*Phasianus colchicus*). *European Journal of Wildlife Research* 56(5):809-813.

Hoffman, L.C., Crafford, K., Muller, N., Schutte, D.W. (2003) Perceptions and consumption of game meat by a group of tourists visiting South Africa. *South African Journal of Wildlife Research* 33(2):125-130.

Hoffman, L.C., Muller, M., Schutte, D.W., Crafford, K. (2004) The retail of South African game meat: current trade and marketing trends. *South African Journal of Wildlife Research* 34(2):123-134.

Hoffman, L.C., Muller, M., Schutte, D.W., Calitz, F.J., Crafford, K. (2005) Consumer expectations, perceptions and purchasing of South African game meat. *South African Journal of Wildlife Research* 35(1):33-42.

Hoffman, L.C., Wiklund, E. (2006) Game and venison: meat for the modern consumer. *Meat Science* 74:197-208.

Hoffman, L.C. (2013) Producing game meat to meet the International hygiene and food safety requirements in the bush. American Meat Science Association, 66th Annual Reciprocal Meat Conference (RMC) Auburn University, Auburn, ALA.

Honkanen, P., Verplanken, B., Olsen, S.O. (2006) Ethical values and motives driving organic food choice. *Journal of Consumer Behaviour* 5:420-430.

Hrubes, D., Ajzen, I., Daigle, J. (2001). Predicting hunting intentions and behavior: An application of the Theory of Planned Behavior. *Leisure Sciences* 23(3):165-178.

Hutchinson, C.L., Mulley, R.C., Wiklund, E., Flesh, J.S. (2010) Consumer evaluation of venison sensory quality: Effects of sex, body condition score and carcass suspension method. *Meat Science* 86(2):311-316.

Italian National Institute of Statistics (ISTAT) (2018) ISTAT demographic balance January 2018. Rome.

Kaiser, H.F. (1974) An index of factorial simplicity. *Psychometrika* 39:31-36.

Kellert, S.R., Berry, J.K. (1987) Attitudes, knowledge, and behaviors toward wildlife as affected by gender. *Wildlife Society Bulletin* 15:363-371.

Kendal, H.A., Lobao, L.M., Sharp, J.S. (2006) Public concern with animal well-being: Place, social structural location, and individual experience. *Rural Sociology* 71(3):399-428.

Kubberød, E., Dingstag, Ø., Ueland, G.I, Risvik, E. (2006) The effect of animality on disgust response at the prospect of meat preparation. An experimental approach from Norway. *Food Quality and Preference* 17:199-208.

Kwiecińska, K., Kosicka-Gębska, M., Gębski, J., Gutkowska, K. (2017) Prediction of the conditions for the consumption of game by polish consumers. *Meat Science* 131:28-33.

Lusk, J.L., Tonsor, G.T. (2016) How meat demand elasticities vary with price, income, and product category. *Applied Economic Perspectives and Policy* 38(4):673-711.

Ljung, P.E., Riley, S.J., Heberlein, T. A. (2012) Eat Prey and Love: Game-meat consumption and attitudes toward hunting. *Wildlife Society Bulletin* 36(4):669-675.

Malhotra, N.K. (1999) *Marketing research: an applied orientation*. Upper saddle River, NJ: Prentice-Hall International.

Mayfield, L.E., Bennet, R.M., Tranter, R.B., Wooldridge, M.J. (2007) Consumption of welfare-friendly food products in

Great Britain, Italy and Sweden, and how it may be influenced by consumer attitudes to, and behavior towards, animal welfare attributes. *International Journal of Sociology of Food and Agriculture* 15(3):59-73.

Olsen, S.O. (2001) Consumer involvement in seafood as family meals in Norway: An application of the expectancy-value approach. *Appetite* 36(2):173-186.

Olsen, S.O., Scholderer, J., Brunso, K., Verbeke, W. (2007) Exploring the relationship between convenience and fish consumption: A cross-cultural study. *Appetite* 49(1):84-91.

Pérez-Cueto, F.J.A., Pieniak, Z., Verbeke, V. (2011) Attitudinal determinants of fish consumption in Spain and Poland. *Nutr. Hosp.* 26:1412-1419.

Peterson, R.A. (1994) A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research* 21:381-391.

Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K., Ottar Olsen, S. (2008) Impact of consumers' health beliefs, health involvement and risk perception on fish consumption: A study in five European countries. *British Food Journal* 110(9):898-915.

Pieniak, Z., Aertsens, J., Verbeke, W. (2010a) Subjective and objective knowledge as determinants of organic vegetables consumption. *Food Quality and Preferences* 21:581-588.

Pieniak, Z., Verbeke, W., Scholderer, J. (2010b) Health-related beliefs and consumer knowledge as determinants of fish consumption. *Journal of human nutrition and dietetics* 23(5):480-488.

Prestamburgo, S., Sgroi, F. (2018) Agro-food Markets' functional efficiency, products' quality and information's role. *Calitatea – Access la Succes* 19(164):149.

Ramanzin, M., Amici, A., Casoli, C., Esposito, L., Lupi, P., Marsico, G., Mattiello, S., Olivieri, O., Ponzetta, M.P., Russo, C., Trabalza Marinucci, M.M. (2010) Meat from wild ungulates: ensuring quality and hygiene of an increasing resource. *Italian Journal of Animal Science* 9(61):318–331.

Ripoll, G., Alberti, P., Panea, B. (2015) Consumer segmentation based on food-related lifestyles and perception of chicken breast. *International Journal of Poultry Science* 14(5):262-275.

Roininen, K.; Lähteenmäki, L; Tuorila, H. (1999) Quantification of consumer attitudes to health and hedonic characteristics of foods. *Appetite* 33:71-88.

Rule, D.C., Broughton, K.S., Shellito, S.M., Maiorano, G. (2002) Comparison of muscle fatty acid profiles and cholesterol concentrations of bison, beef cattle, elk, and chicken. *Journal of Animal Science* 80:1202-1211.

Sepúlveda, W.S., Maza, M.T., Pardos, L. (2011) Aspects of quality related to the consumption and production of lamb meat. Consumers versus producers. *Meat Science* 87:366-372.

Swanepoel, M., Leslie, A.J., Hoffman, L.C. (2016) Comparative analyses of the chemical and sensory parameters and consumer preference of a semi-dried smoked meat product (cabanossi) produced with warthog (*Phacochoerus africanus*) and domestic pork meat. *Meat Science* 114:103-113.

Thogmartin, W. (2006) Why not consider the commercialization of deer harvests?. *Bioscience* 56:957.

Thulin, C.G., Malmsten, J., Ericsson, G. (2015) Opportunities and challenges with growing wildlife populations and zoonotic diseases in Sweden. *European Journal of Wildlife Research* 61(5):649-266.

Tomasevic, I., Novakovic, S., Solowiej, B., Zdolec, N., Skunca, D., Krocko, M., Nedomova, S., Kolaj, R., Aleksiev, G., Djekic, I. (2018) Consumers' perceptions, attitudes and perceived quality of game meat in ten European countries. *Meat Science* 142:5-13.

Van Loo, E.J., Caputo, V., Nayga, R.M., Meullenet, J.F., Crandall, P.G., Ricke, S.C. (2010) Effect of organic poultry purchase frequency on consumer attitudes toward organic poultry. *Journal of Food Science* 75(7):S384-S397.

Van Loo, E.J., Hoang Diem, M.N., Pieniak, Z., Verbeke, W. (2013) Consumer attitudes, knowledge, and consumption of organic yogurt. *Journal of Dairy Science* 96(4):2118-2129.

Van Wezemael, L., Verbeke, W., Kügler, J.O, de Barcellos, M.D., Grunert, K.G. (2010) European consumers and beef safety: Perceptions, expectations and uncertainty reduction strategies. *Food Control* 21:835-844.

Vanhonacker, F., Verbeke, W., Van Pouche, E., Tuytens, F.A.M. (2007) Segmentation based on consumers' perceived importance and attitude toward farm animal welfare. *International Journal of Sociology of Food and Agriculture* 15(3):84-100.

Vanhonacker, F., Van Loo, E.J., Gellynck, X., Verbeke, W. (2013) Flemish consumer attitudes towards more sustainable food choices. *Appetite* 62:7-16.

Vecchio, R., Annunziata, A. (2012) Italian consumer awareness of layer hens' welfare standards: a cluster analysis. *International Journal of Consumer Studies* 36:647-655.

Verbeke, W., Vackier, I. (2004) Profile and effects of consumer involvement in fresh meat. *Meat Science* 67:159-168.

Verbeke, W.; Viaene, J. (1999) Beliefs, attitude and behavior towards fresh meat consumption in Belgium: empirical evidence from a consumer survey. *Food Quality and Preference* 10:437-445.

Verbeke, W.; Pérez-Cueto, F.J.A.; de Barcellos, M.D.; Krystallis, A.; Grunert, K.G. (2010) European citizen and consumer attitudes and preferences regarding beef and pork. *Meat Science* 84(2):284-292.

Webb, E.C. (2003) Factors that affect the meat quality of domesticated animals and wildlife. *Game and Hunt* 9(7):51.

Willebrand, T. (2009) Promoting hunting tourism in north Sweden: opinions of local hunters. *European Journal of Wildlife Research* 55:209-216.

Wiklund, E., Farouk, M., Finstad, G. (2014) Venison: Meat from red deer (*Cervus elaphus*) and reindeer (*Rangifer tarandus tarandus*). *Animal Frontiers* 4(4):55-61.

Windle, J., Rolfe, J. (2011) Comparing responses from internet and paper-based collection methods in more complex stated preference environmental valuation surveys. *Economic Analysis and Policy* 41(1):83-97.

Wong, S.S., Aini, M.S. (2017) Factors influencing purchase intention of organic meat among consumers in

Klang Valley, Malaysia. *International Food Research Journal* 24(2):767-778.

APPENDIX A: Overview of the Questionnaire

1. **Have you consumed wild game meat in the last year?**
 - Yes
 - No

2. **Please indicate whether the following statements are true or false:**
 - “In Italy the populations of wild ungulates (red deer, wild boar, roe deer, chamois) are rapidly growing” (*True*)
 - “Hunters are not considered producers by the Italian law; therefore they cannot sell the meat they hunt” (*False*)
 - “Game meat (red deer, wild boar, roe deer, chamois) if compared with beef meat has a lower protein content and higher fat and cholesterol content” (*False*)
 - “Consuming game meat (red deer, wild boar, roe deer, chamois) is an ethical choice, sustainable and with a very low environmental impact” (*True*)
 - “Currently in Italy hunting is ‘controlled’, in fact it is subject to well defined rules concerning culling, species, times and places” (*True*)

3. For each statements please indicate which adjectives better describe your feelings towards the consumption of HWGM products.

Unfavourable	<input type="radio"/>	Favourable				
Unsatisfied	<input type="radio"/>	Satisfied				
Dislike	<input type="radio"/>	Like				
Negative	<input type="radio"/>	Positive				
Bad	<input type="radio"/>	Good				
Terrible	<input type="radio"/>	Delightful				

4. For each statements please indicate which adjective better describe your feelings when thinking about wild game meat safety.

Pessimistic	<input type="radio"/>	Optimistic				
Unconfident	<input type="radio"/>	Confident				
Unsatisfied	<input type="radio"/>	Satisfied				
Uncomfortable	<input type="radio"/>	Comfortable				
Suspicious	<input type="radio"/>	Trustful				
Worrying	<input type="radio"/>	At ease				

5. **Would you agree or disagree with the following statements?** (Those statements were not categorized and appeared in mixed order)

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
ANIMAL WELFARE (AW)					
It is important that the food I normally eat has been produced in a way that animals have not experienced pain	0	0	0	0	0
It is important that the food I normally eat has been produced in a way that animals' rights have been respected	0	0	0	0	0
In general humans have too little respect for the quality of life of animals	0	0	0	0	0
Increased regulation of the treatment of animals in farming is needed	0	0	0	0	0
Animal agriculture raises serious ethical questions about the treatment of animals	0	0	0	0	0
As long as animals do not suffer pain, humans should be able to use them for any purpose	0	0	0	0	0
It is acceptable to use animals to test consumer products such as soaps, cosmetics and household cleaners	0	0	0	0	0
Hunting animals for sport is an acceptable form of recreation	0	0	0	0	0

(continued)

Would you agree or disagree with the following statements?
 (Those statements were not categorized and appeared in mixed order) (continued)

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
ATTITUDES TOWARDS					
HUNTING (AH)					
Hunting helps keep nature in balance	0	0	0	0	0
Most hunters are well-prepared when they go hunting	0	0	0	0	0
I see little wrong with harvesting animals for their meat as long as the animal is not endangered	0	0	0	0	0
Hunters are properly trained and follow hunting regulations	0	0	0	0	0
Hunting is an important rural tradition	0	0	0	0	0
I regard any kind of sport and recreational hunting as cruel to animals	0	0	0	0	0
Hunters often ignore safety rules	0	0	0	0	0
Hunters often harm animals, which then dies a slow and painful death	0	0	0	0	0
I do not like people who hunt	0	0	0	0	0

(continued)

Would you agree or disagree with the following statements?
 (Those statements were not categorized and appeared in mixed order) (continued)

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
WILDLIFE-RELATED VALUES (WV)					
It is important to manage the populations of wildlife for benefit of humans	0	0	0	0	0
I enjoy watching wildlife when I take a trip	0	0	0	0	0
It is important to protect wildlife for future generations	0	0	0	0	0
Hunting and fishing are cruel and inhumane to the animals	0	0	0	0	0
I notice birds and wildlife around me every day	0	0	0	0	0
People should not cause pain and suffering to wildlife, regardless of how much we may benefit	0	0	0	0	0
It is important that we learn all we can about wildlife	0	0	0	0	0
Animals should have rights similar to the rights of humans	0	0	0	0	0

APPENDIX B

Table B1. Results of the Factor analysis of the 37-items: rotated component matrix results

	Component (Factor)							
	1	2	3	4	5	6	7	8
GENERAL ATTITUDES (ATT)								
Favorable/Unfavorable (R)	0.690							
Unsatisfied/Satisfied	0.770							
Dislike/Like	0.838							
Negative/Positive	0.841							
Bad/Good	0.828							
Terrible/Delightful	0.837							
PERCEPTION OF SAFETY (SAF)								
Pessimistic/Ottimistic			0.773					
Unconfident/Confident			0.789					
Satisfied/Unsatisfied (R)			0.508					
Uncomfortable/ Comfortable			0.777					
Suspicious/Trustful			0.809					
Worrying/At ease			0.830					

(continued)

Table B1. (continued)

	Component (Factor)							
	1	2	3	4	5	6	7	8
ANIMAL WELFARE (AW)								
It is important that the food I normally eat has been produced in a way that animals have not experienced pain		0.796						
It is important that the food I normally eat has been produced in a way that animals' rights have been respected		0.781						
In general humans have too little respect for the quality of life of animals		0.705						
Increased regulation of the treatment of animals in farming is needed		0.774						
Animal agriculture raises serious ethical questions about the treatment of animals		0.729						
As long as animals suffer pain, humans should not be able to use them for any purpose (R)								0.800
It is acceptable to use animals to test consumer products such as soaps, cosmetics and household cleaners (R)								0.645
Hunting animals for sport is an acceptable form of recreation (R)								0.475

Table B1. (continued)

	Component (Factor)							
	1	2	3	4	5	6	7	8
ATTITUDES TOWARDS HUNTING (AH)								
Hunting helps keep nature in balance				0.606				
Most hunters are well- prepared when they go hunting				0.784				
I see little wrong with harvesting animals for their meat as long as the animal is not endangered				0.548				
Hunters are properly trained and follow hunting regulations				0.758				
Hunting is an important rural tradition				0.663				
I regard any kind of sport of recreational hunting as cruel to animals (R)					0.722			
Hunters often ignore safety rules (R)					0.819			
Hunters often harm animals, which then dies a slow and painful death (R)					0.761			
I do not like people who hunt (R)					0.502			

Table B1. (continued)

	Component (Factor)							
	1	2	3	4	5	6	7	8
WILDLIFE-RELATED VALUES (WV)								
It is important to manage the populations of wildlife for benefit of humans (R)						-0.516		
I enjoy watching wildlife when I take a trip						0.714		
It is important to protect wildlife for future generations						0.605		
Hunting and fishing are cruel and inhumane to the animals							0.708	
I notice birds and wildlife around me every day						0.614		
People should not cause pain and suffering to wildlife, regardless of how much we may benefit		0.588						
It is important that we learn all we can about wildlife						0.609		
Animals should have rights similar to the rights of humans							0.622	

Table B2. PCA components internal reliability consistency

Scale	Original scale	Cronbach's α -values		Reduced scale
		PCA Subscale 1	PCA Subscale 2	
GENERAL ATTITUDES (ATT)	0.946	-	-	
PERCEPTION OF SAFETY (SAF)	0.919	-	-	
ANIMAL WELFARE (AW)	0.696	0.863 (Factor 2)	0.550 (Factor 8)	
ATTITUDES TOWARD HUNTING (AH)	0.866	0.835 (Factor 4)	0.816 (Factor 5)	
WILDLIFE RELATED VALUES (VW)	0.830	0.515 (Factor 6)	0.686 (Factor 7)	0.654*

*Reduced scale obtained by removing the single item that loaded on the factor 2.

CHAPTER 5

Conclusions

In recent years, trends in the population of large wild ungulates (wild boar, red deer, chamois, mouflon) have become worrisome for Italy and many European countries. Ironically, while two decades ago these animals were listed as endangered species, they turned out to be a social cost. In fact, their population is growing, causing damage to ecosystems, economic losses in forestry and agriculture, increased risk of zoonotic diseases and increased frequency of vehicle collisions. Due to this overpopulation, management and containment strategies have been developed, with a cost to public institutions and an increase in culling rates as well as availability of game meat. Furthermore, according to European trade and safety regulations (Reg. EC No. 178/2002, No. 853/2004 and No. 854/2004), hunters are considered primary food producers (such as farmers and breeders), and under certain conditions, they can sell the game they harvest.

On the consumers' side, in recent years, there has been a notable increase in the popularity of hunted wild game meat. In fact, large wild ungulate meat has optimal nutritional values, can be considered an environmentally friendly and local food and represents a sustainable alternative to intensive livestock production of beef, pork or poultry.

The growing demand for these products has led to a growing number of emerging markets for hunted wild game meat in many developed countries, including Europe. However, the expansion of hunted wild game meat markets is often hampered by the lack of a structured food supply chain. This is especially the case in Italy, in which the hunting sector continues to have only a recreational and social connotation.

Despite the growing potential of the hunting sector, in Italy (but also in Europe), only a few economic studies to date have discussed the case of wild game meat, and to the best of our knowledge, there is no research examining the Italian context.

All these premises considered, the present thesis provides an overview of the opportunities and limitations connected to the development of a new Italian professional short food supply chain in the field of animal production, namely, the wild game meat supply chain; it also examines all the hypothetical stakeholders. The results of this study led us to better understand some aspects of the current scenario of the Italian hunted wild game meat sector, highlighting its current strengths and weaknesses; the final aim of the study was to understand if and what types of

strategies implement for the promotion of its future development.

Considering the research findings, we can reasonably assume that the Italian hunting sector presents interesting characteristics in terms of the amount of wild ungulates meat. Nonetheless, the quality of the meat still lacks the hygienic and quality standards required for trade. The low education level and the age of the hunters surely has an effect on non-adequate behaviors; the cultural Italian background of the hunting sector probably represents the most important resistance to change. However, it must be highlighted that a portion of the hunters who were interviewed knows good hunting and post-harvesting practices; the evolution and improvement in hunter behavior is thus possible, and policy-makers and researchers should study the incentives to promote these changes. Building on basic microeconomics principles, the market is the best tool for the allocation of resources, and profit and utility-driven choices are typically efficient. Hence, by evaluating the potential dynamic of the value of game meat, it has been shown that its estimated economic value could be an adequate incentive for hunters; to maximise their revenue, they would seek to achieve a higher quality of meat, which is possible only by following good hunting practices. Moreover, the creation of a market is expected to generate positive outcomes; for example, other stakeholders (transformers and restaurateurs) involved in the supply chain may diversify their production, increasing the availability of locally produced meat and managing wildlife overpopulation at no cost to the public.

However, whether a supply chain of hunted wild game meat is economically sustainable depends on whether there is a demand for these products, which in turn depends on how consumers perceive them. In this regard, it is possible to affirm that if obtained under strict and regulated hunting practices, game meat embeds a number of quality features that may attract modern consumers when purchasing meat products. Considering our findings related to the study of the consumer, the results showed the existence of important information asymmetry between consumers and producers (hunters and transformers) that could act as a barrier to consumption. Consumers, in fact, are often not aware that hunting may be practiced ethically and that it is an activity subjected to strict and well-defined regulation. There is a need to better inform and educate citizens about the hunted wild game meat sector, and about hunted wild game meat. Only by improving consumers' knowledge about game meat is it possible to increase the likelihood of its consumption.

The present doctoral thesis contributes to the development of a new Italian professional market by analysing its feasibility from different point of view. Overall, findings from this study can help policy makers design new strategic and effective interventions for the management of large wild ungulate overpopulation (i.e. hunters training to increase hunters' awareness about their basic role; information campaigns for increase consumers' knowledge; financial support for the development of control centers for the meat; drafting of official production specification rules; organization of stakeholders meeting and focus group). This management aims to be sustainable, with well-defined

culling plans, guaranteeing the respect of the environment, and ensuring control over wild ungulate populations and safeguarding the environment and wild animals.

The results of this study, which offer more information to stakeholders, may be useful for the positioning and pricing of novel game meat products. Knowledge about the socio-demographic and attitudinal profiles of consumers in relation to how they perceive wild game meat may in fact allow marketers to better target their novel game meat products, improving the effectiveness of future marketing strategies.

Finally, the study limitations are worth mentioning. Firstly, with reference to the quality of the meat, the stated experiences collected can be partly biased. A multidisciplinary approach, introducing microbiological and sanitary data harvested species during the hunting seasons would enhance the survey's reliability and informative capacity. Moreover, while the research provides original estimates of the value of large wild ungulate game meat, the costs have not been taken into consideration; consequently, it is not possible to calculate the expected profit for each stakeholder and therefore no strong, neither final, results can be inferred from the available data. Despite this, the research contribution is relevant for Italian hunting sector management because the market prices are always important for private stakeholders when deciding whether to enter the market, as well as for public institutions when planning policy interventions.

In conclusion, this research provides evidence that the development of a sustainable local supply chain for Italian wild ungulates meat represents an economic resource for private and public stakeholders and a resilient source for marginal territories.

Further research on this topic will focus on consumer preferences and willingness to pay for an Italian game meat product.

“My life has no purpose, no direction, no aim, no meaning,
and yet I’m happy.

I can’t figure it out. What am I doing right?”

Charles M. Schulz

Acknowledgments

Undertaking this Ph.D. was a magnificent as well as challenging experience to me. In these three years, several people have been by my side on this journey. Here is a small tribute to all of them.

First of all, I would like to express my special gratitude to my advisor prof. Anna Gaviglio for all the support, advice, encouragement and all the numerous opportunities that she gave me throughout my doctoral studies.

I owe my deepest gratitude to prof. Vincenzina Caputo for her generosity to transfer all her knowledge to me and for have invested her time on me. It has been a great honor for me spent a semester working and learning near her side.

I would like to thank the referee of my thesis for allowing their precious time to read the manuscript.

Many thanks are also due to Eugenio Demartini for all his valuable support and for have introduced me to the consumer study, to prof. Alberto Pirani for his wisdom and for all the advices, fruit of a long academic experience, and to Rosalia Filippini for all her words of encouragement during these last tough months.

I gratefully acknowledge the funding sources received towards my PhD from Fondazione Cariplo and from the Department of Health, Animal Science and Food Safety (VESPA) of the University of Milan. I also want to thank the Department of Agricultural, Food and Resource Economics

(AFRE) of Michigan State University for hosting me as Visiting Scholar and for offering me the opportunity to attend useful courses and inspiring seminars.

A special thanks goes to all the people who believed in the ambitious project “Filiere Ecoalimentare”, and who have offered their precious knowledge and experience; a special mention should go to Andrea Cottini and Federica Fili from Ars.UNI.VCO and Roberto Viganò from Alp Vet for their professionalism and passion.

Moreover, I have great pleasure in acknowledging my gratitude to all the amazing young colleagues and great professors that I had the chance to meet during these years during congress, classes, summer school and during my period abroad. In particular my special thanks are due to Petjon Ballco, Mattia Bertocchi, Elena Facchini, Marco Gelati, Danielle Kaminski, Angelos Lagoudakis, Lucia Pacca, for all the support and the laughs, for have being wonderful colleagues and great friends.

I would like to dedicate this work to my family and my husband Matteo. Words are powerless to express my gratitude to them who have always believed in me when I have not, supported me at my weakest and encouraged me to be my best.

Maria Elena

