

# **Perceptions about commercial ostrich farming: views of consumers, farmers and secondary stakeholders**

by

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## Summary

South Africa is the premier producer of ostrich products worldwide. The ostrich industry has recently come under scrutiny due to the global increased awareness of the welfare of production animals. This lucrative, niche market industry is not well known in most parts of the world and as a result of the public's limited exposure to the ostrich industry and its husbandry practices, views and opinions about the industry and the welfare status of ostriches might be inadequate. However, the perceptions and opinions of the general public and specifically ostrich product consumers could increasingly determine the global market for ostrich products.

This study aimed to determine the differences in knowledge, opinion and perceptions amongst consumers, farmers and secondary stakeholders in the ostrich industry with respect to ostrich production practices and the resulting welfare impact thereof. Participants were asked to complete a comprehensive survey, which firstly determined demographic factors – as these often influence the way in which a person's opinion is expressed. Questions related to participants' knowledge of ostrich farming followed; thereafter how important they perceive the impact of management and production aspects on the welfare of ostriches, and the potential impact of welfare aspects on buying decisions. Farmers and secondary stakeholders in the industry were specifically asked about their preferences regarding husbandry practices implemented on-farm and the perceived welfare impacts thereof. Most answers in the survey were scored on a scale of 1 to 5, from least to most important/likely/knowledgeable or from a highly negative to highly positive impact.

The main results of this study highlighted a significant lack of knowledge about the ostrich industry and associated production practices, amongst consumers and specifically women

and the youth. Generally, all participants agreed on the importance of basic needs (feed, water, health) for the well-being of ostriches. Significant emphasis was placed on natural rearing and husbandry practices as it appears that consumers, women, vegetarians and high-income participants, prefer production animals to be reared in environments that resemble their natural habitat. Importance was also placed on the level of knowledge and skill of stockmen involved in the industry. It appeared that specifically women and vegetarian participants placed a high value on the general welfare of farmed ostriches, while ostrich farmers emphasised the welfare of animals destined for slaughter in order to maintain product quality. Consumers indicated that there is a need to implement a formal welfare protocol for commercial ostrich production.

Farmers preferred artificial rearing and incubation/hatching practices with human assistance (when necessary) and they placed emphasis on the importance of product quality when compared to secondary stakeholders. It was also evident that farmers more readily preferred welfare conscious production practices in contrast to the preference for welfare neutral or even potentially compromising production practices by secondary stakeholders. Farmers showed their preference for frequent visual inspection of birds and seemed to score the importance of the welfare of ostriches for product quality higher than stakeholders. Furthermore the transportation and relocation of birds was identified as a potential welfare problem in the industry. Farmers were also less likely to promote the introduction of ostrich-specific welfare protocols on-farm than stakeholders in the industry.

The results of this survey aided in identifying potential welfare problems in the ostrich industry and could form the basis of future work for the development of a welfare protocol for the commercial farming of ostriches. Some considerations for welfare indicators and measures have been developed stemming from the results of this study (Appendix G). Further studies

could investigate the effect of different handling and transportation practices on the well-being of commercially farmed ostriches. This study thus emphasizes the need for a formal welfare protocol or “Code of best practices” for the commercial farming industry as this will improve product quality and transparency and will also enable farmers to promote the welfare of ostriches produced for slaughter.

## Opsomming

Suid-Afrika is die wêreldleier in volstruisboerdery. Die produksie van volstruise het onlangs onder die soeklig gekom as deel van die wêreldwye verhoogde bewustheid rakende die welsyn van produksiediere. Dié nismarkbedryf is onbekend in baie dele van die wêreld en die publiek se beperkte kennis ten opsigte van die bedryf en die welsynstatus van produksiediere daarin mag hul opinies en persepsies beïnvloed. Die wêreldmark vir volstruisprodukte sal toenemend deur die persepsies en opinies van die algemene publiek en verbruikers bepaal word.

Die doel van hierdie studie was om verskille tussen verbruikers, boere en aandeelhouers in die bedryf se kennis, kundigheid, opinies en persepsies ten opsigte van produksiepraktyke en die invloed daarvan op die welsyn van volstruise te bepaal. Deelnemers is versoek om 'n volledige vraelys in te vul wat eerstens 'n reeks demografiese faktore bepaal het, omrede die faktore dikwels 'n rol speel in die manier waarop mense hul idees en denke uitdruk. Deelnemers is ook uitgevra oor hul kundigheid van die volstruisbedryf, hoe belangrik sekere bestuurs- en produksiepraktyke geag word en wat koopbesluite beïnvloed. Boere en rolspelers in die bedryf is ook gevra oor hul voorkeure en afkeure met betrekking tot bedryfs- en boerdrypraktyke.

Die meerderheid vrae is op 'n glyskaal van 1 tot 5 beoordeel, van die minste tot meeste belangrikheid en/of kundigheid.

Die hoof resultate van hierdie studie het 'n betekenisvolle tekort aan kennis en kundigheid oor die volstruisbedryf onder verbruikers aangedui, veral by vroulike verbruikers en jong mense. In die algemeen het deelnemers saamgestem oor die belangrikheid van basiese voedings-,

water- en gesondheidsbehoefte van volstruise om goeie welsyn te verseker. Beduidende klem is egter op natuurlike boerderypraktyke geplaas vir die uitbroei en grootmaak van volstruiskuike, veral deur vroue, vegetariërs en deelnemers met hoë inkomste. Deelnemers verkies dat diere in 'n omgewings groot gemaak word wat hul natuurlike habitat bes moontlik naboots. Daar is ook duidelike klem gelê op die belangrikheid daarvan dat werkers in die bedryf volstruise goed ken, asook die nodige ondervinding en vermoëns het om met die diere te werk. Dit blyk ook dat spesifiek vroue en vegetariërs hoë waarde aan die welsyn van volstruise heg, terwyl volstruisboere meer bekommerd is oor die algemene welsyn van produksiediere om produkkwaliteit te verseker. Verbruikers het ook aangedui dat die implementering van 'n formele volstruiswelsynsprotokol vir hulle belangrik is.

Dit blyk duidelik dat boere kunsmatige grootmaak en natuurlike produksie- en bestuurstelsels verkies, moontlik as gevolg van hoër produksie-uitsette. Boere het ook in vergelyking met ander rolspelers in die bedryf beduidend meer klem gelê op die belang van dierewelsyn vir eindproduk kwaliteit. Dit was ook duidelik dat boere meer geneig is om welsynsbewuste bestuurspraktyke te implementeer en te verkies vergeleke met ander rolspelers. Hoë waarde is op die gereelde inspeksie van voëls deur boere geplaas, en klaarblyklik ag boere die belangrikheid van volstruiswelsyn vir produksie-eienskappe aansienlik hoër as ander rolspelers. Die vervoer en verskuiwing van volstruise is as 'n potensiële probleemarea in die bedryf geïdentifiseer, wat verdere ondersoek verlang. Hierdie studie het ook daarop gewys dat volstruisboere minder geneig was om die implementering van 'n formele welsynsprotokol in die bedryf te ondersteun.

Die resultate van die studie het bygedra tot die identifikasie van potensiële welsynsprobleme in die volstruisbedryf en sal die basis vorm van die toekomstige ontwikkeling van 'n welsynsprotokol spesifiek vir die bedryf. Daar bestaan 'n duidelike behoefte vir so 'n

welsynsprotokol om die deursigtigheid van die bedryf te bevorder en om boere in staat te stel om die welsyn van produksiediere te bevorder. Oorwegings vir welsynsfaktore en aanwysers is uit die resultate van hierdie studie geïdentifiseer (Appendix G). Verdere studies behoort die effek van hanterings- en vervoerpraktyke op die welsyn van volstruise te ondersoek en sodoende 'n kode van beste praktye vir volstruisboerdery en –produksie daar te stel.



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"Patience is a virtue"

## **Preface**

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# **Chapter 1**

## **General Introduction**

Animal welfare is loosely defined and variably understood by different people, corporations and industries. This concept is therefore rarely agreed upon by all parties, and as such has sparked increased interest worldwide (Hewson, 2003). Various studies have focussed on physiological measures of welfare by studying heart rates, endorphins, cortisol levels and other physiological measures to determine how animals cope with their environment (Broom, 1991). These measures do, however, have their limitations when used in isolation. Hewson (2003) indicated for example that even though good genetics and suitable environments may have positive physical outcomes, animals may still have altered mental states. Animal welfare cannot therefore only be viewed from a physiological perspective; it must also include emotional states or mental well-being (Hewson, 2003). In more recent years animals have also been seen as sentient beings with feelings and it was thus proposed that animal welfare should encompass an animal's feelings and mental well-being as well (Duncan, 2005; Hewson, 2003).

Animal welfare has since moved towards a multidisciplinary approach that includes the animal's biological functioning, its subjective feelings, health and the demeanour of the animal. Another component of animal welfare is freedom to exhibit natural behaviour and to be raised in an environment that allows natural behaviours such as foraging, exploration, reproduction and parental care, social interaction and playing.

Due to the ever-increasing human population and demand for animal-derived food products, intense pressure has been placed on animal production systems to increase product output and production efficiency. This has led to the need to intensify animal production systems for maximal production in the shortest possible timeframe. Such industrialized production systems have sensitised the public to animal welfare concerns to the extent that welfare considerations increasingly influence buying decision along with ecological and socio-cultural

aspects of livestock production (Vanhonacker *et al.*, 2007). The industrialisation or intensification of livestock production systems in an attempt to provide adequate amounts of animal derived products for the increasing human population has resulted in the need to formulate and implement welfare and production standards that can be implemented on a farming level. Recently, on-farm protocols have been developed for other major livestock species, including sheep, chickens and pigs (Dalmau *et al.*, 2009; Heath *et al.*, 2014; De Jong *et al.*, 2015). Such protocols not only aimed at improving the welfare quality of these animals within production systems, but also the production efficiency of these systems along with consumer transparency and traceability, to ensure high product quality. No formal welfare protocol has yet been developed for ostrich farming to be used as a guideline for the welfare and production of farmed ostriches, mainly because it is such a young and relatively small industry supplying niche products to a mostly affluent overseas clientele.

The ostrich industry was first established in the 19<sup>th</sup> century in South Africa (Douglass, 1881). The domestication of ostriches is therefore much more recent than other livestock species that have been farmed with for centuries. As a result, the ostrich industry still faces multiple challenges at least in part due to the notoriously wild demeanour of these animals and their difficulty to handle, which might reflect their failure to adapt to farming environments. To date, no information has been gathered on the preferences and expectations of consumers, farmers, and other stakeholders in terms of product quality, management practices, welfare implications and buying decisions in the ostrich industry. The need for a comprehensive survey of consumers' perceptions of welfare in the ostrich industry has thus arisen to identify the public's main welfare concerns. Farm animal welfare as a whole is yet to be fully understood and addressed, but efforts should be made to determine the public's views and opinions thereof to assist with establishing welfare standards in the commercial ostrich industry. Similarly, little is known about farmer and stakeholder preferences of management

and production practices implemented in the industry and the perceived impact thereof on the welfare of farmed ostriches. Therefore, this study aimed to establish the level of knowledge and understanding of management and production processes in the ostrich industry, the overall perception of farmed ostrich welfare from all stakeholders' viewpoints and the welfare concerns and expectations that consumers and farmers have of ostrich products in the commodity market. This will potentially highlight welfare issues and will aid in developing protocols specifically tailored to commercial ostrich farming to not only improve management practices implemented in the industry, but also the on-farm welfare and production efficiency of this species.

# **Chapter 2**

## **Literature Review**



## 2.1 The concept of animal welfare

### 2.1.1 Defining the concept of animal welfare

Animal welfare was first defined by Broom (1986; 1991; 2001) as the state of an animal in relation to its environment, in terms of its body and physical environment. Farmers and veterinarians also classified welfare in terms of physical health and the animal's direct environment (Blood *et al.*, 1988), whereby an animal in good health and with acceptable production was regarded as being in a good welfare state. The second view of animal welfare has related welfare with the mind, feelings or emotions of animals (Duncan, 1996; Dawkins, 2006; Nordenfeldt, 2006) i.e. an animal is in a good state of welfare when it has a positive emotional state and/or when it is feeling well. More recently it has generally been accepted that animals are sentient beings that have feelings and this theory that animal welfare should encompass an animal's feelings and mental well-being has more generally been accepted (Brambell *et al.*, 1965; Duncan, 2002; Hewson, 2003). This has led to a feelings-based approach to animal welfare research that is based on behavioural outcomes and assessments. A third approach towards animal welfare has described animal welfare in terms of free or natural living - this approach proposes that animals are in a good state of well-being when they are allowed to live according to their nature, which includes being able to freely express their natural behaviours (Rollin, 1981; Kiley-Worthington, 1989).

Despite increasing awareness of the importance of animal welfare in the food production chain (Verbeke, 2009), animal welfare has been essentially left to the public's opinion, even if their knowledge with regards to production processes used in animal husbandry is relatively limited (Vanhonacker *et al.*, 2012). It is therefore important to acknowledge the vital role that the end-

chain consumer plays, in contrast to the practical knowledge of farmers when determining the welfare status of farmed animals.

### 2.1.2 Consumer and stakeholder perceptions of farmed animal welfare

The global need to intensify animal production systems to fulfil the ever-increasing global population's nutritional demands may be perceived by the public to compromise the well-being of intensively farmed animals. Concerns related to health, management, facilities, equipment, behaviour, pain and distress are typically associated with these intensified production systems (Swanson, 1995). As a consequence, consumers and non-consumers of animal products are increasingly concerned about food safety, the consequences food production systems have on the environment as well as farm animal welfare (Brom, 2000). Insights into how the public perceives animal welfare are vital, as animal welfare is a social concept that reflects the values of society (McInerney, 1991; Fisher, 2009). Societal values and norms steer the behaviour of the public, which in turn influences buying decisions. For instance, consumer concerns are influenced by the widened distance between consumers and farmers in the emerging global market. Brom (2000) highlighted that the majority of modern-day consumers have no direct contact with the farms that produce the food that they purchase. This physical distance between consumers and farmers has also widened the mental distance between the two groups and has increased the differences between the common morality of consumers and farmers (Brom, 2000).

Consumer buying decisions are often influenced by their expectations and perceptions of livestock production, and the way in which consumers perceive the products that they buy is influenced by the lack of contact with farmers. This, in turn, influences the way they build their trust towards certain products (Brom, 2000). Consumers often feel the need to know the origin

of the products they buy and often prefer products with adequate reassurance in terms of traceability and product quality. First world countries (i.e. Europe, Australia and North America) have increasingly criticized intensive livestock production. Although the demand for animal derived products has not been influenced extensively, public concern for animal welfare issues has a marked influence on the marketing and sale of such animal derived products (Maria, 2006). Specifically, the welfare of animals that are farmed for slaughter is becoming an important driver in consumer debates and food-choice decision making concerning animal derived products. This has also led to the rapid development of animal rights movements across these first world countries (Maria, 2006). Contrary to the latter, the tendency to buy cheap sources of meat still prevails across the globe, especially in developing countries. It seemed that consumers often attribute less importance to animal welfare in reality than they claim to. For instance, most Americans attributed a lower importance to animal welfare when direct questioning was compared to indirect questioning (Lusk and Norwood, 2009). The development of farm animal welfare is still relatively limited in countries such as China (You *et al.*, 2014). European citizens, however, clearly do value good farm animal welfare (You *et al.*, 2014) and their concerns and perceptions do exert an influence on animal production systems in other countries, especially those exporting to the EU (Miranda-de la Lama *et al.*, 2017).

Numerous studies have shown that there is a generally accepted discordance between different categories of the public, based on their involvement with the farm animal industry. Consumers, farmers and stakeholders generally disagree on whether to integrate the welfare of farmed animals as an additional factor to support buying decisions. This is primarily based on divergent opinions and perspectives of the importance of animal welfare amongst these categories of people (Lassen *et al.*, 2006; Marie, 2006; Vanhonacker *et al.*, 2008). According to Te Velde *et al.* (2002) a person's perception is shaped according to their frame of reference,

which is influenced by their convictions, values, norms, knowledge and interests. Different categories of the public have different views of not only the definition of animal welfare, but also of its importance with regards to animal-derived products and the impact on these animals. Generally, consumers' concerns are vaguely defined, easily influenced and related to their role in society, as well as the way in which they perceive a 'good society' (Brom, 2000). Typically, as consumers of animal-derived products, they prefer inexpensive, tasty and readily available products, while in their role as citizens, they regard morally and ethically accepted production methods as highly important when purchasing animal-derived products (Brom, 2000; Bennet *et al.*, 2002; Vanhonacker *et al.*, 2008).

However, they often have difficulties in forming a clear picture of the circumstances around the production of their food, essentially because of the remoteness of, or lack of involvement in the production process of their food (Brom, 2000). Consumers tend to be highly influenced by the surrounding societal pressure and media, even more so when there is a substantial lack of direct knowledge of and involvement in a subject. Consequently, it often leads to biased perceptions of certain concepts.

Generally, consumers have a negative perception of the state of farmed animal welfare (Vanhonacker *et al.*, 2008). The 2005 Eurobarometer study showed that 82.3% of European citizens rate the welfare of these animals as moderate to very bad. However, this study also illustrated that 89.3% of Europeans lack knowledge of the status of farmed animal welfare conditions, illustrating a clear need for consumers to be informed about such issues (European commission 2005).

With the intensification of livestock production systems to meet the demands of the ever-growing global population, consumers' knowledge of animal production systems are actually deteriorating (Harper and Henson, 2001; Frewer *et al.*, 2005; Maria, 2006). This is due to animal production systems expanding and intensifying, increasing the gap between consumers and farmers, so much so that most end-users are often not even aware of the origin of the products that they buy in supermarkets.

In addition, media coverage has increasingly created a negative image of the animal production industry, which in turn influences consumers' perceptions and opinions (Verbeke and Ward, 2001; Swinnen *et al.*, 2005). Generally, little informative public guidance on animal production is provided. In contrast, animal rights' groups often broadcast negative images about farming enterprises, without providing the context or full background regarding these production systems. The need for adequate information and transparency of the on-farm production systems has arisen to allow consumers to make informed buying decisions.

Most commonly consumers' perceptions of welfare are focussed around physical health, adequate feed, water and housing, freedom of movement and the ability to express natural behaviours (Te Velde *et al.*, 2002; Lassen *et al.*, 2006; Marie, 2006). In a study done by Miranda-de la Lama *et al.* (2017), the majority of Mexican consumers were willing to pay more for certified welfare-friendly products based on the benefits associated with product quality and improved consumer health. Similarly, amongst young, educated professionals and female Chinese and Spanish consumers, a higher regard for animal welfare was observed when purchasing animal products (Maria, 2006; You *et al.*, 2014). Both studies on Mexican and Spanish consumers illustrated the need to inform consumers about ethical food production to convince both consumers and producers of the economic importance and business opportunities related to good welfare of farm animals (Maria, 2006; Miranda-de la

Lama, 2017). Informed consumers might make better buying decisions by supporting farming systems with high ethical standards, which would place indirect pressure on producers that do not adhere to welfare and production standards for farmed animals.

Interestingly, farmers were shown to have a much more positive view of the overall current welfare of farmed animals compared to consumers (Vanhonacker *et al.*, 2008). However, Te Velde *et al.* (2002) and Lassen *et al.* (2006) indicated that farmers relate their norms and opinions to factors that are important for optimizing production. These factors may include basic health, feed and water needs, as well as the implementation of production practices that improve the efficiency of farming systems and increase productivity as well as product output. This suggests that farmers' opinions are driven by economical or financial concerns and the need to produce high quality products to satisfy consumers' needs. Farmers also positively relate optimal production and efficiency with animal welfare. In that sense, they principally rely on their knowledge and experience of animal health, production and nutrition to formulate their norms with regards to certain welfare aspects (Vanhonacker *et al.*, 2008). Hence, farmers tend to place aspects of welfare that are in their views not directly related to production (such as the ability to exhibit natural behaviour), at a lower level of importance in comparison to other factors, such as physical health, sufficient high-quality feed and water as well as adequate housing (Te Velde *et al.*, 2002; Maria, 2006; Morgan-Davies *et al.*, 2006). This might lead to conflicts between consumers and farmers preferences as attitudes towards welfare and the meaning thereof might differ between these groups. Farmers might be under the impression that they comply with animal welfare standards according to what they perceive as important indicators, without realizing that consumers might not share the same opinion.

Few studies have been done on the perceptions and opinions of other stakeholders that play a role in the animal industries, such as personnel at processing plants and veterinarians.

Contrasts between consumers and farmers are often considered in the absence of secondary stakeholders, resulting in the notion that the wants and needs of consumers and farmers differ when it comes to production and welfare. However, secondary stakeholders are in a position to make large profits from farming enterprises and their large influence on production systems is often overlooked. For instance, secondary stakeholders may exert pressure on farmers to increase production outputs in order to generate greater profits, without taking animal welfare into account. The contrary might also be true: stakeholders may exert pressure to improve the welfare status of production animals if they see fit. Further research in these areas is thus needed to determine whether stakeholders agree or disagree to a greater or lesser extent with the views and opinions of consumers and/or farmers.

### 2.1.3 Measuring farm animal welfare

With the growing importance of a compromise between human interests and those of animals reared for slaughter being recognized in developed countries, increasingly more secondary stakeholders (restaurants, supermarkets, butcheries, etc.) request higher welfare standards from primary suppliers of animal products (Hewson, 2003). These stakeholders also assess farmers' compliance herewith through independent on-farm welfare audits.

The need for adequate, practical ways to measure the welfare of animals in a reliable and accurate way has thus emerged. The most agreed upon method used to evaluate farm animal welfare involves a multidisciplinary approach that evaluates measures of physiology, behaviour and health. This approach must also consider the current societal issues that include sustainability, environmentally friendly and ethical production, food safety, economics, public perception, consumer demands and international trade (McGlone, 2001). Measuring farm animal welfare has, however, been immensely challenging, not only because of the

disagreement amongst parties on the definition of animal welfare, but because of the many practical challenges with assessing the welfare of different species within divergent farming environments.

On top of these challenges complicating matters further is that public perception drives consumer demand as well. Both consumers and non-consumers share views related to animals' feelings as noted by Duncan (1993), essentially due to a general lack of understanding of animal physiology, anatomy and other practical production measures that scientists perceive as more important when evaluating welfare (Moberg, 1987; McGlone, 1993; Barnett, 1997).

Various welfare evaluation systems have been developed, most of which are welfare indices based on environmental observations of design measures (resource or management based measures) that may influence animal welfare, and selected animal observations (animal based measures), mainly of performance measures and behavioural attributes that reflect the internal state of the animal. These welfare measures are often translated into a single overall welfare score, the danger herewith being that "bad" aspects of welfare may be moderated by other satisfactory welfare aspects (Blokhuys *et al.*, 2008). To develop an overall inclusive welfare evaluation protocol, measures based on assessing the actual state of the animal should be included (i.e. behaviour, physiology, health, performance and immunity), as well as an assessment of management and the interaction between the animal and its environment. Resource and management-based measures are usually also included to highlight potential causes of poor welfare with the aim of developing practical remedial strategies that can be implemented on-farm.



The Welfare Quality® project ([www.welfarequality.net](http://www.welfarequality.net)) has recently been developed for commonly farmed livestock species (i.e. cattle, pigs and poultry), and was implemented in several European countries. The perspectives encapsulated in the Welfare Quality® project is a framework built on the comparison between the perspectives and opinions of all stakeholders involved. This project has in essence been designed to meet European consumers' demands and concerns regarding their strong commitment to animal welfare and its attribution to overall food quality in an attempt to improve welfare standards and legislation across European farming systems (Blokhuys *et al.*, 2008).

The Welfare Quality® project aimed to develop practical and implementable strategies to improve animal welfare by developing a protocol for the assessment of the welfare of production animals both on-farm and at slaughter. This project also aimed to translate assessment data to product information and to integrate the expertise of specialists in a multidisciplinary approach to animal welfare ([www.welfarequality.net](http://www.welfarequality.net)). This approach integrates the need for transparent and reliable information about the production processes of animal derived products. Consumers are committed to animal welfare and the development of a scientifically sound method of evaluating the welfare status of farmed animals. The Welfare quality approach thereby allows the translation of welfare measures into accessible and understandable information to be relayed to consumers (Blokhuys *et al.*, 2008). Furthermore the Welfare Quality® project aims to develop knowledge-based, practical and remedial species-specific strategies to improve the welfare quality of animals reared for production purposes that can be implemented on-farm.

Such protocols have already been developed for the most numerous, profitable and commonly farmed livestock species and are currently being used as a baseline for the development of similar protocols for other livestock species that are less common and often farmed for a luxury

market. The need and importance of such on-farm welfare protocols for the livestock industry in general is thus highlighted in an attempt to meet the demands and concerns of both consumers and non-consumers of animal products, not only with regards to animal welfare, but also food safety and security. Keeling and Veissier (2005) suggested four welfare principles and related criteria to be included in a welfare assessment protocol – see Table 2.1.3.1.

*Table 2.1.3 1 Welfare principles and criteria (Keeling and Veissier, 2005)*

<i>Principles</i>	<i>Welfare criteria</i>
Good feeding	Absence of prolonged hunger Absence of prolonged thirst
Good housing	Comfort around resting Thermal comfort Ease of movement
Good health	Absence of injuries Absence of disease Absence of pain induced by management procedures
Appropriate behaviour	Expression of social behaviours Expression of other behaviours Good human-animal relationship Absence of general fear

## 2.2 The ostrich industry

The first wild ostriches were domesticated in South Africa around the mid-19<sup>th</sup> century for the sole purpose of feather production for the fashion industry (Douglass, 1881). As the feather industry boomed, ostriches were exported from South Africa to other countries worldwide (i.e. Egypt, Australia, Argentina and the United States). However, these countries had limited success with the farming of the birds. Following the outbreak of the First World War, the then lucrative feather industry collapsed overnight, forcing South African ostrich farmers to restructure the industry to survive. The ostrich industry had to find new ways to sustain itself by exploiting the leather and meat trade. Interestingly, Brown and Thompson (1996) suggested that the meat production potential of ostriches far exceeds that of other commercially farmed livestock in New Zealand. Ostrich leather was valued amongst the most attractive exotic leathers (National Agricultural Marketing Council, 2003), becoming in high demand as a result of its unique quill pattern and suppleness (Cooper, 2001). Furthermore, the low cholesterol concentration of ostrich meat combined with its' highly bio-available proteins made the commercialization of this product a potentially lucrative venture (Cloete *et al.*, 2008). Ostrich skins contribute around 40 to 50% of the income generated from slaughter birds (Engelbrecht *et al.*, 2005) while meat contributes up to 40% and feathers the remaining 10% of the total slaughter income of ostriches (Cloete *et al.*, 2012).

However, due to their relatively short period of domestication, ostriches remain wild and notoriously difficult and dangerous to handle (Mellett, 1985). As a result, ostriches appear to not be fully adapted to commercial farming environments compared to other livestock species that have been farmed with for many centuries (Smit, 1964; Cloete and Malecki, 2011; Wang *et al.*, 2012). This lack of adaptation along with sub-optimal production practices in the industry may contribute to the poor production performance commonly observed on

commercial ostrich farms. Ostrich producers face an array of production challenges, ranging from low fertility and hatchability of eggs to high chick mortality rates (Verwoerd *et al.*, 1999). To date, little research has been done on the development of adequate handling practices and best practise standard operating procedures for ostrich production (Bonato *et al.*, 2013). Similarly, little knowledge is available about the proper environmental and behavioural needs of ostriches. According to Adams and Revell (2003), there is a widespread lack of knowledge in the ostrich industry regarding effective management systems, ostrich welfare and chick rearing practices. This lack of information could compromise the welfare of farmed ostriches, while impacting negatively on product quality and marketability, and consequently the growth of the industry.

It should be noted that the development of proper standard production processes in the ostrich industry is often hindered by extensive market fluctuations, high chick mortality rates and recurring avian influenza episodes (Wang *et al.*, 2012). Verwoerd *et al.* (1999) therefore highlighted the need to examine key factors that influence the welfare of farmed ostriches throughout all life stages, to specifically alleviate the aforementioned problems that could prevent advances in breeding and management protocols, as well as productivity in this industry.

### 2.2.1 General ostrich husbandry and the challenges faced within the industry

Ostrich farming systems vary from intensive housed rearing systems with artificially controlled temperature systems to extensive farming on large areas of land with low stocking densities; and are tailored to each unique farm set-up (Shanawany, 1995). Ostrich farming systems also vary between farms and within age groups of birds. As such, the choice of system implemented on-farm is highly dependent on available land-area, scale of production, labour

and associated costs (Shanawany, 1995). High mortality rates of up to 50% or higher within the first three months after hatching make the chick rearing phase the most crucial aspect of ostrich farming (Verwoerd *et al.*, 1999). Ostriches are very dependent on the housing system in which they are put as a result of exposure to environmental changes (Shanawany, 1995). Different chick rearing systems are used, ranging from intensive farming systems, where chicks are artificially hatched and reared in closed, temperature-controlled houses, to semi-extensive rearing systems, which may involve a combination of closed houses and pasture grazing, or extensive systems where chicks are hatched and reared by breeder pairs on large areas of land without any human assistance. These vast differences between farming systems utilised in industry complicates the evaluation of production differences as well as the welfare status of birds reared under each system.

Failure to adapt to farming environments, high stress levels, disease outbreaks and poor management are some of the main factors contributing to high mortality rates and impair not only production but also the welfare status of these animals (Verwoerd *et al.*, 1999; Cloete *et al.*, 2001). General routine farming practices used in the commercial rearing of animals, including weighing, vaccination etc. are considered to be stressful to ostriches exposed to such procedures (Bonato *et al.*, unpublished data). Muvhali *et al.* (2018) showed that routine ostrich feather management practices are experienced as stressful by the ostriches, but that human habituation from a young age reduced the amount of stress experienced by birds during these routines. This is consistent with the theory that positive human-interaction is a valid tool that can be used to improve animal welfare.

Sudden changes in housing, e.g. from chick enclosures with cement floors to sudden outdoor access on sandy floors may not only lead to welfare related problems, but also health problems, as observed by Kamau *et al.* (2002) and Mushi *et al.* (1998b). Both studies

demonstrated that, when ostriches were suddenly exposed to sandy floors, they ingested copious amounts of sand, causing proventriculus impaction and death. The effect of transport, relocation and mixing of different groups of ostriches have also been demonstrated as stressful to ostriches, because of the breaking and forming of social bonds and the effect of disorientation (Kamau *et al.*, 2002). Similarly, sudden diet changes are known to cause stress in ostriches (Warrington, 1998). As a result, all these changes in routine practices might impair growth and production. Preventative measures should thus be taken to limit or reduce the stress exerted by management and production processes. However, best practice methods are yet to be established for the ostrich farming industry (Bonato *et al.*, 2013), which has partly resulted in a lack of standard operating procedures for most aspects of ostrich farming (Muvhali *et al.*, 2018).

### 2.2.2 Rearing ostrich chicks in a commercial set-up

The two contrasting methods of chick rearing that are commonly used in the ostrich industry are the rearing of chicks with adult foster parents compared to intensively rearing chicks in closed houses or open runs (Verwoerd *et al.*, 1999). The chosen rearing method is often determined by the farm set-up and varies extensively across the country. Farmers who prefer extensively rearing chicks often have access to large areas of land. This practice is commonly used where irrigation for pastures are readily available (Verwoerd *et al.*, 1999). This makes the use of a breeder pair to rear small chicks with minimal human interference a common farming practice in areas with access to sufficient space and pastures.

When implementing foster-pair rearing, a pair of breeder birds is allowed to brood a clutch of eggs and when these eggs hatch (normally after 42 days of incubation) more chicks from artificially incubated eggs from other breeder birds are added to their offspring. This ensures

that the foster parents readily accept additional chicks. Ostriches can raise roughly 30 chicks per pair without any human interference; covering them at night with their feathers, but larger numbers of chicks (50 plus) can in this way be given to a pair of breeders to rear, with some provision of additional shelter. Hence, the number of chicks given to the foster parents determines the need for additional infrastructure to provide chicks with protection against adverse weather conditions (Wang *et al.*, 2012). Chicks that are successfully reared in such systems have been proven to grow faster, with increased survival when compared to intensive chick rearing systems, provided that good foster parents that readily accept and raise these chicks are chosen (Wang *et al.*, 2012). However, Bonato *et al.* (2013) showed that chicks reared by adult birds tend to show less interest in human association and may be generally more difficult to handle later in life due to a wilder demeanour.

The intensive rearing of ostrich chicks is a common choice where smaller areas of land and more manpower are available. This practice is widely used across the farming areas in South Africa and is believed to be the rearing method of choice among farmers in the Western/Southern Cape of South Africa. Chicks are often restricted to indoor facilities for different amounts of time, varying from 7 to 30 days or more, depending on the housing system, and are supplied with feed and water (Verwoerd *et al.*, 1999; Bunter, 2002). Some facilities make use of temperature-controlled enclosed facilities where heaters are set to automatically control the indoor temperature at optimal levels according to chick age (Verwoerd *et al.*, 1999). Optimal temperatures are required to prevent hypo- and hyperthermia that negatively influence chick health and welfare. When chicks are kept inside, type of flooring and ventilation is important to allow easy cleaning and adequate air flow to prevent ammonia build-up (Verwoerd *et al.*, 1999; Glatz and Mia, 2008). Chicks are gradually allowed outdoor access and are then transferred to outdoor runs before being housed in feedlots (Verwoerd *et al.*, 1999; Deeming, 2011). This gradual exposure to outdoor runs are important

to prevent leg injuries as chicks that are suddenly allowed access to large areas tend to run around excessively, which can be problematic when leg muscles are not fully developed due to chicks being kept in small enclosures for the first few weeks of life.

Furthermore, a semi-extensive approach to chick rearing is also widely used. This system combines intensive and extensive chick rearing methods, by allowing chicks to grow up in large pastures and sleeping in enclosures at night to protect them against adverse weather conditions when they are still small. The latter requires less manpower and is readily implemented by farmers with both access to large areas of land and an adequate workforce.

### 2.2.3 Juvenile and slaughter bird rearing systems

In extensive juvenile rearing systems, birds are reared as close as possible to their 'natural' environment with limited human interference or assistance (Shanawany, 1995), which requires access to large areas of land. These systems are cost effective as production and labour costs are relatively low, with birds foraging on pastures and requiring less human assistance. Shanawany (1995) has, however, mentioned that the disadvantages of this system might outweigh the advantages, since monitoring and identification of birds are problematic, and high levels of predation might contribute to increased mortality rates. Moreover, these birds are generally difficult to handle and notoriously wild as a result of the lack of human contact, which makes handling, capture and transportation of birds difficult, with high mortality and injury rates (Shanawany, 1995) as well as potential dangers to the occupational health and safety of their human handlers.



Intensive systems on the other hand require less land and are therefore a popular system (Shanawany, 1995). However, intensive systems are also associated with higher feed costs as total mixed diets are provided to birds with additional costs for fencing and labour substantially increasing production costs. It does allow better monitoring of diseases and injuries because evaluation of flocks is easier, while controlled diets allow for growth and production potential to be fully exploited. Accurate feed consumption and conversion records can be kept, and handling is normally not as much of an issue as birds are familiar with daily human interaction and/or presence.

Semi-intensive systems require camps large enough to allow birds to roam to an extent, while supplementary interval feeding is practised. Feeding sites are normally located along perimeter fences to allow ease of feeding and accessibility and reduces human disturbance (Shanawany, 1995). Predation might be lower than in extensive systems, but handling might still prove to be difficult as birds may not be as accustomed to regular human interaction.

#### 2.2.4 Breeding systems

Breeding systems can be classified as intensive, semi-intensive or extensive and farmers usually use a system based on the available resources, and specifically feed (Shanawany, 1995). However, different mating systems may influence fertility rates. In extensive breeding systems large flocks of male and female breeding birds are kept in large camps allowing free mate choice (Cloete and Malecki, 2011). Production costs associated with these systems are generally lower, but the limitations of these systems result in a lack of pedigree information and an inability to identify birds with low production. Farmers also face difficulty with egg collection in these large camps that are often rugged terrain, hence impairing the location of nests and the regularity of egg collection (Shanawany, 1995). This might influence both

hatchability of eggs and survival of chicks. Predation on both birds and their eggs also contribute significantly to losses.

Intensive breeding systems, on the other hand, allow full control over breeding, monitoring and identification of good/bad breeders (Cloete and Malecki, 2011). This system allows farmers to pair birds in small camps, to allow control over pedigrees and carefully monitor breeding and performance records. Production costs are however high but are outweighed by the advantages of the system (Shanawany, 1995). The small camps allow for daily egg collection that might result in improved artificial incubation, hatching and survival of ostrich chicks.

Semi-intensive breeding systems with moderate production costs allow flock breeding on a small scale and relative ease in terms of egg collection (Shanawany, 1995). Birds are allowed the freedom to choose their mates, which might improve compatibility between males and females and potentially contribute to higher production rates. Intermediate production costs associated with fencing and supplementary feeding is a determining factor in this system.

## 2.2.5 Determining current perceptions of farmed ostrich welfare

The ostrich industry is a lucrative yet niche industry that mostly sells its products to luxury overseas markets. Ninety percent of South African ostrich products are exported to the European Union (nda.agric.za, 2018) where consumers are increasingly aware of the welfare quality and origin of animal derived products. In addition to the demand for high quality products, consumers increasingly demand products differentiated by sustainable and ethical production practices, traceability and product integrity, putting additional strain on the

successful marketing of ostrich products both locally and internationally. This is specifically true as ostrich farming systems are unfamiliar in most parts of the world, including Europe. Hence, this could potentially influence buying decisions of European consumers, specifically as they often prefer certified ethically produced products.

At present, little information is available regarding consumer and farmer demands and perspectives about the ostrich industry. It is therefore vital to evaluate the current knowledge of consumers about ostrich production, as well as to determine the wants and needs of the consumer with reference to product demands. This will enable the industry to comply with customers' demands while also promoting and marketing products successfully, in order to allow the successful growth and sustainability of the ostrich industry. In parallel to this, successful incorporation of auditable indicators of animal welfare and ethics into the production process is vital to address welfare concerns as this will allow the production of high quality and ethical ostrich products. This, in turn, will also ensure that the local ostrich industry remains viable by providing stability through improving the marketability of the products. Expansion of the primary ostrich industry through products of improved quality will also expand the agro-processing sector linked to it.

Furthermore, while South Africa has to date been the main provider of ostrich products worldwide, ostrich production in Iran has been steadily increasing over the last two decades (en.eghtesadonline.com, 2018). After only 14 years, Iran is now the second largest ostrich producing country, and has officially submitted plans to start exporting ostrich products to the EU. Therefore, the South African ostrich industry will have to provide products of excellent quality backed by ethical production practices in order to be competitive and keep their highly valued market share.

No research has yet been done on the perceptions and opinions of the public or stakeholders in the ostrich industry with reference to the welfare quality of farmed ostriches. Insights into public perception are crucial in order to create a proper concept of animal welfare and to optimize the delicate balance between economic output and the welfare quality of farmed animals (Van Tichelen, 2009). This can be achieved by promoting the involvement of end-users and by transparently and effectively informing the public about the efforts and actions undertaken to improve animal welfare (Garnier *et al.*, 2003; Fisher, 2009). The public's concerns should also be addressed with marketing strategies based on welfare assessments (such as free-range labels on products) and by informing consumers about important welfare aspects of certain production systems. This could better align societal concerns and behaviour with welfare-orientated legislation (Vanhonacker *et al.*, 2012). Successful integration of all aspects of animal welfare and ethical production to responsibly produce high quality products will assist the South African ostrich industry to remain competitive in the global market. It is also expected to provide some stability to this high-risk industry that is constantly struggling due to increasing costs and occasional bans on meat exports that put farming income under pressure.

## 2.3 Aims of the study

The aim of the study was to determine and compare the knowledge and perceptions of the public and stakeholders in the ostrich industry. Specifically, it would assist in obtaining a detailed insight into the differences in opinion between the public and all stakeholders in the ostrich industry in South Africa with regards to: (1) their knowledge of production processes currently used in the industry; (2) their perceptions of welfare implications of production and management processes and; (3) buying decisions as well as preferred production and management processes that should be used in commercial ostrich farming. To accomplish this, a comprehensive survey was drafted with questions pertaining to husbandry practices implemented in the industry and their perceived impact on the welfare of commercially farmed ostriches. Questions related to buying decisions and general animal welfare, were also included.

The analysis of the results of this study specifically focussed on the quantification of the opinions between different groups of participants. Firstly, participants were asked to assign a score of importance to specific welfare aspects (i.e. how important frequent visual inspection is for ostrich welfare), and secondly to assign a score to the perceived impact of these aspects to ostrich welfare. All responses were then compiled and compared between categories of participants (i.e. consumers, farmers and stakeholders) to identify potential welfare problem areas in the industry. Furthermore, farmers and stakeholders in the ostrich industry were questioned on their preferences for management and production practices implemented on-farm, as well as the perceived impact of these procedures on the welfare of farmed ostriches. It was specifically prioritised to compare the perceptions of farmers and secondary stakeholders involved in commercial ostrich production.

Finally, this study also aimed to contribute to the future development of a welfare assessment protocol that can be utilised on-farm to determine the welfare status of farmed ostriches. Ultimately, this was anticipated to assist in determining possible causes of poor welfare and to develop practical species-specific strategies that farmers could implement to improve the welfare status of their birds, considering both direct and indirectly involved parties' preferences and expectations.

## **Chapter 3**

### **Materials and Methods**

### 3.1 Study description and design

In an attempt to establish the perceptions and opinions about the welfare status of farmed ostriches in South Africa amongst consumers, commercial ostrich farmers and secondary stakeholders (i.e. veterinarians, nutritionists, tanners, etc.) in the ostrich industry, a customised questionnaire was distributed across the country between September 2018 and September 2019. The questionnaire was available in Afrikaans and English making it accessible to most of South Africans. The questionnaire was distributed widely in an attempt to include participants from a large range of socio-demographic and lifestyle backgrounds. In order to distribute the questionnaire nationwide an online survey platform (GoogleForms®) was used to create web-based questionnaires.

The online version of the questionnaire was then sent via mailing distribution lists from the following companies/institutions; the South African Society of Animal Scientists (SASAS), Animal Feed Manufacturers Association (AFMA), the University of Stellenbosch and the Western Cape Department of Agriculture. Physical copies were distributed in Oudtshoorn, the “ostrich capital of the world”, situated in the Western Cape region of South Africa where the largest global population of farmed ostriches is found. Ostrich farmers were specifically targeted through farmers’ meetings in the most popular ostrich farming areas in the Klein Karoo and Southern Cape regions (i.e. Herold, De Rust, Volmoed and Heidelberg). Three versions of the questionnaire were prepared: one for the general public (included as Appendix A), one tailored to stakeholders in the ostrich industry (Appendix B) and one specifically for ostrich farmers (Appendix C). The Afrikaans versions of the questionnaires are included as Appendices D, E and F. Ethical clearance for the distribution of this questionnaire was obtained through the Research Ethical Committee (REC-humanities) of Stellenbosch University (reference number: 7699).



### 3.2 Questionnaire design and measurement scale

A multidisciplinary approach was followed while developing questions for the questionnaire, including resource and management-based measures of welfare, as well as animal-based outcomes. The four principles of the Welfare Quality® approach (i.e. good feeding, good housing, good health and appropriate behaviour) formed the baseline for the formulation of the questions ([www.welfarequality.net](http://www.welfarequality.net)). However, topics included in the questionnaire were also based on literature reviews of welfare indicators and measurements commonly used in other surveys to establish the opinions and preferences of the public in terms of animal welfare. The questionnaire also included topics related to consumer acceptance and preferences covering on-farm and end product standards as suggested by Vanhonacker *et al.* (2008), Vanhonacker *et al.* (2010), Bejaei and Cheng (2014), You *et al.* (2014) and Miranda-de la Lama *et al.* (2017). To assess the answers of participants pertaining to their welfare opinions and perceptions, a 5-point Likert scale was used throughout the questionnaire (Maria 2006; Miranda-de la Lama *et al.*, 2017).

The survey consisted of three different sections: the first two sections were distributed to all categories of participants (i.e. consumers, ostrich farmers and secondary stakeholders in the industry including tanners, veterinarians, processors etc.), while the third section was tailored to active (or experienced) participants in the ostrich industry only (i.e. farmers and secondary stakeholders). The first section involved demographic questions to establish the socio-demographical characteristics of the sample population as well as their level of welfare consciousness. This aimed to determine the influence of different factors on attitudes toward welfare and included questions about the participants' age, gender, level of education, income level, province of residence and dietary preference.

The second section of the questionnaire consisted of questions pertaining to participants' general understanding of the ostrich industry and knowledge of ostrich husbandry practices, as well as their welfare perception of the industry and the impact thereof on the buying decisions of the respondent. The inclusion of knowledge-based questions assumed that the ostrich industry is a relatively unfamiliar industry to most South African citizens (as compared to other livestock industries) and that the level of knowledge about the industry could potentially influence opinions and perceptions about the welfare quality of farmed ostriches. Hence, the first question required participants to rate their knowledge of general ostrich production as well as key management and production processes currently being used in the ostrich industry, on a score ranging from 1 (poor/no knowledge) to 5 (very knowledgeable) (see Appendix A). The second and third questions tested participants' perceptions of the importance of several aspects of farmed ostrich welfare and ostrich-specific management and production processes, also scored on a scale of 1 (not important) to 5 (very important). Participants were asked to indicate their perceived importance of fifteen factors suspected to affect the well-being of farmed ostriches (i.e. feed/water availability/quality; housing conditions; animal health, behaviour etc.). as well as other factors related to hatching and rearing practices and general management aspects (i.e. visual inspection of birds, regular handling, medication, isolation of sick birds and transport).

Participants were then asked to score the perceived importance of human-factors necessary to obtain acceptable levels of farmed ostrich welfare in the fourth question, using the 5-point scale mentioned previously. Factors related to the level of knowledge that farmers, stockmen or workers in the ostrich industry have pertaining to the anatomy and behaviour of ostriches, detecting signs of stress or health-related issues, handling and restraining of ostriches and transportation were considered. The last two questions investigated the importance of ostrich specific and general animal welfare aspects and their impact on the buying decisions of

participants. Hence, for the 5<sup>th</sup> question, participants were asked to score the importance of farmed ostrich welfare in general, the welfare of slaughter animals in terms of product quality, the importance of perceived animal welfare when buying animal products and the importance of implementing a formal welfare protocol for the production of ostriches for meat, leather and feather products, also on a scale of 1 to 5 (from least to most important). Finally, buying-decision related questions were assessed in the last question by asking participants to rate their likeliness to buy and pay more for welfare conscious products.

In addition, a third section was included in questionnaires distributed to ostrich farmers and secondary stakeholders in the industry so as to establish the participants' preferred or currently implemented production and management practices in the case of farmers, as well as their perception of the impact of these practices on farmed ostrich welfare (see Appendix A). For this purpose, questions were grouped according to the age or life stage of ostriches. The questions firstly aimed to establish farmers' and stakeholders' preferences with regards to ostrich-specific husbandry practices (i.e. incubation, hatching and rearing methods, toenail clipping and feather harvesting practices, methods of restraint, etc.) by providing them with multiple options for each husbandry practice (most commonly known to be used in the industry). This was then followed by questions on the perceived impact of these husbandry practices on the well-being of ostriches, scored from 1 (strong negative impact) to 5 (strong positive impact).

Participants were further asked to score the importance of factors related to the transport of ostrich chicks and juvenile/slaughter birds (i.e. stocking density, ventilation; driver skill etc.) on the welfare of these birds. Thereafter farmers' and secondary stakeholders' perceptions of the importance of factors related to human-animal interaction on-farm while rearing ostrich chicks were investigated. Participants were then asked to indicate their opinion of the

likeliness (scored from 1 to 5; least to most likely) that improved on-farm welfare of ostriches would improve end-product quality. Lastly, participants were asked to rate the importance of implementing a formal welfare protocol for commercial farming of ostriches and the likeliness that farmers would follow such a protocol if it was to be implemented (scored from 1 to 5; from least to most important/likely).

Questionnaires tailored to ostrich farmers included questions related to their own farming experience (See Appendix C). In this section, farmers had to indicate the prevalence of injuries to birds exposed to handling, transportation and translocation practices. They were also asked about the prevalence of stress behaviours observed during or directly after birds have been subjected to movement either between camps (where mixing of social groups take place) or to pre-transport camps. These questions were scored on a scale of 1 (not likely to induce stress) to 5 (very likely to induce stress).

### 3.3 Data description

#### 3.3.1 Socio-demographical distribution of the sample population

In total, 302 South African participants completed and returned the questionnaire, of which 58% classified themselves as consumers, 32% as secondary stakeholders in the ostrich industry (processors, tanners, veterinarians, etc.) and 10% as ostrich farmers, with an overall distribution of 64% male, 35% female and 1% undisclosed gender participants. While the gender distribution among consumers were relatively equal (47% men and 53% women), the majority of farmers and secondary stakeholders answering the questionnaire were men (84% and 89% respectively, Table 3.3.1), with only 6% and 11% of farmers and secondary

stakeholders who identified themselves as female. Ten percent of farmers and less than one percent of consumers did not disclose their gender.

*Table 3.3.1 Socio-demographical distribution of South African participants (N = 302) according to category (consumers, farmers and stakeholders).*

		<b>Consumers (%)</b>	<b>Farmers (%)</b>	<b>Stakeholders (%)</b>
		N = 175	N = 31	N = 96
<b>Gender</b>	Men	46.9	83.9	88.5
	Women	52.6	6.5	11.5
	Undisclosed	0.6	9.7	0.0
<b>Age (years)</b>	< 20	0.0	0.0	0.0
	20-35	62.9	35.5	22.9
	36-50	20.0	25.8	49.0
	51-65	13.1	29.0	20.8
	>65	3.4	0.0	6.3
	Undisclosed	0.6	9.7	1.0
<b>Education</b>	Primary	0.0	0.0	1.0
	Secondary	7.4	25.8	29.2
	Tertiary	92.0	64.5	67.7
	Undisclosed	0.6	9.7	2.1
<b>Income (per year)</b>	< R50 000	13.1	3.2	5.2
	R 50 000 - R200 000	16.0	25.8	25.0
	R 200 000 - R 400 000	14.9	16.1	17.7
	R 400 000 - R 600 000	8.0	3.2	9.4
	> R 600 000	13.1	12.9	16.7
	Undisclosed	34.9	38.7	26.0
<b>Province of residence</b>	Western Cape	44.0	96.8	82.3
	Eastern Cape	10.3	0.0	1.0
	Northern Cape	0.6	0.0	1.0
	Limpopo	8.0	0.0	1.0
	Mpumalanga	0.0	0.0	0.0
	Gauteng	17.7	3.2	7.3
	KwaZulu-Natal	1.7	0.0	0.0
	North-West	0.0	0.0	0.0
	Free State	1.7	0.0	0.0
	Undisclosed	16.0	0.0	7.3
<b>Dietary preference</b>	No preference	54.9	54.8	52.1
	Preference for meat	32.6	38.7	44.8
	Vegetarian / vegan	10.3	0.0	1.0
	Undisclosed	2.3	6.5	2.1

To facilitate the analysis of the gender effects on participants' perceived opinions and perceptions, the results of the participants that did not disclose their gender were not included (see Table 3.3.2).

*Table 3.3.2 Regrouped socio-demographical distribution of South African participants according to category (consumers, farmers and stakeholders) as used in further analysis.*

		<b>Consumers (%)</b>	<b>Farmers (%)</b>	<b>Stakeholders (%)</b>
<b>Gender</b>	Men	47.1	92.9	88.5
	Women	52.9	7.1	11.5
<b>Age (years)</b>	< 36	63.2	39.3	23.2
	36-50	20.1	28.6	49.5
	> 50	16.7	32.1	27.4
<b>Education</b>	Not tertiary educated	7.5	28.6	30.9
	Tertiary educated	92.5	71.4	69.1
<b>Income level</b>	Low	44.7	47.4	40.9
	Middle	22.8	26.3	23.9
	High	32.5	26.3	35.2
<b>Province of residence</b>	Traditional ostrich farming provinces	65.3	96.8	91.0
	Not traditionally ostrich farming provinces	34.7	3.2	9.0
<b>Dietary preference</b>	No preference	56.1	58.6	53.2
	Preference for meat	33.3	41.4	45.7
	Vegetarian / vegan	10.5	0.0	1.1

All participants of known age were older than 20 years of age, with 47% of participants classifying themselves as 20-35 years of age, 30% as 36-50 years, 17% as 51-65 years and 4% as older than 65. The remaining 2% of participants chose not to disclose their age. The age distribution for the different categories is presented in Table 3.3.1. In order to facilitate the analysis of the effect of age on responses, participants were grouped into three new age categories: younger than 36 years; between 36 and 50 years and older than 50 years. In addition, participants that chose not to disclose their age were not included in the final analysis (Table 3.3.2).

With regard to level of education, 81% of participants of the overall sample population had received tertiary education (i.e. college/university diplomas or degrees), while 16% and less

than 1% of participants reported to only have received secondary and primary education, respectively. Two percent of participants chose not to disclose their level of education. The majority of consumers (92%), farmers (65%) and stakeholders (68%) indicated that they had tertiary qualifications (Table 3.3.1). To facilitate analyses of the effect of education level on responses, participants were grouped into two categories: those that received tertiary education and those who had not (i.e. secondary and primary educated participants were combined). Furthermore, the 2% of respondents that chose not to disclose their level of education were not included (Table 3.3.2).

Thirty-two percent of participants chose not to disclose their income levels (Table 3.3.1). Nevertheless, 10% reported an annual income of less than R50 000; 20% indicated annual earnings of between R50 000 and R200 000; 16% reported an annual income of R200 000 to R400 000; 8% indicated between R400 000 and R600 000 annual income and 14% reported earning more than R600 000 per year. Hence, to facilitate the analysis of the effect of income level on participants' opinions and perceptions, those that chose not to disclose their income level were excluded from the analysis and three new income categories were created. The first category grouped "low income level" participants with income levels of <R50 000 and R50 000 – R200 000 per year; the second category grouped "middle income level" participants who indicated earnings of R200 000 – R400 000 per year; and the third category included "high income level" participants who earned more than R400 000 per year. Hence, according to these new categories, 44% of participants belonged to the low-income category, 24% of participants to the middle-income category and 33% of to the high income category (Table 3.3.2).

Participants from only seven out of the nine provinces of South Africa completed and returned the questionnaire, with no participants from the provinces of Mpumalanga and North West.

Furthermore, more than half of the sample population declared their province of residence as the Western Cape Province (61%), while only 13% of participants indicated that they reside in the Gauteng Province and 14% of participants were distributed across the Eastern and Northern Cape, Limpopo, KwaZulu-Natal and Free State provinces. The remaining 12% of participants chose not to disclose their province of residence. As a result, provinces were regrouped into those commonly known for ostrich farming (Western, Eastern and Northern Cape) and those not traditionally known for ostrich farming (Limpopo, Gauteng, KwaZulu-Natal and Free State; Table 3.3.2). Participants that chose not to disclose their province of residence were also excluded from the analysis.

With regards to dietary preferences, 54% of participants indicated that they had no specific dietary preference, while 37% of participants indicated a preference for meat (37%) and 6% declared they were vegetarian/vegan. In the original document the latter two categories were separate, but due to the low incidence of vegetarian and vegan participants these options were pooled. The remaining 3% of participants did not disclose their dietary preferences. The same trend was observed across the participant categories, with 55% of consumers and farmers and 52% of secondary stakeholders declaring that they had no specific diet preferences (Table 3.3.1). Interestingly, no farmers indicated that they were vegetarian or vegan. Similar to what was done with the previous socio-demographic factors, participants that did not disclose their dietary preference were excluded from the analysis (Table 3.3.2).



### 3.4 Statistical analysis

Both bivariate and multivariate statistics were used to analyse the data. To investigate potential differences between two or more groups of independent variables on ordinal dependent variables for questions asked to all categories of participants, a non-parametric one-way ANOVA was used. Thereafter fractional ranks were computed to perform a general linear model (GLM) with multiple comparisons to establish which specific categories within independent variables differed. Independent variables tested included all demographic factors included in the questionnaire: category of participant (consumer, ostrich farmer or secondary stakeholder in the ostrich industry), gender, age, level of education, level of income, province of residence and dietary preference as defined in Table 3.3.2. The same bivariate method of analysis through comparison of means was followed for the second section of questions specific to farmers and secondary stakeholders in the ostrich industry.

With regards to questions specific to farmers and secondary stakeholders, the participants' preferences for management and production practices currently implemented within the ostrich industry were calculated as percentage distribution. Similar bivariate and regression analyses were also done on the second section of questions answered by farmers and secondary stakeholders in the ostrich industry. Finally, to investigate potential differences between the preferences of stakeholders and farmers in terms of management and production practices implemented on-farm a Chi-square analysis was done. Data was analysed using the Statistical Analysis Software (SAS 9.4, 2013) and Statistical Analysis Software Enterprise Guide (SAS EG. 7.1). Significance at  $P < 0.05$  was accepted as being statistically different.

## **Chapter 4**

### **Results**

## 4.1 Knowledge of the ostrich industry, welfare importance of production practices and buying decisions of consumers, farmers and secondary stakeholders

### 4.1.1 General trends particular to the sample population

Overall, participants indicated that they had limited to average knowledge of the husbandry practices implemented in the ostrich industry, with mean scores ranging from  $2.41 \pm 0.07$  to  $2.85 \pm 0.07$  (Table 4.1.1). However, relatively high scores ( $4.11 \pm 0.05$  to  $4.71 \pm 0.03$ ) were allocated in terms of the welfare importance of basic feed, water, housing and health needs for the commercial production of ostriches, as well as for the importance of limiting stress and pain (mean scores of  $4.39 \pm 0.04$  and  $4.42 \pm 0.05$ , respectively). Although slightly lower scores were observed as compared to the latter, participants tended to consider factors pertaining to natural living (ability to exhibit natural behaviour, freedom of movement and environmental enrichment), relatively important with mean scores ranging from  $4.00 \pm 0.05$  to  $4.23 \pm 0.05$  (Table 4.1.1).

*Table 4.1.1 Mean scores (and standard errors) allocated by participants with regards to their knowledge of commercial ostrich production, welfare perceptions/importance of husbandry practices in the ostrich industry, as well as their buying decisions with regards to welfare aspects, scored on a scale of 1 to 5 (from least to most knowledge/importance/likely)*

	Mean (s. e.)	Range
<b>Knowledge of husbandry practices:</b>		
General ostrich production	2.85 (0.07)	1-5
Transportation of ostriches	2.64 (0.07)	1-5
Handling of ostriches	2.80 (0.08)	1-5
Artificial incubation of eggs	2.41 (0.07)	1-5
Artificial chick rearing	2.53 (0.08)	1-5
<b>Importance of factors for the well-being of ostriches:</b>		
Feed availability	4.60 (0.03)	1-5
Feed quality	4.56 (0.04)	1-5
Water availability	4.71 (0.03)	2-5
Water quality	4.54 (0.04)	1-5
Chick housing	4.35 (0.04)	2-5
Shelters in outside camps	3.97 (0.05)	1-5
Stocking density	4.11 (0.05)	1-5
Body condition of ostriches	4.46 (0.04)	1-5
Internal parasites	4.41 (0.05)	1-5
External parasites	4.36 (0.05)	1-5
Limited stress	4.39 (0.04)	1-5
Absence of pain	4.42 (0.05)	1-5
Ability to exhibit natural behaviour	4.18 (0.05)	1-5
Freedom of movement	4.23 (0.05)	2-5
Environmental enrichment	4.00 (0.05)	1-5
<b>Importance of management and production practices for the well-being of ostriches:</b>		
Manually assisting chicks to hatch	3.39 (0.06)	1-5
Human rearing of chicks	3.31 (0.06)	1-5
Frequent visual inspection of ostriches	4.33 (0.04)	2-5
Regular handling of ostriches	3.53 (0.06)	1-5
Stockmanship skill	4.45 (0.04)	2-5
Type of vehicle used for transporting ostriches	4.36 (0.04)	1-5
Isolation of sick/injured birds	4.55 (0.04)	1-5
Preventative medication	4.24 (0.05)	1-5
<b>Importance of the level of knowledge of people involved in the ostrich industry with regards to the following factors:</b>		
Anatomy of ostriches	3.93 (0.06)	1-5
Ostrich behaviour	4.33 (0.04)	2-5
Detecting signs of stress in ostriches	4.52 (0.04)	2-5
Detecting signs of illness in ostriches	4.68 (0.03)	3-5
Handling and restraining ostriches	4.53 (0.04)	2-5
Transporting ostriches	4.49 (0.04)	2-5
<b>Importance of the following:</b>		
The welfare of farmed ostriches	4.50 (0.04)	1-5
The welfare of slaughter animals for product quality	4.51 (0.04)	2-5
Animal welfare when buying animal products	4.26 (0.05)	1-5
Implementing a formal welfare protocol for farmed ostriches	4.34 (0.05)	1-5
<b>Likelihood to:</b>		
Buy welfare conscious products	3.92 (0.06)	1-5
Pay more for welfare conscious products	3.61 (0.07)	1-5

Interestingly, the means pertaining to the importance of giving human assistance to hatching chicks, human rearing of chicks and regular handling of ostriches for the well-being of ostriches indicated a measure of neutrality regarding these practices, with mean scores ranging from  $3.31 \pm 0.06$  to  $3.53 \pm 0.06$  (Table 4.1.1). On the other hand, participants allocated a relatively high importance to the level of skill/experience of stockmen and isolation of sick/injured birds, with mean scores of  $4.45 \pm 0.04$  and  $4.55 \pm 0.044$ , respectively. Other factors related to the management of commercially farmed ostriches, including regular visual inspection, type of vehicle used for transportation and the use of preventative medicine were also all rated as rather important for the well-being of the birds ( $4.24 \pm 0.05$  to  $4.36 \pm 0.04$ ).

Generally, relatively high mean scores were allocated pertaining to the importance of stockmen's knowledge of ostrich behaviour, detecting signs of sickness/stress, handling, restraining and transportation of ostriches when working in the industry ( $4.33 \pm 0.04$  to  $4.68 \pm 0.04$ ). However, participants tended to attribute a slightly lower score of importance to the level of knowledge of stockmen in terms of ostrich anatomy, with a mean score of  $3.93 \pm 0.06$  (Table 4.1.1).

Interestingly, all participants considered the overall welfare of ostriches and the welfare of slaughter animals in terms of product quality as important ( $4.50 \pm 0.04$  and  $4.51 \pm 0.04$ , respectively). Similarly, they valued animal welfare when buying animal products and the implementation of a formal welfare protocol for the commercial production of ostriches also as relatively important, with mean scores of  $4.26 \pm 0.05$  and  $4.34 \pm 0.05$ , respectively. Furthermore, they showed a likeliness to buy welfare conscious products rather than welfare neutral products and to pay more for welfare conscious products with mean scores of  $3.92 \pm 0.06$  and  $3.61 \pm 0.06$ , respectively.

## 4.2 Socio-demographical effect on the welfare perceptions of commercially farmed ostriches

### 4.2.1. The effect of gender

A significant difference between men and women was observed pertaining to knowledge of general ostrich production practices, with women tending to rate their knowledge lower than men ( $P < 0.05$ ; Table 4.2.1.1).

*Table 4.2.1.1 The effect of gender on the knowledge of ostrich husbandry practices and the perceived importance of various factors on ostrich welfare, scored on a scale of 1 to 5 (least to most knowledge/important)*

	Men Mean (s. e.)	Women Mean (s. e.)	F-value	Significance
<b>Knowledge of production processes:</b>				
General ostrich production	3.01 (0.09)	2.55 (0.12)	10.61	**
Transportation of ostriches	2.85 (0.09)	2.25 (0.12)	16.81	***
Handling of ostriches	2.98 (0.09)	2.46 (0.13)	11.51	**
Artificial incubation of eggs	2.51 (0.09)	2.21 (0.12)	5.04	*
Artificial chick rearing	2.66 (0.09)	2.27 (0.13)	7.84	*
<b>Importance of factors for the well-being of ostriches:</b>				
Feed availability	4.56 (0.04)	4.68 (0.06)	3.51	NS
Feed quality	4.54 (0.05)	4.59 (0.06)	0.11	NS
Water availability	4.67 (0.04)	4.78 (0.05)	2.50	NS
Water quality	4.49 (0.05)	4.65 (0.05)	2.79	NS
Chick housing	4.30 (0.06)	4.43 (0.07)	1.42	NS
Shelters in outside camps	3.85 (0.07)	4.20 (0.08)	9.93	**
Stocking density	4.04 (0.06)	4.23 (0.08)	4.97	*
Body condition of ostriches	4.35 (0.05)	4.65 (0.06)	15.81	***
Internal parasites	4.39 (0.05)	4.43 (0.09)	1.27	NS
External parasites	4.35 (0.06)	4.38 (0.08)	0.60	NS
Limited stress	4.27 (0.06)	4.60 (0.06)	13.73	**
Absence of pain	4.22 (0.06)	4.77 (0.04)	33.51	***
Ability to exhibit natural behaviour	3.98 (0.07)	4.56 (0.06)	36.22	***
Freedom of movement	4.01 (0.06)	4.65 (0.05)	47.46	***
Environmental enrichment	3.81 (0.07)	4.34 (0.07)	24.05	***

Degrees of freedom varied between 1; 276 and 1; 296

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Several factors related to the well-being of farmed ostriches were also significantly affected by gender, namely: shelter in outside camps, stocking density, body condition of ostriches, limited stress, absence of pain, ability to exhibit natural behaviour, freedom of movement and environmental enrichment. For all these factors, women tended to allocate higher scores for the importance thereof than men ( $P < 0.05$ ; Table 4.2.1.1). However, no such gender difference was observed for the perceived importance of basic feed, water or health needs (feed and water availability and quality, chick housing, internal and external parasites;  $P > 0.05$ ; Table 4.2.1.1).

Participants' scores for the welfare importance of management and production practices also significantly differed between men and women. Women allocated significantly lower scores to the importance for welfare of manually assisting chicks to hatching and human rearing of chicks ( $P < 0.05$ ; Table 4.2.1.2). On the other hand, men allocated significantly lower scores than women to their perceived importance of stockman skill/experience and the type of vehicle/trailer used when transporting ostriches ( $P < 0.05$ ; Table 4.2.1.2). No other gender effect was observed for frequent visual inspection and regular handling of birds, isolation of sick or injured birds or the use of preventative medication ( $P > 0.05$ ; Table 4.2.1.2).

*Table 4.2.1.2 The effect of gender on the perceived importance of the level of knowledge of stockmen for ostrich welfare, the importance of general animal welfare and on buying decisions. Scores were allocated on a scale of 1 to 5 (least to most knowledge/important/likely)*

	Men Mean (s. e.)	Women Mean (s. e.)	F-value	Significance
<b>Importance of management and production practices for the well-being of ostriches:</b>				
Manually assisting chicks to hatch	3.58 (0.07)	3.03 (0.11)	18.32	***
Human rearing of chicks	3.49 (0.07)	2.96 (0.11)	15.78	***
Frequent visual inspection of ostriches	4.31 (0.05)	4.36 (0.07)	0.27	NS
Regular handling of ostriches	3.61 (0.07)	3.34 (0.11)	3.54	NS
Stockmanship skill	4.40 (0.04)	4.55 (0.06)	5.98	*
Type of vehicle used for transporting ostriches	4.27 (0.06)	4.53 (0.07)	9.57	**
Isolation of sick/injured birds	4.52 (0.05)	4.62 (0.06)	0.83	NS
Preventative medication	4.22 (0.06)	4.25 (0.09)	0.39	NS
<b>Importance of ostrich stockmen having knowledge of the following factors:</b>				
Anatomy of ostriches	3.78 (0.07)	4.19 (0.09)	14.74	**
Ostrich behaviour	4.17 (0.06)	4.62 (0.06)	23.49	***
Detecting signs of stress in ostriches	4.42 (0.05)	4.72 (0.05)	14.01	*
Detecting signs of illness in ostriches	4.57 (0.04)	4.88 (0.04)	21.77	***
Handling and restraining ostriches	4.45 (0.05)	4.67 (0.06)	10.73	*
Transporting ostriches	4.42 (0.05)	4.64 (0.06)	8.37	**
<b>Importance of the following:</b>				
The welfare of farmed ostriches	4.43 (0.05)	4.63 (0.05)	5.26	*
The welfare of slaughter animals for product quality	4.45 (0.05)	4.60 (0.06)	3.55	NS
Animal welfare when buying animal products	4.16 (0.06)	4.46 (0.08)	10.09	**
Implementing a formal welfare protocol for farmed ostriches	4.19 (0.06)	4.60 (0.07)	18.99	***
<b>Likelihood to:</b>				
Buy welfare conscious products	3.81 (0.08)	4.13 (0.10)	7.7	**
Pay more for welfare conscious products	3.49 (0.08)	3.87 (0.12)	10.00	**

Degrees of freedom varied between 1; 276 and 1; 296

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

In terms of the importance of the level of knowledge of stockmen who work with ostriches, gender had a significant influence on participants' responses on all factors investigated. Overall, women scored the importance of knowledgeable stockmen involved with ostriches higher than men. As such, they gave higher scores to knowledge of ostrich industry stockmen



with regards to the anatomy and behaviour of ostriches, detecting signs of stress and disease/illness in ostriches, handling/restraining ostriches and the transportation of ostriches ( $P < 0.05$ ; Table 4.2.1.2).

Similarly, women perceived factors such as the welfare of farmed ostriches, the importance of animal welfare when buying animal products and the importance of implementing a formal welfare protocol for the commercial production of ostriches, as more important than men ( $P < 0.05$ ; Table 4.2.1.2). Interestingly, no such difference was observed between men and women with regards to the importance of welfare of slaughter animals for product quality ( $P > 0.05$ ; Table 4.2.1.2). Lastly, women indicated a higher likeliness to buy and pay more for welfare conscious products compared to welfare neutral products compared to men ( $P < 0.05$ ; Table 4.2.1.2).

#### 4.2.2. The effect of age of the participant

Participants' age had a significant effect on their knowledge of commercial ostrich farming in terms of general ostrich husbandry, the transportation of ostriches and the human rearing of ostrich chicks. In all three cases, participants older than 50 years rated their knowledge significantly higher than other age categories ( $P < 0.05$ ; Table 4.2.2.1). However, participants older than 50 and younger than 36 years both rated their knowledge about handling of ostriches lower than the middle age group (36-50 years;  $P < 0.05$ ). Participants in the latter category also allocated higher scores than those younger than 36 years with regards to the artificial incubation of ostrich eggs ( $P < 0.05$ ).

With regards to the perceived importance of factors related to the well-being of ostriches, differences between age categories of participants were only observed on two occasions. Firstly, the absence of pain was scored of higher importance by participants younger than 36 years when compared to participants older than 50 years ( $P < 0.05$ ; Table 4.2.2.1). Secondly, scores related to the importance of environmental enrichment were significantly higher for participants younger than 36 years than for participants of the middle age group category (36-50 years;  $P < 0.05$ ; Table 4.2.2.1). However, no significant differences were found between age categories for the importance of production factors such as feed and water availability/quality, chick housing, shelter, stocking density, body condition, internal/external parasites, limited stress, ability to exhibit natural behaviour or freedom of movement ( $P > 0.05$ ; Table 4.2.2.1).

*Table 4.2.2.1 The effect of participant age on the knowledge of ostrich production processes and the importance of factors for the welfare of ostriches. Scores were allocated on a scale of 1 to 5 (least to most knowledge/importance)*

	<36 years Mean (s. e.)	36-50 years Mean (s. e.)	>50 years Mean (s. e.)	F-value	Significance
<b>Knowledge of production processes:</b>					
General ostrich production	2.51 (0.10) <sup>a</sup>	3.14 (0.13) <sup>b</sup>	3.17 (0.14) <sup>b</sup>	11.22	***
Transportation of ostriches	2.26 (0.10) <sup>a</sup>	2.96 (0.15) <sup>b</sup>	3.02 (0.15) <sup>b</sup>	12.34	***
Handling of ostriches	2.44 (0.11) <sup>a</sup>	3.13 (0.14) <sup>b</sup>	3.11 (0.15) <sup>b</sup>	10.44	***
Artificial incubation of eggs	2.18 (0.10) <sup>a</sup>	2.62 (0.14) <sup>b</sup>	2.59 (0.16) <sup>a</sup>	4.44	*
Artificial chick rearing	2.26 (0.10) <sup>a</sup>	2.70 (0.15) <sup>b</sup>	2.84 (0.15) <sup>ab</sup>	5.85	**
<b>Importance of factors for the well-being of ostriches:</b>					
Feed availability	4.62 (0.05)	4.62 (0.06)	4.59 (0.08)	0.05	NS
Feed quality	4.57 (0.05)	4.59 (0.06)	4.50 (0.09)	0.20	NS
Water availability	4.73 (0.04)	4.70 (0.06)	4.70 (0.07)	0.05	NS
Water quality	4.57 (0.05)	4.46 (0.07)	4.61 (0.09)	1.53	NS
Chick housing	4.37 (0.06)	4.19 (0.09)	4.50 (0.08)	2.73	NS
Shelters in outside camps	4.07 (0.07)	3.78 (0.11)	4.03 (0.10)	2.66	NS
Stocking density	4.11 (0.07)	4.09 (0.09)	4.14 (0.09)	0.06	NS
Body condition of ostriches	4.52 (0.06)	4.46 (0.07)	4.36 (0.08)	2.44	NS
Internal parasites	4.45 (0.07)	4.33 (0.09)	4.44 (0.08)	0.70	NS
External parasites	4.39 (0.07)	4.25 (0.10)	4.48 (0.07)	0.87	NS
Limited stress	4.38 (0.06)	4.47 (0.08)	4.30 (0.08)	1.97	NS
Absence of pain	4.55 (0.06) <sup>b</sup>	4.34 (0.09) <sup>ab</sup>	4.23 (0.11) <sup>a</sup>	3.72	*
Ability to exhibit natural behaviour	4.27 (0.07)	4.09 (0.09)	4.11 (0.11)	1.45	NS
Freedom of movement	4.36 (0.07)	4.13 (0.09)	4.11 (0.10)	3.08	NS
Environmental enrichment	4.17 (0.07) <sup>b</sup>	3.74 (0.10) <sup>a</sup>	3.94 (0.12) <sup>ab</sup>	7.13	**

Degrees of freedom varied between 2; 287 and 2; 291

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* = P<0.05; \*\* = P<0.01 and \*\*\* =P<0.0001

Age category also affected the perceived importance of several management factors within the ostrich industry. For instance, participants older than 50 years allocated significantly higher scores to the importance of frequent visual inspection of birds than those younger than 36 years (P<0.05; Table 4.2.2.2). A significant age effect was also observed for the use of preventative medication, where participants younger than 36 years scored this of a higher importance than those aged 36-50 years (P<0.05; Table 4.2.2.2). However, participants' age

had no effect on their perceived importance of the manual assistance of hatching chicks, artificial chick rearing, regular handling of birds, stockmanship skill/experience, type of vehicle used for transportation of ostriches or the isolation of sick/injured birds ( $P > 0.05$ ; Table 4.2.2.2).

*Table 4.2.2.2 The effect of participant age on the importance of the level of knowledge of stockmen for ostrich welfare, the importance of general animal welfare and buying decisions. Scores were allocated on a scale of 1 to 5 (least to most knowledge/importance/likely)*

	<36 years Mean (s. e.)	36-50 years Mean (s. e.)	>50 years Mean (s. e.)	F-value	Significance
<b>Importance of management and production practices for the well-being of ostriches:</b>					
Manually assisting chicks to hatch	3.28 (0.09)	3.40 (0.11)	3.59 (0.13)	2.16	NS
Human rearing of chicks	3.19 (0.09)	3.37 (0.11)	3.48 (0.15)	2.43	NS
Frequent visual inspection of ostriches	4.22 (0.06) <sup>a</sup>	4.42 (0.07) <sup>ab</sup>	4.49 (0.07) <sup>b</sup>	3.77	*
Regular handling of ostriches	3.50 (0.09)	3.42 (0.11)	3.73 (0.11)	1.58	NS
Stockmanship skill	4.41 (0.06)	4.40 (0.07)	4.62 (0.07)	2.68	NS
Type of vehicle used for transporting ostriches	4.37 (0.07)	4.35 (0.08)	4.40 (0.07)	0.21	NS
Isolation of sick/injured birds	4.56 (0.05)	4.46 (0.08)	4.67 (0.07)	1.14	NS
Preventative medication	4.37 (0.07) <sup>b</sup>	4.00 (0.11) <sup>a</sup>	4.27 (0.09) <sup>ab</sup>	4.60	*
<b>Importance of the level of knowledge people involved in the ostrich industry should have of the following factors:</b>					
Anatomy of ostriches	4.08 (0.08)	3.80 (0.12)	3.77 (0.12)	3.09	NS
Ostrich behaviour	4.42 (0.06)	4.25 (0.09)	4.24 (0.10)	1.85	NS
Detecting signs of stress in ostriches	4.56 (0.06)	4.52 (0.06)	4.43 (0.07)	2.95	NS
Detecting signs of illness in ostriches	4.75 (0.05) <sup>b</sup>	4.69 (0.06) <sup>ab</sup>	4.53 (0.07) <sup>a</sup>	5.15	*
Handling and restraining ostriches	4.58 (0.05)	4.49 (0.07)	4.46 (0.07)	1.65	NS
Transporting ostriches	4.52 (0.06)	4.52 (0.07)	4.39 (0.08)	2.04	NS
<b>Importance of the following:</b>					
The welfare of farmed ostriches	4.51 (0.06)	4.49 (0.07)	4.48 (0.07)	0.46	NS
The welfare of slaughter animals for product quality	4.55 (0.06)	4.45 (0.07)	4.51 (0.08)	1.35	NS
Animal welfare when buying animal products	4.38 (0.08) <sup>b</sup>	4.10 (0.09) <sup>a</sup>	4.21 (0.10) <sup>ab</sup>	4.71	*
Implementing a formal welfare protocol for farmed ostriches	4.48 (0.07) <sup>b</sup>	4.19 (0.10) <sup>a</sup>	4.21 (0.10) <sup>a</sup>	5.86	**
<b>Likelihood to:</b>					
Buy welfare conscious products	3.93 (0.10)	3.82 (0.11)	4.03 (0.11)	0.62	NS
Pay more for welfare conscious products	3.59 (0.11)	3.54 (0.12)	3.83 (0.12)	1.00	NS

Degrees of freedom varied between 2; 287 and 2; 291

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

The only significant age effect related to participants' responses toward the importance of the knowledge of stockmen was observed in terms of detecting signs of disease/illness, where participants younger than 36 years rated the importance thereof significantly higher than those older than 50 years ( $P < 0.05$ ; Table 4.2.2.2). No difference between the age group categories was observed in terms of their rating of the importance of stockmen's knowledge of ostrich anatomy, behaviour of ostriches, detecting signs of stress, handling, restraining or transporting of ostriches ( $P > 0.05$ ; Table 4.2.2.2).

With regards to buying decisions, participants younger than 36 years rated the importance of general animal welfare when buying products more important than those aged 36-50 years ( $P < 0.05$ ; Table 4.2.2.2). Similarly, participants younger than 36 years allocated a higher importance to the implementation of a formal welfare protocol for the commercial production of ostriches than the older age categories ( $P < 0.05$ ; Table 4.2.2.2). No such difference was, however, noted for neither the importance of farmed ostrich welfare, nor for the importance of the welfare of slaughter animals for product quality ( $P > 0.05$ ; Table 4.2.2.2).

Furthermore, no difference was observed between the age categories for participants' likeliness to buy welfare conscious products rather than welfare neutral products; or for the likeliness to pay more for products originating from welfare conscious farms or production lines ( $P > 0.05$ ; Table 4.2.2.2).

#### 4.2.3 The effect of education level

With regards to the level of knowledge of ostrich production processes, the only difference between the levels of education of participants was observed for artificial ostrich rearing (Table 4.2.3.1). Tertiary educated participants scored their knowledge of artificial ostrich chick rearing significantly lower than those without tertiary education ( $P < 0.05$ ; Table 4.2.3.1).

Similarly, education level only influenced participants' responses toward the importance of a single production aspect of commercial ostrich farming, i.e. the absence of pain, whereby tertiary educated participants allocated higher scores of importance than those without tertiary education ( $P < 0.05$ ; Table 4.2.3.1). All other production factors investigated (i.e. feeding, water and health needs of ostriches, importance of limited stress, ability to exhibit natural behaviour, freedom of movement, environmental enrichment) were not affected by the education level of participants ( $P > 0.05$ ; Table 4.2.3.1).

However, participants without a tertiary education allocated higher scores of importance for three management and production practices for the well-being of ostriches. These included the manual assistance of chicks to hatch, artificial chick rearing and regular handling of ostriches ( $P < 0.05$ ; Table 4.2.3.2). No differences were observed between participants of different education levels for the frequent visual inspection of birds, the type of trailer/vehicle used when transporting ostriches, the isolation of sick/injured birds or the use of preventative medicine ( $P > 0.05$ ; Table 4.2.3.2).

*Table 4.2.3.1 The effect of education level on the knowledge of ostrich production processes and the perceived importance of factors for the welfare of ostriches. Scores were allocated on a scale of 1 to 5 (from least to most knowledge/important)*

	Non- tertiary educated Mean (s. e.)	Tertiary educated Mean (s. e.)	F-value	Significance
<b>Knowledge of production processes:</b>				
General ostrich production	3.20 (0.17)	2.76 (0.08)	5.62	*
Transportation of ostriches	3.14 (0.19)	2.52 (0.08)	9.35	**
Handling of ostriches	3.42 (0.18)	2.65 (0.08)	14.43	**
Artificial incubation of eggs	2.55 (0.18)	2.35 (0.08)	1.01	NS
Artificial chick rearing	2.92 (0.20)	2.44 (0.08)	5.26	*
<b>Importance of factors for the well-being of ostriches:</b>				
Feed availability	4.56 (0.09)	4.61 (0.04)	0.12	NS
Feed quality	4.62 (0.09)	4.53 (0.04)	0.94	NS
Water availability	4.76 (0.07)	4.69 (0.04)	0.69	NS
Water quality	4.55 (0.09)	4.53 (0.04)	0.04	NS
Chick housing	4.32 (0.10)	4.34 (0.05)	0.21	NS
Shelters in outside camps	3.94 (0.12)	3.98 (0.06)	0.18	NS
Stocking density	4.10 (0.10)	4.10 (0.05)	0.04	NS
Body condition of ostriches	4.51 (0.09)	4.44 (0.04)	0.39	NS
Internal parasites	4.36 (0.12)	4.40 (0.05)	0.07	NS
External parasites	4.40 (0.12)	4.34 (0.05)	0.55	NS
Limited stress	4.38 (0.11)	4.38 (0.05)	0.04	NS
Absence of pain	4.18 (0.12)	4.47 (0.05)	5.66	*
Ability to exhibit natural behaviour	4.04 (0.12)	4.21 (0.05)	1.95	NS
Freedom of movement	4.08 (0.12)	4.26 (0.05)	2.51	NS
Environmental enrichment	3.91 (0.14)	4.00 (0.06)	0.40	NS

Degrees of freedom varied between 1; 274 and 1; 293

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Furthermore, no significant effect of level of education on scores allocated to the importance of the knowledge of stockmen in the industry regarding the anatomy or behaviour of stress, detecting signs of stress, illness/disease, handling, restraining and transporting of ostriches was observed ( $P > 0.05$ ; Table 4.2.3.2). Similarly, level of education did not influence participants' perceptions in terms of general animal welfare, farmed ostrich welfare, animal welfare when buying products or implementing a formal welfare protocol in the ostrich industry

( $P > 0.05$ ; Table 4.2.3.2). They also did not differ in neither their willingness to buy welfare conscious products rather than welfare neutral products nor their willingness to pay more for these products ( $P > 0.05$ ; Table 4.2.3.2).

*Table 4.2.3.2 The effect of level of education on the importance of the level of knowledge of stockmen for ostrich welfare, the importance of general animal welfare and buying decisions. Scores were allocated on a scale of 1 to 5 (from least to most knowledge/important/likely)*

	Non- tertiary educated Mean (s. e.)	Tertiary educated Mean (s. e.)	F-value	Significance
<b>Importance of management and production practices for the well-being of ostriches:</b>				
Manually assisting chicks to hatch	3.71 (0.14)	3.32 (0.07)	5.61	*
Human rearing of chicks	3.63 (0.14)	3.24 (0.07)	4.52	*
Frequent visual inspection of ostriches	4.38 (0.11)	4.32 (0.04)	0.49	NS
Regular handling of ostriches	3.79 (0.15)	3.46 (0.07)	4.88	*
Stockmanship skill	4.33 (0.10)	4.47 (0.04)	1.76	NS
Type of vehicle used for transporting ostriches	4.33 (0.10)	4.36 (0.05)	0.40	NS
Isolation of sick/injured birds	4.52 (0.09)	4.55 (0.04)	0.19	NS
Preventative medication	4.40 (0.10)	4.19 (0.06)	1.48	NS
<b>Importance of the level of knowledge people involved in the ostrich industry should have of the following factors:</b>				
Anatomy of ostriches	3.89 (0.16)	3.94 (0.06)	0.03	NS
Ostrich behaviour	4.17 (0.11)	4.37 (0.05)	3.18	NS
Detecting signs of stress in ostriches	4.44 (0.09)	4.54 (0.04)	1.57	NS
Detecting signs of illness in ostriches	4.56 (0.09)	4.70 (0.04)	2.86	NS
Handling and restraining ostriches	4.48 (0.09)	4.53 (0.04)	0.52	NS
Transporting ostriches	4.46 (0.11)	4.49 (0.04)	0.08	NS
<b>Importance of the following:</b>				
The welfare of farmed ostriches	4.40 (0.11)	4.51 (0.04)	0.88	NS
The welfare of slaughter animals for product quality	4.50 (0.10)	4.50 (0.04)	0.00	NS
Animal welfare when buying animal products	4.26 (0.12)	4.26 (0.06)	0.10	NS
Implementing a formal welfare protocol for farmed ostriches	4.30 (0.12)	4.34 (0.06)	0.31	NS
<b>Likelihood to:</b>				
Buy welfare conscious products	3.68 (0.16)	3.97 (0.07)	3.16	NS
Pay more for welfare conscious products	3.49 (0.16)	3.64 (0.08)	1.27	NS

Degrees of freedom varied between 1; 274 and 1; 293

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$



#### 4.2.4 The effect of income level

No significant differences were observed between participants with different income levels regarding their perceived knowledge about general ostrich husbandry, transportation and handling of ostriches, artificial incubation of eggs and human rearing of chicks ( $P > 0.05$ ; Table 4.2.4.1).

*Table 4.2.4.1 The effect of level of income on the knowledge of ostrich production processes and the importance of factors for the welfare of ostriches. Scores were allocated on a scale of 1 to 5 (from least to most knowledge/important)*

	Low Mean (s. e.)	Middle Mean (s. e.)	High Mean (s. e.)	F-value	Significance
<b>Knowledge of production processes:</b>					
General ostrich production	2.88 (0.12)	2.71 (0.19)	3.06 (0.15)	1.23	NS
Transportation of ostriches	2.60 (0.14)	2.60 (0.19)	2.78 (0.16)	0.41	NS
Handling of ostriches	2.82 (0.14)	2.67 (0.20)	2.85 (0.16)	0.34	NS
Artificial incubation of eggs	2.33 (0.13)	2.30 (0.18)	2.45 (0.16)	0.15	NS
Artificial chick rearing	2.45 (0.14)	2.49 (0.19)	2.55 (0.17)	0.08	NS
<b>Importance of factors for the well-being of ostriches:</b>					
Feed availability	4.64 (0.07)	4.52 (0.08)	4.67 (0.06)	1.70	NS
Feed quality	4.63 (0.06)	4.40 (0.09)	4.55 (0.07)	2.74	NS
Water availability	4.78 (0.05)	4.66 (0.08)	4.76 (0.06)	1.11	NS
Water quality	4.65 (0.06) <sup>b</sup>	4.33 (0.10) <sup>a</sup>	4.54 (0.08) <sup>ab</sup>	3.86	*
Chick housing	4.44 (0.07)	4.25 (0.11)	4.30 (0.09)	1.44	NS
Shelters in outside camps	4.11 (0.10)	3.79 (0.13)	3.88 (0.11)	2.87	NS
Stocking density	4.17 (0.10)	4.00 (0.11)	4.10 (0.09)	1.35	NS
Body condition of ostriches	4.57 (0.07) <sup>b</sup>	4.30 (0.10) <sup>a</sup>	4.40 (0.07) <sup>ab</sup>	4.80	*
Internal parasites	4.44 (0.09)	4.33 (0.10)	4.40 (0.09)	1.25	NS
External parasites	4.36 (0.09)	4.26 (0.11)	4.39 (0.09)	0.89	NS
Limited stress	4.43 (0.07) <sup>b</sup>	4.21 (0.11) <sup>a</sup>	4.58 (0.07) <sup>ab</sup>	3.81	*
Absence of pain	4.52 (0.08)	4.23 (0.13)	4.54 (0.09)	2.16	NS
Ability to exhibit natural behaviour	4.27 (0.09)	4.11 (0.13)	4.14 (0.11)	0.84	NS
Freedom of movement	4.36 (0.09)	4.17 (0.12)	4.14 (0.11)	2.17	NS
Environmental enrichment	4.13 (0.10) <sup>b</sup>	3.85 (0.14) <sup>a</sup>	3.75 (0.12) <sup>ab</sup>	4.09	*

Degrees of freedom varied between 2; 193 and 2; 201

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

However, four production factors and the importance thereof for the well-being of farmed ostriches were significantly influenced by the participants' level of income. Participants indicating a low level of income scored the importance of water quality and body condition significantly higher than those belonging to the middle-income level ( $P < 0.05$ ; Table 4.2.4.1). Moreover, participants in the high income bracket scored the importance of limiting stress higher than those in the middle income level ( $P < 0.05$ ; Table 4.2.4.1), while they attached a lower importance to environmental enrichment than participants in the low income bracket ( $P < 0.05$ ; Table 4.2.4.1). No other effects of level of income was detected on the importance of any other production factors ( $P > 0.05$ ; Table 4.2.4.1).

When asked to score the importance of management practices, participants in the middle-income level group allocated significantly lower scores to the importance of stockmanship skill/experience than both the high and low income categories ( $P < 0.05$ ; Table 4.2.4.2). However, scores allocated to the importance of manually assisting chicks to hatch, human rearing of chicks, frequent visual inspection and regular handling of ostriches, type of vehicle used for transport, isolation of sick/injured birds and the use of preventative medication were not influenced by the participants' level of income ( $P > 0.05$ ; Table 4.2.4.2).

No significant differences were observed between participants of different income levels in terms of the importance of knowledgeable stockmen in the ostrich industry, with reference to ostrich anatomy and behaviour, detecting signs of stress and disease/illness, handling and restraining ostriches and the transportation of ostriches ( $P > 0.05$ ; Table 4.2.4.2).

*Table 4.2.4.2 The effect of income on 302 South African citizens on the importance of the level of knowledge of stockmen for ostrich welfare, the importance of general animal welfare and buying decisions. Scores were allocated on a scale of 1 to 5 (least to most knowledge/importance/likely)*

	Low Mean (s. e.)	Middle Mean (s. e.)	High Mean (s. e.)	F-value	Significance
<b>Importance of management and production practices for the well-being of ostriches:</b>					
Manually assisting chicks to hatch	3.44 (0.12)	3.31 (0.15)	3.12 (0.12)	2.22	NS
Human rearing of chicks	3.25 (0.12)	3.15 (0.16)	3.35 (0.14)	0.51	NS
Frequent visual inspection of ostriches	4.38 (0.07)	4.27 (0.09)	4.39 (0.08)	0.92	NS
Regular handling of ostriches	3.46 (0.12)	3.46 (0.15)	3.37 (0.12)	0.23	NS
Stockmanship skill	4.49 (0.06) <sup>b</sup>	4.19 (0.09) <sup>a</sup>	4.56 (0.07) <sup>b</sup>	5.76	**
Type of vehicle used for transporting ostriches	4.44 (0.09)	4.34 (0.09)	4.36 (0.08)	1.73	NS
Isolation of sick/injured birds	4.55 (0.08)	4.38 (0.11)	4.61 (0.07)	1.98	NS
Preventative medication	4.27 (0.10)	4.23 (0.11)	3.95 (0.12)	2.90	NS
<b>Importance of the level of knowledge people involved in the ostrich industry should have of the following factors:</b>					
Anatomy of ostriches	4.11 (0.10)	3.87 (0.13)	3.85 (0.11)	2.50	NS
Ostrich behaviour	4.45 (0.08)	4.23 (0.10)	4.35 (0.10)	2.21	NS
Detecting signs of stress in ostriches	4.57 (0.07)	4.42 (0.08)	4.58 (0.07)	2.14	NS
Detecting signs of illness in ostriches	4.76 (0.06)	4.60 (0.08)	4.70 (0.06)	2.51	NS
Handling and restraining ostriches	4.64 (0.07)	4.48 (0.08)	4.48 (0.08)	2.71	NS
Transporting ostriches	4.58 (0.07)	4.38 (0.09)	4.48 (0.08)	2.25	NS
<b>Importance of the following:</b>					
The welfare of farmed ostriches	4.48 (0.08)	4.50 (0.07)	4.54 (0.07)	0.23	NS
The welfare of slaughter animals for product quality	4.58 (0.07)	4.48 (0.08)	4.51 (0.07)	1.04	NS
Animal welfare when buying animal products	4.38 (0.08)	4.21 (0.12)	4.20 (0.11)	1.05	NS
Implementing a formal welfare protocol for farmed ostriches	4.38 (0.10)	4.19 (0.13)	4.29 (0.10)	1.41	NS
<b>Likelihood to:</b>					
Buy welfare conscious products	3.93 (0.11)	3.81 (0.17)	4.06 (0.12)	0.47	NS
Pay more for welfare conscious products	3.60 (0.13)	3.57 (0.17)	3.78 (0.14)	0.60	NS

Degrees of freedom varied between 2; 193 and 2; 201

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

There were no significant differences between the different income categories with regards to the importance of general animal welfare, the welfare of slaughter animals in terms of product

quality, animal welfare when buying products and implementing a formal welfare protocol for the commercial production of ostriches ( $P>0.05$ , Table 4.2.4.2).

Similarly, participants' income level did not influence their likeliness to buy welfare conscious products rather than welfare neutral products or the likeliness of paying more for welfare conscious products ( $P>0.05$ ; Table 4.2.4.2). Participants were either neutral to or slightly likely to buy and pay more for welfare conscious products.

#### 4.2.5 The effect of provincial distribution

Unsurprisingly, the province of residence of participants had a significant effect on the perceived knowledge of the ostrich industry in terms of general ostrich production, transportation and handling of ostriches, artificial incubation of ostrich eggs and artificial rearing of ostrich chicks. In all instances, participants that originated from provinces traditionally known for ostrich farming indicated a substantially higher level of knowledge than those residing in provinces where ostrich farming is not widely practiced ( $P<0.05$ ; Table 4.2.5.1).

*Table 4.2.5.1 The effect of province of residence on the perceived knowledge of ostrich production processes and the importance of factors for the welfare of ostriches. Scores were allocated on a scale of 1 to 5 (least to most knowledge/important)*

	Ostrich Mean (s. e.)	Other Mean (s. e.)	F-value	Significance
<b>Knowledge of production processes:</b>				
General ostrich production	3.00 (0.09)	2.37 (0.14)	13.40	**
Transportation of ostriches	2.80 (0.09)	2.08 (0.14)	15.19	**
Handling of ostriches	3.01 (0.09)	2.15 (0.15)	21.02	***
Artificial incubation of eggs	2.49 (0.09)	2.08 (0.15)	5.08	*
Artificial chick rearing	2.65 (0.09)	2.08 (0.15)	9.29	**
<b>Importance of factors for the well-being of ostriches:</b>				
Feed availability	4.59 (0.04)	4.53 (0.08)	0.59	NS
Feed quality	4.55 (0.04)	4.52 (0.08)	0.13	NS
Water availability	4.72 (0.04)	4.63 (0.08)	0.66	NS
Water quality	4.49 (0.05)	4.62 (0.08)	1.43	NS
Chick housing	4.32 (0.05)	4.38 (0.09)	0.11	NS
Shelters in outside camps	3.91 (0.06)	4.12 (0.11)	2.69	NS
Stocking density	4.04 (0.06)	4.25 (0.11)	3.52	NS
Body condition of ostriches	4.42 (0.05)	4.51 (0.09)	0.95	NS
Internal parasites	4.34 (0.06)	4.47 (0.09)	0.92	NS
External parasites	4.34 (0.06)	4.37 (0.09)	0.00	NS
Limited stress	4.35 (0.05)	4.38 (0.09)	0.01	NS
Absence of pain	4.29 (0.06)	4.68 (0.07)	10.08	**
Ability to exhibit natural behaviour	4.09 (0.06)	4.33 (0.10)	3.28	NS
Freedom of movement	4.15 (0.06)	4.43 (0.09)	5.54	*
Environmental enrichment	3.85 (0.07)	4.37 (0.09)	14.36	**

Degrees of freedom varied between 1; 258 and 1; 265

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Province of residence also influenced the perception of the importance of absence of pain, freedom of movement and environmental enrichment for the well-being of ostriches. Interestingly, in all instances, participants residing in ostrich farming provinces allocated lower scores (i.e. less important) than those that indicated residence beyond these areas ( $P < 0.05$ ; Table 4.2.5.1). No other significant provincial effects were observed for the importance of feed, water or health needs ( $P > 0.05$ ; Table 4.2.5.1).

The perceived importance of human rearing of ostrich chicks, as opposed to natural rearing for the well-being of ostriches were significantly influenced by participants' province of residence: participants residing in provinces where ostrich farming is common allocated a significantly higher score when compared to participants from other provinces ( $P < 0.05$ ; Table 4.2.5.2). On the other hand, the latter group of participants scored the importance of the type of vehicle/trailer used to transport ostriches significantly higher than participants that reside in provinces where ostrich farming is common ( $P < 0.05$ ; Table 4.2.5.2).

Significant effects were also observed regarding the importance of stockpeople's knowledge about the anatomy and behaviour of ostriches. In both cases participants residing in provinces where commercial ostrich farming is uncommon allocated significantly higher scores than those residing in provinces where ostrich farming is common ( $P < 0.05$ ; Table 4.2.5.2). The same trend was observed for the perceived importance that stockmen should be knowledgeable about detecting signs of disease/illness as well as for handling and restraining ostriches ( $P < 0.05$ ; Table 4.2.5.2).

In terms of buying decisions, participants residing in provinces where ostrich farming is common rated the importance of animal welfare when buying animal products and the importance of implementing a formal welfare protocol for the commercial production of ostriches significantly lower than participants from provinces where ostrich farming is uncommon ( $P < 0.05$ ; Table 4.2.5.2). No significant differences were however observed for neither the importance of animal welfare in general nor for the welfare of slaughter animals in terms of product quality ( $P > 0.05$ ; Table 4.2.5.2). Province of origin also had no significant

effect on participants' willingness to buy and pay more for welfare conscious products rather than welfare neutral products ( $P>0.05$ ; Table 4.2.5.2)

*Table 4.2.5.2 The effect of province of residence on the perceived importance of the level of knowledge of stockmen for ostrich welfare, the importance of general animal welfare and buying decisions. Scores were allocated on a scale of 1 to 5 (least to most knowledge/important/likely)*

	Ostrich Mean (s.e.)	Other Mean (s. e.)	F-value	Significance
<b>Importance of management and production practices for the well-being of ostriches:</b>				
Manually assisting chicks to hatch	3.48 (0.07)	3.17 (0.15)	3.27	NS
Human rearing of chicks	3.40 (0.07)	3.02 (0.16)	5.06	*
Frequent visual inspection of ostriches	4.31 (0.05)	4.38 (0.09)	0.69	NS
Regular handling of ostriches	3.56 (0.07)	3.56 (0.14)	0.00	NS
Stockmanship skill	4.44 (0.04)	4.47 (0.08)	0.19	NS
Type of vehicle used for transporting ostriches	4.29 (0.05)	4.52 (0.09)	5.20	*
Isolation of sick/injured birds	4.55 (0.05)	4.54 (0.09)	0.04	NS
Preventative medication	4.26 (0.06)	4.22 (0.13)	0.01	NS
<b>Importance of the level of knowledge people involved in the ostrich industry should have of the following factors:</b>				
Anatomy of ostriches	3.82 (0.07)	4.08 (0.14)	5.59	*
Ostrich behaviour	4.22 (0.06)	4.55 (0.08)	8.94	**
Detecting signs of stress in ostriches	4.46 (0.05)	4.63 (0.08)	3.60	NS
Detecting signs of illness in ostriches	4.62 (0.04)	4.77 (0.07)	4.27	*
Handling and restraining ostriches	4.46 (0.05)	4.63 (0.08)	3.93	*
Transporting ostriches	4.44 (0.05)	4.60 (0.08)	3.21	NS
<b>Importance of the following:</b>				
The welfare of farmed ostriches	4.48 (0.05)	4.53 (0.07)	0.06	NS
The welfare of slaughter animals for product quality	4.49 (0.05)	4.57 (0.08)	0.77	NS
Animal welfare when buying animal products	4.20 (0.06)	4.48 (0.09)	5.06	*
Implementing a formal welfare protocol for farmed ostriches	4.24 (0.06)	4.57 (0.08)	5.25	*
<b>Likelihood to:</b>				
Buy welfare conscious products	3.86 (0.07)	4.05 (0.14)	1.75	NS
Pay more for welfare conscious products	3.55 (0.08)	3.73 (0.16)	1.50	NS

Degrees of freedom varied between 1; 258 and 1; 265

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

#### 4.2.6 The effect of dietary preference

When comparing participants' perceived knowledge about the commercial production of ostriches across different dietary preferences, it was evident that vegetarian/vegan participants showed less knowledge about the handling of ostriches than participants that have a preference for meat ( $P < 0.05$ ; Table 4.2.6.1). However, no other differences were observed between participants with different dietary preferences in terms of their perceived knowledge about general ostrich production, transportation of ostriches or artificial incubation and rearing of ostrich chicks ( $P > 0.05$ ; Table 4.2.6.1)

The perceived importance of several factors related to the well-being of ostriches was also influenced by dietary preference. These included the absence of pain, ability to exhibit natural behaviour, freedom of movement and environmental enrichment for the well-being of ostriches, for which vegetarian/vegan participants allocated significantly higher scores of importance than both participants without any specific dietary preference and those with a preference for meat, the latter allocating the lowest scores ( $P < 0.05$ ; Table 4.2.6.1). No other significant effects of dietary preference were observed for production factors related to basic feed, water and health needs of ostriches ( $P > 0.05$ ; Table 4.2.6.1).



*Table 4.2.6.1 The effect of participants' diet on their perceived knowledge of ostrich production processes and the importance of factors for the welfare of ostriches. Scores were allocated on a scale of 1 to 5 (least to most knowledge/important)*

	Meat Mean (s. e.)	None Mean (s. e.)	Veg Mean (s. e.)	F-value	Significance
<b>Knowledge of production processes:</b>					
General ostrich production	2.96 (0.11)	2.83 (0.10)	2.37 (0.32)	2.29	NS
Transportation of ostriches	2.74 (0.12)	2.64 (0.10)	2.16 (0.33)	2.00	NS
Handling of ostriches	2.92 (0.13) <sup>b</sup>	2.80 (0.10) <sup>ab</sup>	2.11 (0.30) <sup>a</sup>	3.33	*
Artificial incubation of eggs	2.46 (0.12)	2.43 (0.10)	2.00 (0.28)	1.26	NS
Artificial chick rearing	2.68 (0.12)	2.48 (0.10)	2.05 (0.29)	2.33	NS
<b>Importance of factors for the well-being of ostriches:</b>					
Feed availability	4.63 (0.05)	4.59 (0.05)	4.63 (0.11)	0.02	NS
Feed quality	4.50 (0.06)	4.57 (0.05)	4.63 (0.11)	0.76	NS
Water availability	4.67 (0.05)	4.74 (0.04)	4.68 (0.11)	0.89	NS
Water quality	4.50 (0.06)	4.56 (0.05)	4.68 (0.11)	0.60	NS
Chick housing	4.30 (0.08)	4.35 (0.06)	4.53 (0.12)	0.42	NS
Shelters in outside camps	3.93 (0.08)	3.96 (0.07)	4.26 (0.23)	1.82	NS
Stocking density	4.07 (0.07)	4.10 (0.06)	4.42 (0.25)	3.12	NS
Body condition of ostriches	4.42 (0.06)	4.45 (0.06)	4.68 (0.11)	1.18	NS
Internal parasites	4.32 (0.07)	4.44 (0.06)	4.42 (0.23)	2.13	NS
External parasites	4.34 (0.07)	4.34 (0.07)	4.42 (0.23)	0.68	NS
Limited stress	4.35 (0.06)	4.37 (0.06)	4.74 (0.10)	2.74	NS
Absence of pain	4.35 (0.08) <sup>a</sup>	4.41 (0.06) <sup>a</sup>	4.89 (0.07) <sup>b</sup>	4.27	*
Ability to exhibit natural behaviour	4.09 (0.08) <sup>a</sup>	4.21 (0.07) <sup>a</sup>	4.68 (0.13) <sup>b</sup>	5.24	*
Freedom of movement	4.17 (0.08) <sup>a</sup>	4.22 (0.07) <sup>a</sup>	4.79 (0.10) <sup>b</sup>	5.51	*
Environmental enrichment	3.87 (0.10) <sup>a</sup>	4.02 (0.07) <sup>a</sup>	4.58 (0.16) <sup>b</sup>	5.10	*

Degrees of freedom varied between 2; 271 and 2; 290

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* = P<0.05; \*\* = P<0.01 and \*\*\* = P<0.0001

Only a single management practice was observed to be influenced by dietary preference, with both participants without a dietary preference and those with a preference for meat rating the importance of regular handling of ostriches higher than vegetarian/vegan participants (P<0.05; Table 4.2.6.2). The importance of manually assisting chicks to hatch, artificial chick rearing, frequent visual inspection, stockmanship skill, type of vehicle/trailer used for transporting

ostriches, isolation of sick/injured birds and the use of preventative medicine were all independent of participants' dietary preferences ( $P>0.05$ ; Table 4.2.6.2).

*Table 4.2.6.2 The effect of participants' diet on the perceived importance of the level of knowledge of stockmen for ostrich welfare, the importance of general animal welfare and buying decisions. Scores were allocated on a scale of 1 to 5 (least to most importance/likely)*

	Meat Mean (s. e.)	None Mean (s. e.)	Veg Mean (s. e.)	F-value	Significance
<b>Importance of management and production practices for the well-being of ostriches:</b>					
Manually assisting chicks to hatch	3.58 (0.10)	3.29 (0.08)	3.00 (0.25)	4.22	NS
Human rearing of chicks	3.49 (0.10)	3.23 (0.09)	3.05 (0.30)	2.62	NS
Frequent visual inspection of ostriches	4.34 (0.07)	4.33 (0.05)	4.21 (0.14)	0.50	NS
Regular handling of ostriches	3.59 (0.10) <sup>b</sup>	3.55 (0.08) <sup>b</sup>	2.78 (0.26) <sup>a</sup>	4.40	*
Stockmanship skill	4.39 (0.06)	4.47 (0.05)	4.58 (0.12)	0.88	NS
Type of vehicle used for transporting ostriches	4.29 (0.08)	4.35 (0.06)	4.68 (0.11)	2.18	NS
Isolation of sick/injured birds	4.46 (0.07)	4.61 (0.05)	4.37 (0.17)	2.01	NS
Preventative medication	4.25 (0.07)	4.24 (0.07)	4.00 (0.24)	0.55	NS
<b>Importance of the level of knowledge people involved in the ostrich industry should have of the following factors:</b>					
Anatomy of ostriches	3.82 (0.09) <sup>a</sup>	3.93 (0.08) <sup>ab</sup>	4.47 (0.16) <sup>b</sup>	4.06	*
Ostrich behaviour	4.21 (0.07) <sup>a</sup>	4.35 (0.07) <sup>ab</sup>	4.74 (0.13) <sup>b</sup>	5.52	**
Detecting signs of stress in ostriches	4.50 (0.07)	4.50 (0.05)	4.79 (0.10)	1.68	NS
Detecting signs of illness in ostriches	4.62 (0.06)	4.69 (0.04)	4.89 (0.07)	2.01	NS
Handling and restraining ostriches	4.51 (0.06)	4.50 (0.05)	4.84 (0.09)	2.66	NS
Transporting ostriches	4.50 (0.06)	4.44 (0.06)	4.79 (0.10)	2.09	NS
<b>Importance of the following:</b>					
The welfare of farmed ostriches	4.45 (0.07) <sup>a</sup>	4.48 (0.05) <sup>a</sup>	4.84 (0.09) <sup>b</sup>	3.22	*
The welfare of slaughter animals for product quality	4.44 (0.07)	4.50 (0.05)	4.84 (0.09)	2.96	NS
Animal welfare when buying animal products	4.09 (0.09) <sup>a</sup>	4.30 (0.06) <sup>a</sup>	4.79 (0.12) <sup>b</sup>	6.16	**
Implementing a formal welfare protocol for farmed ostriches	4.21 (0.09) <sup>a</sup>	4.37 (0.06) <sup>a</sup>	4.79 (0.12) <sup>b</sup>	3.97	*
<b>Likelihood to:</b>					
Buy welfare conscious products	3.87 (0.10) <sup>a</sup>	3.92 (0.08) <sup>a</sup>	4.42 (0.29) <sup>b</sup>	4.47	*
Pay more for welfare conscious products	3.60 (0.11) <sup>a</sup>	3.59 (0.09) <sup>a</sup>	4.16 (0.31) <sup>b</sup>	3.61	*

Degrees of freedom varied between 2; 271 and 2; 290

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

Dietary preference also influenced the perceived importance of the level of knowledge of stockmen in the ostrich industry regarding the anatomy and behaviour of ostriches, with participants with a preference for meat allocating significantly lower scores than vegetarian/vegan participants ( $P < 0.05$ ; Table 4.2.6.2). No other factors related to the knowledge of stockmen involved in ostrich production were influenced by the dietary preference of participants.

Interestingly, vegetarian/vegan participants allocated significantly higher scores to the importance of welfare of farmed ostriches, animal welfare when buying animal products and implementing a formal welfare protocol for the commercial production of ostriches than both participants without dietary preferences and those that prefer meat ( $P < 0.05$ ; Table 4.2.6.2). The importance of the welfare of slaughter animals for product quality was, however, not influenced by participants' dietary preferences ( $P > 0.05$ ; Table 4.2.6.2).

Finally, participants' willingness to buy and pay more for welfare conscious rather than welfare neutral products were also influenced by dietary preferences. Vegetarian/vegan participants indicated to be more willing to do so than both participants without dietary preferences and those that preferred meat ( $P < 0.05$ ; Table 4.2.6.2).

### 4.3 Perceived knowledge and welfare perceptions of consumers versus ostrich farmers and secondary stakeholders in the ostrich industry

Clear differences were observed between consumers', ostrich farmers' and secondary stakeholders' perceived knowledge about the commercial production of ostriches, general ostrich production, transportation and handling of ostriches, the artificial incubation of eggs and the artificial rearing of chicks (Table 4.3.1). Consumers scored their knowledge of all aspects of ostrich production significantly lower than both secondary stakeholders and farmers ( $P < 0.05$ ; Table 4.3.1). However, while secondary stakeholders in the ostrich industry scored their knowledge of all aspects of commercial ostrich production significantly higher than consumers, they still allocated significantly lower scores than farmers ( $P < 0.05$ ; Table 4.3.1).

Good accordance was observed between all three categories of participants in terms of the importance of factors related to the basic feed, water and health needs of ostriches ( $P > 0.05$ ; Table 4.3.1). In terms of the importance of factors for the welfare of ostriches, a significant difference between categories of participants was observed for the importance of chick housing ( $P < 0.05$ ; Table 4.3.1), whereby ostrich farmers allocated significantly higher scores than secondary stakeholders ( $P < 0.05$ ; Table 4.3.1). Similarly, there was a significant difference between categories of participants for factors related to natural living (i.e. freedom of movement and the ability to exhibit natural behaviours). The importance of the absence of pain was scored significantly higher by consumers compared to farmers and secondary stakeholders ( $P < 0.05$ ; Table 4.3.1). Scores allocated by consumers for the importance of the ability to exhibit natural behaviour were also higher than that of both farmers and secondary stakeholders ( $P < 0.05$ ; Table 4.3.1). Furthermore, consumers scored the importance of freedom of movement ( $P < 0.05$ ; Table 4.3.1) significantly higher than secondary stakeholders ( $P < 0.05$ ; Table 4.3.1), while farmers allocated intermediate values between consumers and stakeholders. A similar trend was observed for scores pertaining to the importance of

environmental enrichment, with consumers giving higher scores than secondary stakeholders and farmers ( $P < 0.05$ ; Table 4.3.1). The category of participants had no effect on the other factors investigated ( $P > 0.05$ ; Table 4.3.1).

*Table 4.3.1 The effect of category of participants on their perceived knowledge of ostrich production processes and the importance of factors for the welfare of ostriches. Scores were allocated on a scale of 1 to 5 (least to most knowledge/important)*

	Consumers Mean (s. e.) (n=175)	Farmers Mean (s. e.) (n=31)	Stakeholders Mean (s. e.) (n=96)	F value	Significance
<b>Knowledge of production processes:</b>					
General ostrich production	2.42 (0.08) <sup>a</sup>	3.90 (0.18) <sup>c</sup>	3.30 (0.12) <sup>b</sup>	34.18	*
Transportation of ostriches	2.12 (0.08) <sup>a</sup>	3.86 (0.18) <sup>c</sup>	3.22 (0.13) <sup>b</sup>	46.72	*
Handling of ostriches	2.30 (0.09) <sup>a</sup>	4.07 (0.17) <sup>c</sup>	3.33 (0.13) <sup>b</sup>	42.13	*
Artificial incubation of eggs	2.09 (0.08) <sup>a</sup>	3.67 (0.19) <sup>c</sup>	2.61 (0.13) <sup>b</sup>	23.54	*
Artificial chick rearing	2.12 (0.09) <sup>a</sup>	3.63 (0.18) <sup>c</sup>	2.94 (0.14) <sup>b</sup>	27.68	*
<b>Importance of factors for the well-being of ostriches:</b>					
Feed availability	4.62 (0.05)	4.61 (0.12)	4.56 (0.06)	0.35	NS
Feed quality	4.55 (0.05)	4.71 (0.14)	4.53 (0.06)	2.38	NS
Water availability	4.75 (0.04)	4.68 (0.12)	4.65 (0.06)	0.85	NS
Water quality	4.55 (0.05)	4.65 (0.14)	4.50 (0.07)	1.31	NS
Chick housing	4.38 (0.05) <sup>ab</sup>	4.55 (0.13) <sup>b</sup>	4.22 (0.08) <sup>a</sup>	3.25	*
Shelters in outside camps	4.03 (0.07)	4.00 (0.17)	3.87 (0.09)	1.41	NS
Stocking density	4.19 (0.06)	4.00 (0.14)	4.00 (0.09)	2.21	NS
Body condition of ostriches	4.48 (0.05)	4.45 (0.12)	4.43 (0.07)	0.27	NS
Internal parasites	4.43 (0.06)	4.52 (0.13)	4.34 (0.09)	0.62	NS
External parasites	4.35 (0.06)	4.60 (0.10)	4.31 (0.09)	1.21	NS
Limited stress	4.42 (0.06)	4.45 (0.12)	4.32 (0.07)	1.16	NS
Absence of pain	4.57 (0.05) <sup>b</sup>	4.13 (0.16) <sup>a</sup>	4.24 (0.09) <sup>a</sup>	7.68	*
Ability to exhibit natural behaviour	4.32 (0.07) <sup>b</sup>	3.94 (0.15) <sup>a</sup>	4.01 (0.09) <sup>a</sup>	7.73	*
Freedom of movement	4.37 (0.06) <sup>b</sup>	4.10 (0.13) <sup>ab</sup>	4.01 (0.09) <sup>a</sup>	8.11	*
Environmental enrichment	4.14 (0.07) <sup>b</sup>	3.87 (0.15) <sup>ab</sup>	3.78 (0.10) <sup>a</sup>	6.00	*

Degrees of freedom varied between 2; 292 and 2; 297

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

However, the perceived welfare importance of management and of production practices was significantly different for consumers, farmers and stakeholders. Clear discordance was observed between respondent categories for the importance of manually assisting chicks to hatch ( $P < 0.0001$ ; Table 4.3.2). Ostrich farmers scored the importance thereof significantly higher than both secondary stakeholders and consumers, and secondary stakeholders also scored significantly higher than consumers ( $P < 0.05$ ; Table 4.3.2). Similarly, the importance of human rearing of chicks was influenced by respondent category ( $P < 0.0001$ ; Table 4.3.2). Consumers allocated significantly lower scores than both farmers and stakeholders ( $P < 0.05$ ; Table 4.3.2), while no difference was observed between the latter ( $P > 0.05$ ). For the regular handling of ostriches' consumers allocated lower scores, while farmers allocated higher scores ( $P < 0.05$ , Table 4.3.2). None of the other management or production practices was affected by the category of participants ( $P > 0.05$ ; Table 4.3.2).

*Table 4.3.2 The effect of category of participants on the importance of the knowledge level of stockmen for ostrich welfare, the importance of general animal welfare and buying decisions. Scores were allocated on a scale of 1 to 5 (least to most knowledge/importance/likely)*

	Consumers Mean (s. e.) (n=175)	Farmers Mean (s. e.) (n=31)	Stakeholders Mean (s. e.) (n=96)	F value	Significance
<b>Importance of management and production practices for the well-being of ostriches:</b>					
Manually assisting chicks to hatch	3.08 (0.08) <sup>a</sup>	4.20 (0.14) <sup>c</sup>	3.69 (0.09) <sup>b</sup>	23.42	*
Human rearing of chicks	2.98 (0.09) <sup>a</sup>	4.00 (0.15) <sup>b</sup>	3.71 (0.10) <sup>b</sup>	22.70	*
Frequent visual inspection of ostriches	4.29 (0.06)	4.47 (0.10)	4.38 (0.07)	0.84	NS
(24) Regular handling of ostriches	3.31 (0.08) <sup>a</sup>	4.17 (0.16) <sup>c</sup>	3.71 (0.09) <sup>b</sup>	11.49	*
Stockmanship skill	4.45 (0.05)	4.50 (0.12)	4.43 (0.06)	0.24	NS
Type of vehicle used for transporting ostriches	4.36 (0.06)	4.47 (0.12)	4.33 (0.07)	0.55	NS
Isolation of sick/injured birds	4.57 (0.05)	4.56 (0.10)	4.51 (0.08)	0.17	NS
Preventative medication	4.24 (0.07)	4.47 (0.12)	4.17 (0.09)	1.17	NS
<b>Importance of the level of knowledge people involved in the ostrich industry should have of the following factors:</b>					
Anatomy of ostriches	4.07 (0.08) <sup>b</sup>	3.63 (0.20) <sup>ab</sup>	3.75 (0.10) <sup>a</sup>	6.09	*
Ostrich behaviour	4.46 (0.06) <sup>b</sup>	4.24 (0.13) <sup>ab</sup>	4.12 (0.08) <sup>a</sup>	7.17	*
Detecting signs of stress in ostriches	4.60 (0.05) <sup>b</sup>	4.40 (0.11) <sup>ab</sup>	4.39 (0.07) <sup>a</sup>	6.31	*
Detecting signs of illness in ostriches	4.74 (0.04)	4.53 (0.12)	4.61 (0.06)	3.09	NS
Handling and restraining ostriches	4.56 (0.05)	4.60 (0.10)	4.44 (0.07)	1.38	NS
Transporting ostriches	4.51 (0.05)	4.59 (0.11)	4.42 (0.07)	0.89	NS
<b>Importance of the following welfare aspects:</b>					
The welfare of farmed ostriches	4.51 (0.05)	4.67 (0.11)	4.41 (0.07)	2.52	NS
The welfare of slaughter animals for product quality	4.50 (0.05) <sup>ab</sup>	4.77 (0.09) <sup>b</sup>	4.43 (0.07) <sup>a</sup>	3.54	*
Animal welfare when buying animal products	4.31 (0.07)	4.33 (0.14)	4.14 (0.09)	1.55	NS
Implementing a formal welfare protocol for farmed ostriches	4.45 (0.06) <sup>b</sup>	4.13 (0.18) <sup>ab</sup>	4.19 (0.09) <sup>a</sup>	4.09	*
<b>Likelihood to:</b>					
Buy welfare conscious products	4.05 (0.08) <sup>b</sup>	3.67 (0.20) <sup>ab</sup>	3.76 (0.11) <sup>a</sup>	3.91	*
Pay more for welfare conscious products	3.65 (0.09)	3.63 (0.20)	3.55 (0.11)	0.70	NS

Degrees of freedom varied between 2; 292 and 2; 297

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* = P<0.05; \*\* = P<0.01 and \*\*\* = P<0.0001

The perceived importance of the knowledge levels stockpersons should have also appeared to differ between consumers, farmers and secondary stakeholders. Consumers gave

significantly higher scores than secondary stakeholders for knowledge about the anatomy of ostriches, ( $P < 0.05$ ; Table 4.3.2), ostrich behaviour ( $P < 0.001$ ; Table 4.3.2) and detecting signs of distress ( $P < 0.01$ ; Table 4.3.2). No other differences were observed for the other factors tested ( $P > 0.05$ ; Table 4.3.2).

Similarly, there were no significant differences between participant categories for neither the welfare importance of farmed ostriches ( $P > 0.05$ ; Table 4.3.2), nor for the importance of animal welfare when buying animal products ( $P > 0.05$ ; Table 4.3.2). There was however a significant difference between farmers and secondary stakeholders in terms of the importance of the welfare of slaughter animals for product quality, with farmers allocating higher scores than secondary stakeholders ( $P < 0.05$ ; Table 4.3.2). Participants of different categories ranked the importance of implementing a formal welfare protocol differently ( $P < 0.05$ ; Table 4.3.2), with stakeholders giving lower scores than consumers ( $P < 0.05$ ; Table 4.3.2). Similarly, participants' occupational category influenced their willingness to buy welfare conscious products rather than welfare neutral products ( $P < 0.05$ ; Table 4.3.2), with secondary stakeholders allocating lower scores than consumers ( $P < 0.05$ ; Table 4.3.2). In contrast, occupational category did not have an influence on participants' willingness to pay more for welfare conscious products ( $P > 0.05$ ).



## 4.4 Perceptions of farmers and secondary stakeholders of the welfare impact and importance of ostrich-specific management and production processes in the ostrich industry

### 4.4.1 General trend of responses from ostrich farmers and secondary stakeholders in the ostrich industry.

Ostrich farmers and secondary stakeholders in the ostrich industry scored the welfare impact of incubation and hatching methods between neutral to slightly positive, with scores ranging from  $3.23 \pm 0.10$  to  $3.76 \pm 0.11$  (Table 4.4.1.1). In terms of the perceived welfare impact of rearing methods used in the industry, neutral to slightly positive scores ranging between  $3.74 \pm 0.11$  and  $3.85 \pm 0.09$  were allocated.

*Table 4.4.1.1 Mean scores allocated by 31 farmers and 96 stakeholders in the ostrich industry pertaining to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry, scored on a scale of 1 to 5 from most negative to most positive impact.*

	Mean (s. e.)	Range
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>		
Natural incubation and hatching with breeder birds	3.76 (0.11)	(1.0 - 5.0)
Artificial incubation and hatching without human assistance	3.23 (0.10)	(1.0 - 5.0)
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	3.75 (0.09)	(1.0 - 5.0)
Artificial incubation and hatching with regular human assistance (eggs are routinely cracked/chicks assisted)	3.24 (0.11)	(1.0 - 5.0)
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>		
Natural rearing with breeder birds with human assistance	3.52 (0.11)	(1.0 - 5.0)
Natural rearing with breeder birds without human assistance	3.85 (0.09)	(1.0 - 5.0)
Artificial rearing in extensive systems (pasture-based systems)	3.59 (0.09)	(1.0 - 5.0)
Artificial rearing in semi-extensive systems	3.53 (0.09)	(1.0 - 5.0)
Artificial rearing in intensive systems (dry runs/feedlots)	3.47 (0.11)	(1.0 - 5.0)

In contrast, the perceived impact of toenail clipping practices was scored slightly negative to neutral with scores between  $2.27 \pm 0.10$  and  $3.43 \pm 0.11$ . Their perception of the welfare impact

of feather harvesting practices and methods used to restrain ostriches were mostly neutral with scores ranging between  $2.83 \pm 0.14$  and  $3.24 \pm 0.10$ , and between  $2.82 \pm 0.12$  and  $3.89 \pm 0.10$ , respectively. However, farmers and stakeholders attributed a relatively high importance to the rapid treatment of sick or injured birds, by allocating a mean score of  $4.83 \pm 0.03$  (Table 4.4.1.2).

*Table 4.4.1.2 Mean scores allocated by 31 farmers and 96 stakeholders in the ostrich industry with regards to the perceived welfare impact of management processes in the ostrich industry, scored on a scale of 1 to 5 from most negative to most positive impact*

	Mean (s.e.)	Range
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>		
No toenail clipping	2.88 (0.12)	(1.0 - 5.0)
Toenail clipping with cauterization	2.46 (0.11)	(1.0 - 5.0)
Toenail clipping without cauterization	3.43 (0.11)	(1.0 - 5.0)
Declawing/permanent removal of the nail	2.35 (0.13)	(1.0 - 5.0)
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.83 (0.03)	(4.0 - 5.0)
<b>Impact of the method of feather harvesting on the well-being of birds:</b>		
Feather plucking	2.87 (0.12)	(1.0 - 5.0)
Feather clipping	3.24 (0.10)	(1.0 - 5.0)
Clipping of white feathers, plucking of other feathers	3.20 (0.12)	(1.0 - 5.0)
No feather harvesting	2.83 (0.14)	(1.0 - 5.0)
<b>Impact of restraining method on the well-being of birds:</b>		
No devices used/man-held	2.82 (0.12)	(1.0 - 5.0)
Hooks	3.21 (0.11)	(1.0 - 5.0)
Triangular crush	3.43 (0.10)	(1.0 - 5.0)
Hoods	3.89 (0.10)	(1.0 - 5.0)

In terms of the importance of factors related to the transportation of ostrich chicks, farmers and secondary stakeholders allocated relatively high scores, ranging between  $4.16 \pm 0.08$  and  $4.55 \pm 0.06$ , while scores allocated to factors related to the transportation of juvenile or slaughter birds were between  $3.51 \pm 0.09$  and  $4.61 \pm 0.05$ . Participants generally scored the importance of extensive human presence/bonding from a young age as neutral to moderately

important ( $3.98 \pm 0.08$ ; Table 4.4.1.3). Similarly, they scored the importance of both the familiarity of birds with specific handlers and regular handling and interaction with birds as neutral to moderately important ( $3.77 \pm 0.09$  and  $3.97 \pm 0.08$  respectively).

*Table 4.4.1.3 Mean scores allocated by 31 farmers and 96 stakeholders in the ostrich industry with regards to the perceived welfare importance of transport factors, scored on a scale of 1 to 5, from least to most important*

	Mean (s.e.)	Range
<b>The importance of the following factors for the well-being of chicks when transported:</b>		
Type of vehicle being used	4.16 (0.08)	(1.0 - 5.0)
The use of crates	4.22 (0.07)	(1.0 - 5.0)
Stocking density	4.52 (0.06)	(2.0 - 5.0)
Use of mats in crates	4.45 (0.06)	(2.0 - 5.0)
Time of day when transporting	4.34 (0.08)	(1.0 - 5.0)
Ventilation	4.55 (0.06)	(2.0 - 5.0)
Protection against the elements	4.46 (0.07)	(2.0 - 5.0)
Driver skill/experience	4.35 (0.07)	(1.0 - 5.0)
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>		
Type of vehicle being used	4.45 (0.06)	(2.0 - 5.0)
Presence of a cover on top of the trailer	3.51 (0.09)	(1.0 - 5.0)
Type of flooring	4.52 (0.06)	(3.0 - 5.0)
Stocking density	4.49 (0.06)	(2.0 - 5.0)
Time of day when transporting	4.30 (0.08)	(1.0 - 5.0)
Ventilation	4.44 (0.06)	(3.0 - 5.0)
Presence of workers with birds	4.47 (0.06)	(2.0 - 5.0)
Driver skill/experience	4.61 (0.05)	(3.0 - 5.0)

In terms of improved product quality through improved welfare quality, farmers and stakeholders scored the likeliness of improved product quality relatively high, between  $4.13 \pm 0.09$  and  $4.24 \pm 0.09$ . A mean score of  $3.82 \pm 0.10$  (Table 4.4.1.4) was allocated to the importance of implementing a formal welfare protocol for the commercial production of ostriches. A similar neutral to positive view was expressed for the likeliness that farmers would follow such a protocol, with a mean allocated score of  $3.50 \pm 0.10$ .

*Table 4.4.1.4 Mean scores allocated by 31 farmers and 96 stakeholders in the ostrich industry for the perceived importance/likeliness of welfare factors, scored on a scale of 1 to 5 from least to most important/likely*

	Mean (s. e.)	Range
<b>The importance of the following factors for ostrich well-being:</b>		
Extensive human presence/bonding from a young age	3.98 (0.08)	(1.0 - 5.0)
Familiarity of birds with specific handlers	3.77 (0.09)	(1.0 - 5.0)
Regular handling and interaction with birds	3.97 (0.08)	(1.0 - 5.0)
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following:</b>		
Meat	4.18 (0.09)	(1.0 - 5.0)
Leather	4.24 (0.09)	(1.0 - 5.0)
Feathers	4.13 (0.09)	(1.0 - 5.0)
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches:</b>	3.82 (0.10)	(1.0 - 5.0)
<b>The likeliness that farmers will follow such a protocol if it were to be implemented:</b>	3.50 (0.10)	(1.0 - 5.0)

## 4.5 The effect of socio-demographical aspects on the perceived welfare impact and importance of ostrich-specific management and production factors according to ostrich farmers and secondary stakeholders in the ostrich industry

### 4.5.1 Gender effect of farmers and secondary stakeholders in the ostrich industry's responses

No effect of gender was observed on participants' perception of the welfare impact of incubation and hatching methods of ostrich chicks, or rearing methods ( $P > 0.05$ ; Table 4.5.1.1).

*Table 4.5.1.1 Gender effect on scores allocated by 31 farmers and 96 stakeholders in the ostrich industry with regards to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry, scored on a scale of 1 to 5 from highly negative to highly positive impact*

	Men Mean (s. e.)	Women Mean (s. e.)	F-value	Significance
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>				
Natural incubation and hatching with breeder birds	3.73 (0.12)	4.08 (0.24)	0.65	NS
Artificial incubation and hatching without human assistance	3.26 (0.10)	3.08 (0.37)	0.37	NS
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	3.75 (0.10)	3.62 (0.27)	0.36	NS
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	3.28 (0.11)	2.85 (0.39)	1.27	NS
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>				
Natural rearing with breeder birds without human assistance	3.47 (0.11)	4.08 (0.26)	3.32	NS
Natural rearing with breeder birds without human assistance	3.83 (0.09)	4.31 (0.21)	3.25	NS
Artificial rearing in extensive systems (pasture-based systems)	3.59 (0.10)	3.69 (0.33)	0.43	NS
Artificial rearing in semi-extensive systems	3.57 (0.09)	3.38 (0.29)	0.13	NS
Artificial rearing in intensive systems (dry-runs/feedlots)	3.55 (0.11)	2.77 (0.36)	4.95	*

Degrees of freedom varied between 1; 106 and 1; 116

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

However, a significant gender effect was observed in terms of their opinion of the welfare impact of artificially rearing ostrich chicks in intensive (feedlot/dry run) systems ( $P < 0.05$ ; Table 4.5.1.1). By allocating a lower score, women indicated a negative perception about the potential welfare impacts of this rearing method. No other significant difference between men and women was observed with regards to the potential welfare impact of chick rearing methods ( $P > 0.05$ ).

Gender differences were observed for the perceived welfare impact of several management and production practices. In terms of toenail clipping practices, women indicated a more negative perception of the welfare implications of toenail clipping without cauterization than men ( $P < 0.05$ ; Table 4.5.1.2). No such gender differences were found with regards to other toenail clipping practices (i.e. no toenail clipping, toenail clipping with cauterization and declawing;  $P > 0.05$ ). Similarly, no significant differences were observed between the perceptions of men and women in terms of the welfare impact of feather harvesting methods ( $P > 0.05$ ) and of the methods used to restrain commercially farmed ostriches ( $P > 0.05$ ).

*Table 4.5.1.2 Gender effects on scores allocated by 31 farmers and 96 stakeholders in the ostrich industry with regards to the perceived welfare impact of management processes in the ostrich industry scored on a scale of 1 to 5 from most negative to positive impact*

	Men Mean (s. e.)	Women Mean (s. e.)	F-value	Significance
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>				
No toenail clipping	2.87 (0.12)	3.00 (0.42)	0.10	NS
Toenail clipping with cauterization	2.42 (0.12)	2.85 (0.39)	1.18	NS
Toenail clipping without cauterization	3.55 (0.12)	2.62 (0.33)	6.85	*
Declawing/permanent removal of the nail and part of the toe	2.40 (0.14)	2.00 (0.25)	0.42	NS
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.82 (0.04)	4.92 (0.08)	0.90	NS
<b>Impact of the method of feather harvesting on the well-being of birds:</b>				
Feather plucking	2.90 (0.13)	2.54 (0.37)	0.80	NS
Feather clipping	3.26 (0.11)	3.15 (0.30)	0.23	NS
Clipping of white feathers, plucking of other feathers	3.19 (0.12)	2.92 (0.35)	0.54	NS
No feather harvesting	2.81 (0.15)	3.00 (0.41)	0.20	NS
<b>Impact of restraining method used on the well-being of birds:</b>				
No devices used/man held	2.80 (0.13)	2.85 (0.34)	0.00	NS
Hooks	3.19 (0.11)	3.08 (0.35)	0.05	NS
Triangular crush	3.44 (0.11)	3.00 (0.32)	1.95	NS
Hoods	3.89 (0.10)	3.85 (0.32)	0.00	NS

Degrees of freedom varied between 1; 106 and 1; 116

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Furthermore, while both men and women agreed upon the importance of rapidly treating sick or injured birds by scoring it similarly ( $P > 0.05$ ; Table 4.5.1.2), their opinions differed for the transportation of ostrich chicks; the use of crates, stocking density, time of day when transporting chicks and protection against the elements ( $P < 0.05$ ; Table 4.5.1.2). For all five of these factors women rated the importance thereof for the well-being of ostriches higher than men. No such gender effects were however observed in the scores for the type of vehicle used during transport, ventilation and driver skill ( $P > 0.05$ ; Table 4.5.1.2).

Upon comparison of participants' perception of the welfare importance of factors related to the transport of juvenile ostriches or slaughter birds, only the importance of the type of flooring, stocking density and ventilation were scored higher by women than by men ( $P < 0.05$ ; Table 4.5.1.3). No such gender difference was observed for any other factors related to this specific aspect (i.e. type of vehicle used for transportation, presence of a cover on top, time of day during transport, presence of workers with birds and driver skill or experience;  $P > 0.05$ ).

*Table 4.5.1.3 Gender effects on scores allocated by 31 farmers and 96 stakeholders in the ostrich industry with regards to the perceived welfare importance of transport factors in the ostrich industry, scored on a scale of 1 to 5 from least to most important / lowest to highest importance.*

	Men Mean (s. e.)	Women Mean (s. e.)	F-value	Significance
<b>The importance of the following factors for the well-being of chicks when transported:</b>				
Type of vehicle being used	4.10 (0.09)	4.46 (0.18)	1.64	NS
The use of crates	4.14 (0.08)	4.62 (0.14)	4.27	*
Stocking density	4.47 (0.06)	4.85 (0.10)	4.59	*
Use of mats in crates	4.38 (0.07)	4.92 (0.08)	8.81	**
Time of day when transporting	4.26 (0.08)	4.85 (0.10)	6.65	*
Ventilation	4.52 (0.06)	4.77 (0.17)	2.68	NS
Protection against the elements	4.40 (0.08)	4.85 (0.10)	4.70	*
Driver skill/experience	4.32 (0.08)	4.46 (0.18)	0.28	NS
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>				
Type of vehicle being used	4.40 (0.07)	4.69 (0.13)	1.76	NS
Presence of a cover on top of the trailer	3.44 (0.10)	3.92 (0.26)	2.13	NS
Type of flooring	4.46 (0.06)	4.85 (0.10)	4.73	*
Stocking density	4.45 (0.07)	4.85 (0.10)	4.61	*
Time of day when transporting	4.26 (0.08)	4.62 (0.18)	2.28	NS
Ventilation	4.39 (0.07)	4.77 (0.17)	4.46	*
Presence of workers with birds	4.44 (0.06)	4.62 (0.24)	2.10	NS
Driver skill/experience	4.57 (0.06)	4.85 (0.10)	2.81	NS

Degrees of freedom varied between 1; 106 and 1; 116

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$



Furthermore, no significant gender effects were observed for the perceived welfare importance of extensive human presence/bonding from a young age, familiarity of birds with specific handlers, or regular handling and interaction with birds ( $P>0.05$ ; Table 4.5.1.4).

*Table 4.5.1.4 The effect of gender effects on scores allocated by 31 farmers and 96 stakeholders in the ostrich industry with reference to the perceived importance/likeliness of welfare factors scored on a scale of 1 to 5 from least to most important/likely*

	Men Mean (s. e.)	Women Mean (s. e.)	F-value	Significance
<b>The importance of the following factors when ostriches are reared for their well-being:</b>				
Extensive human presence/bonding from a young age	3.95 (0.09)	4.23 (0.23)	1.09	NS
Familiarity of birds with specific handlers	3.74 (0.10)	4.08 (0.21)	1.26	NS
Regular handling and interaction with birds	3.96 (0.09)	4.17 (0.24)	0.43	NS
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following:</b>				
Meat	4.16 (0.09)	4.38 (0.24)	0.78	NS
Leather	4.30 (0.09)	3.77 (0.32)	3.43	NS
Feathers	4.17 (0.09)	3.69 (0.36)	1.50	NS
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches:</b>	3.80 (0.11)	4.38 (0.18)	3.50	NS
<b>The likeliness that farmers will follow such a protocol if it were to be implemented:</b>	3.53 (0.11)	3.23 (0.43)	0.20	NS

Degrees of freedom varied between 1; 106 and 1; 116

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

Finally, no differences were observed between men and women in terms of the likeliness that the improved welfare quality of ostriches would also improve the product quality of meat, leather or feather products, the importance of implementing a formal welfare protocol for the commercial production of ostriches and the likeliness that farmers would follow such a welfare protocol if it were implemented on-farm ( $P>0.05$ ; Table 4.5.1.4).

#### 4.5.2 The effect of age on farmers and secondary stakeholders

No significant differences were observed with regards to age effect on neither farmers' nor stakeholders' scores relating to the welfare impact of incubation and hatching methods ( $P>0.05$ ; Table 4.5.2.1). A significant difference between age categories was however observed for the welfare impact of methods used to rear ostrich chicks. The youngest participants (<36 years) generally allocated higher scores and hence had a more positive outlook on semi-intensive systems than those aged 36-50 years ( $P<0.05$ ; Table 4.5.2.1). Significant age effects were also observed for the welfare impact of artificial rearing in intensive systems, where participants aged 36-50 years allocated more neutral scores than those older than 50 years ( $P<0.05$ ; Table 4.5.2.1). No significant differences between participants of different ages were observed for the welfare impact of natural and extensive rearing of ostrich chicks ( $P>0.05$ ).

*Table 4.5.2.1 Effect of age on scores allocated by 31 farmers 96 stakeholders with regards to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry scored on a scale of 1 to 5 from most negative to positive impact*

	<36 years Mean (s. e.)	36-50 years Mean (s. e.)	>51 years Mean (s. e.)	F-value	Significance
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>					
Natural incubation and hatching with breeder birds	3.50 (0.25)	3.86 (0.15)	3.89 (0.18)	0.48	NS
Artificial incubation and hatching without human assistance	3.30 (0.19)	3.12 (0.14)	3.36 (0.22)	0.59	NS
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	4.06 (0.16)	3.65 (0.12)	3.59 (0.20)	2.37	NS
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	3.21 (0.22)	3.31 (0.15)	3.18 (0.22)	0.16	NS
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>					
Natural rearing with breeder birds without human assistance	3.30 (0.19)	3.63 (0.17)	3.62 (0.20)	0.95	NS
Natural rearing with breeder birds without human assistance	3.82 (0.18)	3.92 (0.11)	3.91 (0.16)	0.07	NS
Artificial rearing in extensive systems (pasture-based systems)	3.84 (0.14)	3.41 (0.14)	3.68 (0.19)	1.70	NS
Artificial rearing in semi-extensive systems	3.81 (0.14) <sup>b</sup>	3.29 (0.13) <sup>a</sup>	3.73 (0.18) <sup>b</sup>	4.11	*
Artificial rearing in intensive systems (dry runs/feedlots)	3.72 (0.19) <sup>b</sup>	3.10 (0.18) <sup>a</sup>	3.84 (0.17) <sup>b</sup>	4.81	*

Degrees of freedom varied between 2; 104 and 2; 116

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

When asked to score the welfare impact of toenail clipping methods, a significant difference between age categories was observed pertaining to the welfare impact of not doing toenail clipping ( $P < 0.05$ ; Table 4.5.2.2). Middle-aged participants (36-50 years) allocated a higher score than older participants (>50 years) who had a less positive opinion of this practice. Similarly, perceptions regarding declawing differed between age group categories ( $P < 0.05$ ; Table 4.5.2.2). Participants older than 50 years indicated a negative view of the practice, while participants younger than 36 recorded a more neutral view. No such difference was however observed in terms of the other toenail clipping practices (i.e. toenail clipping with cauterization and toenail clipping without cauterization;  $P > 0.05$ ).

In terms of the welfare impact of feather harvesting practices, there were only differences in perceptions between age categories with regard to the impact of not harvesting the feathers ( $P < 0.05$ ; Table 4.5.2.2). Middle-aged participants allocated higher scores ( $3.27 \pm 0.22$ ) than young participants (<36 years). However, no age effect was detected on perceptions regarding feather clipping, plucking or a combination of the two methods ( $P > 0.05$ ).

*Table 4.5.2.2 Age effects on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of management processes in the ostrich industry scored on a scale of 1 to 5 from most negative to positive impact*

	<36 years Mean (s. e.)	36-50 years Mean (s. e.)	>51 years Mean (s. e.)	F-value	Significance
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>					
No toenail clipping	2.85 (0.19) <sup>ab</sup>	3.19 (0.19) <sup>b</sup>	2.41 (0.21) <sup>a</sup>	4.03	*
Toenail clipping with cauterization	2.74 (0.21)	2.52 (0.18)	2.07 (0.17)	2.50	NS
Toenail clipping without cauterization	3.38 (0.20)	3.35 (0.18)	3.69 (0.22)	0.96	NS
Declawing/permanent removal of the nail and part of the toe	2.97 (0.25) <sup>b</sup>	2.23 (0.19) <sup>ab</sup>	1.90 (0.23) <sup>a</sup>	5.51	*
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.87 (0.06)	4.81 (0.05)	4.81 (0.07)	0.26	NS
<b>Impact of the method of feather harvesting on the well-being of birds:</b>					
Feather plucking	3.00 (0.22)	2.86 (0.20)	2.70 (0.20)	0.48	NS
Feather clipping	3.63 (0.13)	3.02 (0.18)	3.21 (0.19)	3.00	NS
Clipping of white feathers, plucking of other feathers	3.06 (0.17)	3.04 (0.20)	3.47 (0.21)	1.01	NS
No feather harvesting	2.44 (0.23) <sup>a</sup>	3.27 (0.22) <sup>b</sup>	2.52 (0.25) <sup>ab</sup>	4.15	*
<b>Impact of restraining method used on the well-being of birds:</b>					
No devices used/man held	2.53 (0.18) <sup>a</sup>	2.60 (0.18) <sup>ab</sup>	3.39 (0.23) <sup>b</sup>	4.68	*
Hooks	3.43 (0.18)	3.08 (0.17)	3.10 (0.21)	0.92	NS
Triangular crush	3.67 (0.17)	3.20 (0.16)	3.41 (0.21)	1.72	NS
Hoods	4.10 (0.16)	3.63 (0.15)	3.10 (0.18)	3.06	NS

Degrees of freedom varied between 2; 104 and 2; 116

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

With regard to methods of restraint, there was a significant age effect in participants' perception regarding the welfare impact of not using any devices/man-held restraint of ostriches ( $P < 0.05$ ; Table 4.5.2.2). Participants older than 50 years of age did not share the

same perception than either of the other age group categories as they scored the welfare impact of man-held ostrich restraint more positively than participants younger than 36 and those aged 36-50. No other differences between age categories were detected for any other methods of restraint, including the use of hooks/hoods or a triangular crush ( $P>0.05$ ).

*Table 4.5.2.3 Age effects on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare importance of transport factors in the ostrich industry scored on a scale of 1 to 5 from least to most importance*

	<36 years Mean (s. e.)	36-50 years Mean (s. e.)	>51 years Mean (s. e.)	F-value	Significance
<b>The importance of the following factors for the well-being of chicks when transported:</b>					
Type of vehicle being used	4.19 (0.13)	4.12 (0.13)	4.15 (0.18)	0.09	NS
The use of crates	4.23 (0.13)	4.10 (0.11)	4.36 (0.15)	1.71	NS
Stocking density	4.58 (0.10)	4.40 (0.10)	4.65 (0.08)	1.19	NS
Use of mats in crates	4.55 (0.11)	4.31 (0.11)	4.59 (0.09)	1.51	NS
Time of day when transporting	4.35 (0.14)	4.23 (0.14)	4.47 (0.11)	0.27	NS
Ventilation	4.52 (0.11)	4.51 (0.10)	4.68 (0.08)	0.53	NS
Protection against the elements	4.42 (0.13)	4.48 (0.10)	4.47 (0.14)	0.17	NS
Driver skill/experience	4.39 (0.13)	4.29 (0.11)	4.39 (0.14)	0.23	NS
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>					
Type of vehicle being used	4.55 (0.11)	4.42 (0.10)	4.38 (0.13)	0.44	NS
Presence of a cover on top of the trailer	3.55 (0.18)	3.60 (0.16)	3.29 (0.15)	1.28	NS
Type of flooring	4.58 (0.10)	4.43 (0.09)	4.59 (0.10)	0.92	NS
Stocking density	4.55 (0.10)	4.38 (0.11)	4.65 (0.09)	1.28	NS
Time of day when transporting	4.10 (0.17)	4.40 (0.12)	4.38 (0.10)	1.32	NS
Ventilation	4.35 (0.14)	4.47 (0.10)	4.50 (0.10)	0.27	NS
Presence of workers with birds	4.52 (0.13)	4.45 (0.09)	4.47 (0.11)	0.26	NS
Driver skill/experience	4.58 (0.10)	4.63 (0.08)	4.62 (0.09)	0.10	NS

Degrees of freedom varied between 2; 104 and 2; 116

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

Similarly, no significant differences were observed between age categories for the importance of the rapid treatment of sick or injured birds ( $P>0.05$ ; Table 4.5.2.3). Furthermore, the

perceptions of welfare importance of factors related to the transport of both chicks and juveniles or slaughter birds were not affected by age ( $P>0.05$ ; Table 4.5.2.3).

When considering the likelihood that improved welfare would improve product quality, age significantly affected the opinion of participants with respect to the quality of feathers and leather products ( $P<0.05$ ; Table 4.5.2.4). In both instances, participants older than 50 years indicated that these products' quality would most likely be improved with better welfare than middle-aged participants. No such difference between age categories was reported in the case of meat quality and the effect of welfare thereon ( $P>0.05$ ).

No further significant differences between age categories were observed for either the importance of implementing a welfare protocol specifically tailored to the commercial ostrich farming industry, or for the likeliness that farmers would follow such a protocol if it were to be implemented ( $P>0.05$ ; Table 4.5.2.4).

*Table 4.5.2.4 Age effect on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived importance/likeliness of management factors on ostrich welfare, product quality and implementation of a welfare protocol, scored on a scale of 1 to 5 from least to most important/likely.*

	<36 years Mean (s. e.)	36-50 years Mean (s. e.)	>51 years Mean (s. e.)	F-value	Significance
<b>The importance of the following factors when ostriches are reared for their well-being:</b>					
Extensive human presence/bonding from a young age	4.06 (0.17)	3.86 (0.12)	4.12 (0.14)	1.19	NS
Familiarity of birds with specific handlers	3.81 (0.19)	3.76 (0.14)	3.79 (0.16)	0.02	NS
Regular handling and interaction with birds	4.20 (0.15)	3.88 (0.13)	3.97 (0.17)	1.11	NS
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following:</b>					
Meat	4.13 (0.14)	4.04 (0.16)	4.47 (0.11)	1.76	NS
Leather	4.42 (0.12) <sup>ab</sup>	3.94 (0.16) <sup>a</sup>	4.58 (0.12) <sup>b</sup>	4.34	*
Feathers	4.26 (0.15) <sup>ab</sup>	3.84 (0.16) <sup>a</sup>	4.44 (0.12) <sup>b</sup>	3.59	*
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches</b>	3.84 (0.18)	3.98 (0.13)	3.79 (0.21)	0.14	NS
<b>The likeliness that farmers will follow such a protocol if it were to be implemented</b>	3.19 (0.21)	3.58 (0.15)	3.76 (0.19)	2.15	NS

Degrees of freedom varied between 2; 104 and 2; 116

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* = P<0.05; \*\* = P<0.01 and \*\*\* = P<0.0001

### 4.5.3 The effect of level of education of farmers and secondary stakeholders

Participants' level of education did not significantly influence their perceptions of the welfare impact on any of the listed methods used to incubate and hatch ostrich chicks ( $P > 0.05$ ; Table 4.5.3.1). However, participants who received tertiary education allocated lower scores to the welfare impact of intensive rearing systems compared to those that did not receive tertiary education ( $P < 0.05$ ; Table 4.5.3.1). No such difference with level of education of participants was noted for natural, extensive and semi-intensive rearing systems ( $P > 0.05$ ).

*Table 4.5.3.1 The effect of education level on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry, scored on a scale of 1 to 5 from most negative to positive impact*

	Non-tertiary educated Mean (s. e.)	Tertiary educated Mean (s. e.)	F-value	Significance
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>				
Natural incubation and hatching with breeder birds	3.61 (0.21)	3.83 (0.13)	0.62	NS
Artificial incubation and hatching without human assistance	3.11 (0.20)	3.32 (0.12)	0.72	NS
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	3.86 (0.17)	3.67 (0.11)	1.18	NS
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	3.51 (0.19)	3.11 (0.13)	3.51	NS
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>				
Natural rearing with breeder birds without human assistance	3.63 (0.17)	3.46 (0.13)	0.34	NS
Natural rearing with breeder birds without human assistance	3.89 (0.15)	3.90 (0.10)	0.03	NS
Artificial rearing in extensive systems (pasture-based systems)	3.60 (0.19)	3.63 (0.10)	0.01	NS
Artificial rearing in semi-extensive systems	3.55 (0.17)	3.57 (0.10)	0.01	NS
Artificial rearing in intensive systems (dry-runs/feedlots)	3.83 (0.19)	3.32 (0.13)	5.15	*

Degrees of freedom varied between 1; 103 and 1; 116

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$



With regard to toenail clipping practices, no significant differences in the perception of the welfare impact of any toenail clipping practice was observed between participants who received tertiary education or those who did not ( $P>0.05$ ; Table 4.5.3.2). However, there was a significant difference between tertiary and non-tertiary educated participants regarding their perception of the welfare impact of not harvesting feathers ( $P<0.05$ ; Table 4.5.3.2), with tertiary educated participants allocating higher scores than those without tertiary education.

The welfare impact of other methods of feather harvesting (i.e. feather clipping, plucking and a combination thereof) however were not scored significantly differently by participants with different levels of education ( $P>0.05$ ). When the perceptions of the welfare impact of methods used to restrain ostriches was compared, participants shared different views on the use of hooks and hoods, where in both instances non-tertiary educated participants allocated higher scores than those compared to respondents with tertiary education ( $P<0.05$ ; Table 4.5.3.2).

All participants shared the same opinion about the importance of rapidly treating sick or injured birds by allocating high scores ( $P>0.05$ ; Table 4.5.3.2).

*Table 4.5.3.2 The effect of education level on scores allocated by 31 farmers and 96 stakeholders in the ostrich industry with regards to the perceived welfare impact of management practices in the ostrich industry scored on a scale of 1 to 5 from highly negative to highly positive impact*

	Non-tertiary educated Mean (s. e.)	Tertiary educated Mean (s. e.)	F-value	Significance
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>				
No toenail clipping	2.79 (0.21)	2.94 (0.14)	0.28	NS
Toenail clipping with cauterization	2.33 (0.25)	2.58 (0.12)	1.82	NS
Toenail clipping without cauterization	3.57 (0.23)	3.41 (0.13)	0.78	NS
Declawing/permanent removal of the nail and part of the toe	2.82 (0.28)	2.22 (0.14)	3.24	NS
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.89 (0.05)	4.80 (0.05)	1.24	NS
<b>Impact of the method of feather harvesting on the well-being of birds:</b>				
Feather plucking	3.22 (0.22)	2.72 (0.14)	3.43	NS
Feather clipping	3.38 (0.24)	3.20 (0.10)	0.84	NS
Clipping of white feathers, plucking of other feathers	3.47 (0.22)	3.08 (0.14)	2.31	NS
No feather harvesting	2.41 (0.28)	3.01 (0.15)	4.59	*
<b>Impact of restraining method used on the well-being of birds:</b>				
No devices used/man held	2.86 (0.23)	2.77 (0.14)	0.25	NS
Hooks	3.74 (0.20)	2.99 (0.12)	10.17	*
Triangular crush	3.55 (0.20)	3.35 (0.13)	1.01	NS
Hoods	4.14 (0.17)	3.81 (0.11)	3.94	*

Degrees of freedom varied between 1; 103 and 1; 116

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Participants' perceived importance of factors related to the transportation of ostrich chicks, juvenile and slaughter birds was not affected by their level of education ( $P > 0.05$ ; Table 4.5.3.3). Level of education also did not influence how important participants perceived the effect of extensive human presence/bonding from a young age, familiarity of birds with specific humans or the regular handling and interaction with birds on the welfare of ostriches ( $P > 0.05$ ; Table 4.5.3.3).

*Table 4.5.3.3 The effect of education level on scores allocated by 31 farmers and 96 stakeholders pertaining to the perceived welfare importance of various factors in the ostrich industry scored on a scale of 1 to 5 from least to most importance*

	Non-tertiary educated Mean (s. e.)	Tertiary educated Mean (s. e.)	F-value	Significance
<b>The importance of the following factors for the well-being of chicks when transported:</b>				
Type of vehicle being used	4.31 (0.13)	4.10 (0.10)	1.03	NS
The use of crates	4.23 (0.14)	4.19 (0.09)	0.13	NS
Stocking density	4.60 (0.10)	4.48 (0.07)	1.03	NS
Use of mats in crates	4.54 (0.10)	4.39 (0.08)	1.01	NS
Time of day when transporting	4.34 (0.16)	4.31 (0.09)	0.42	NS
Ventilation	4.62 (0.10)	4.51 (0.07)	0.71	NS
Protection against the elements	4.32 (0.15)	4.51 (0.08)	0.79	NS
Driver skill/experience	4.39 (0.16)	4.35 (0.07)	1.04	NS
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>				
Type of vehicle being used	4.49 (0.11)	4.42 (0.08)	0.10	NS
Presence of a cover on top of the trailer	3.51 (0.19)	3.49 (0.11)	0.05	NS
Type of flooring	4.40 (0.12)	4.56 (0.07)	1.34	NS
Stocking density	4.37 (0.12)	4.54 (0.08)	2.15	NS
Time of day when transporting	4.06 (0.16)	4.41 (0.08)	3.49	NS
Ventilation	4.37 (0.12)	4.46 (0.08)	0.29	NS
Presence of workers with birds	4.37 (0.12)	4.49 (0.07)	0.57	NS
Driver skill/experience	4.54 (0.10)	4.61 (0.06)	0.31	NS

Degrees of freedom varied between 1; 103 and 1; 116

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

No significant effect of level of education was found pertaining to the likeliness that improved welfare would result in improved quality of meat, leather and feather products, the importance of implementing a formal welfare protocol for commercial ostrich production and the likeliness that farmers would follow such a protocol if it was implemented, ( $P > 0.05$ ; Table 4.5.3.4).

*Table 4.5.3.4 The effect of education level on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived importance/likeliness of welfare factors pertaining to ostrich rearing, product quality and implementation of a welfare protocol, scored on a scale of 1 to 5 from least to most important/likely*

	Non-tertiary educated Mean (s. e.)	Tertiary educated Mean (s. e.)	F-value	Significance
<b>The importance of the following factors when ostriches are reared for their well-being:</b>				
Extensive human presence/bonding from a young age	3.86 (0.17)	4.04 (0.09)	0.43	NS
Familiarity of birds with specific handlers	3.80 (0.18)	3.78 (0.11)	0.14	NS
Regular handling and interaction with birds	3.86 (0.17)	4.06 (0.09)	0.64	NS
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following</b>				
Meat	4.26 (0.15)	4.14 (0.11)	0.30	NS
Leather	4.35 (0.15)	4.24 (0.10)	0.51	NS
Feathers	4.38 (0.14)	4.05 (0.11)	3.23	NS
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches</b>	3.89 (0.19)	3.81 (0.12)	0.19	NS
<b>The likeliness that farmers will follow such a protocol if it were to be implemented</b>	3.86 (0.18)	3.40 (0.13)	3.89	NS

Degrees of freedom varied between 1; 103 and 1; 116

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

#### 4.5.4 The effect of income level of farmers and secondary stakeholders

Level of income influenced participants' perception of the welfare impact of incubation and hatching methods used in the industry ( $P < 0.05$ ; Table 4.5.4). Participants from the lower income group tended to allocate higher scores than those from the moderate income group when asked about the welfare impact of artificial incubation and hatching, with human assistance only when necessary. No such effects were however observed for any other incubation and hatching methods, or for any of the rearing methods implemented in the commercial ostrich farming industry (i.e. natural rearing with breeders with and without assistance and artificial rearing in extensive, semi-intensive and intensive systems;  $P > 0.05$ ; Table 4.5.4.1).

*Table 4.5.4.1 The effect of income level on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry, scored on a scale of 1 to 5 from most negative to positive impact*

	Low income Mean (s. e.)	Middle income Mean (s. e.)	High income Mean (s. e.)	F-value	Significance
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>					
Natural incubation and hatching with breeder birds	3.56 (0.26)	4.10 (0.18)	4.00 (0.16)	0.47	NS
Artificial incubation and hatching without human assistance	3.35 (0.21)	3.15 (0.18)	3.18 (0.20)	0.46	NS
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	4.03 (0.19) <sup>b</sup>	3.35 (0.15) <sup>a</sup>	3.69 (0.17) <sup>ab</sup>	4.36	*
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	3.24 (0.22)	3.00 (0.23)	3.31 (0.21)	0.40	NS
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>					
Natural rearing with breeder birds without human assistance	3.54 (0.21)	3.71 (0.17)	3.48 (0.20)	0.225	NS
Natural rearing with breeder birds without human assistance	4.13 (0.15)	3.85 (0.18)	3.69 (0.16)	2.43	NS
Artificial rearing in extensive systems (pasture-based systems)	3.46 (0.19)	3.60 (0.24)	3.69 (0.17)	0.32	NS
Artificial rearing in semi-extensive systems	3.50 (0.17)	3.30 (0.21)	3.59 (0.18)	0.65	NS
Artificial rearing in intensive systems (dry runs/feedlots)	3.71 (0.20)	3.05 (0.24)	3.32 (0.23)	2.16	NS

Degrees of freedom varied between 2; 75 and 2; 83

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Income level significantly affected participants' perceptions about the welfare impact of toenail clipping. Participants with moderate income levels allocated higher scores than those with low-income levels for the welfare impact of no toenail clipping ( $P < 0.05$ ; Table 4.5.4.2) indicating a preference for not implementing the practice. Participants with high income levels allocated significantly lower scores compared to low- and middle-income level classes for declawing. No such differences with level of income were observed for other toenail clipping methods used (i.e. toenail clipping with and without cauterization,  $P > 0.05$ ; Table 4.5.4.2).

*Table 4.5.4.2 The effect of income level on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of management processes in the ostrich industry, scored on a scale of 1 to 5 from most negative to positive impact*

	Low income Mean (s. e.)	Middle income Mean (s. e.)	High income Mean (s. e.)	F-value	Significance
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>					
No toenail clipping	2.49 (0.22) <sup>a</sup>	3.30 (0.25) <sup>b</sup>	2.96 (0.22) <sup>ab</sup>	3.38	*
Toenail clipping with cauterization	2.59 (0.23)	2.40 (0.23)	2.59 (0.20)	0.13	NS
Toenail clipping without cauterization	3.56 (0.23)	2.95 (0.23)	3.26 (0.21)	2.04	NS
Declawing/permanent removal of the nail and part of the toe	2.86 (0.26) <sup>b</sup>	2.50 (0.28) <sup>ab</sup>	1.48 (0.15) <sup>a</sup>	9.07	**
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.89 (0.05)	4.77 (0.09)	4.78 (0.08)	0.98	NS
<b>Impact of the method of feather harvesting on the well-being of birds:</b>					
Feather plucking	3.17 (0.21)	2.79 (0.27)	2.48 (0.23)	2.32	NS
Feather clipping	3.62 (0.19) <sup>b</sup>	3.05 (0.27) <sup>ab</sup>	2.85 (0.16) <sup>a</sup>	5.08	*
Clipping of white feathers, plucking of other feathers	3.53 (0.23)	2.90 (0.28)	2.78 (0.22)	2.52	NS
No feather harvesting	2.76 (0.27)	2.63 (0.31)	3.23 (0.26)	1.17	NS
<b>Impact of restraining method used on the well-being of birds:</b>					
No devices used/man held	2.59 (0.23)	2.90 (0.23)	2.92 (0.23)	0.57	NS
Hooks	3.62 (0.17) <sup>b</sup>	2.95 (0.26) <sup>ab</sup>	2.74 (0.24) <sup>a</sup>	4.59	*
Triangular crush	3.38 (0.19)	3.47 (0.21)	3.12 (0.24)	0.40	NS
Hoods	4.24 (0.16) <sup>b</sup>	3.55 (0.23) <sup>a</sup>	3.92 (0.17) <sup>ab</sup>	3.51	*

Degrees of freedom varied between 2; 75 and 2; 83

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

With regards to the perceived welfare impact of feather harvesting methods, a significant effect of level of income was observed for the welfare impact of feather clipping, whereby participants with high income levels perceived the practice more negative than those with low income ( $P < 0.05$ ; Table 4.5.4.2). No other effects were observed for the other feather harvesting methods ( $P > 0.05$ ). The use of hooks and hoods was also perceived differently by participants with different income levels ( $P < 0.05$ ; Table 4.5.4.2). For the use of hooks, participants with high income levels allocated a significantly lower score than those with low income levels ( $P < 0.05$ ; Table 4.5.4.2), while the use of hoods were rated significantly higher by participants from the low income group compared to those from the middle income group ( $P < 0.05$ ). No income group differences were observed for the other methods of restraint used ( $P > 0.05$ ).

Participants of all income levels seemed to agree on the importance of the rapid treatment of sick or injured birds as no significant differences were observed amongst income categories ( $P > 0.05$ ; Table 4.5.4.2).

The welfare importance of the use of crates, mats in crates and ventilation related to the transportation of ostrich chicks showed significant differences between income categories (Table 4.5.4.3). Participants earning a lower income allocated higher scores of importance than those in the moderate-income group for the use of crates and mats in crates when transporting chicks ( $P < 0.05$ ). Participants in the lower and higher income groups scored the importance of ventilation significantly higher than those in the middle-income group ( $P < 0.05$ ). No further effect was noted for the other factors related to transportation of ostrich chicks. With regards to the importance of factors related to the transportation of juvenile or slaughter birds, stocking density during transport was scored as more important by participants earning

higher incomes than by those in the middle-income group ( $P < 0.05$ ). Furthermore, participants in the low-income group scored the importance of ventilation and driver skill or experience during the transport of juvenile/slaughter birds more important than those earning a moderate income ( $P < 0.05$ ). No other effects of income level were noted for the transportation of slaughter and juvenile birds ( $P > 0.05$ ).

*Table 4.5.4.3 The effect of income level on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare importance of transport factors in the ostrich industry, scored on a scale of 1 to 5 from least to most importance*

	Low income Mean (s. e.)	Middle income Mean (s. e.)	High income Mean (s. e.)	F-value	Significance
<b>The importance of the following factors for the well-being of chicks when transported:</b>					
Type of vehicle being used	4.44 (0.11)	3.95 (0.18)	4.04 (0.19)	3.08	NS
The use of crates	4.39 (0.12) <sup>b</sup>	3.86 (0.16) <sup>a</sup>	4.29 (0.12) <sup>ab</sup>	3.94	*
Stocking density	4.64 (0.09)	4.29 (0.14)	4.64 (0.09)	2.94	NS
Use of mats in crates	4.67 (0.09) <sup>b</sup>	4.19 (0.16) <sup>a</sup>	4.46 (0.12) <sup>ab</sup>	3.49	*
Time of day when transporting	4.47 (0.15)	4.24 (0.18)	4.25 (0.14)	1.47	NS
Ventilation	4.81 (0.07) <sup>b</sup>	4.29 (0.14) <sup>a</sup>	4.68 (0.09) <sup>ab</sup>	6.61	**
Protection against the elements	4.63 (0.10)	4.35 (0.15)	4.54 (0.14)	1.48	NS
Driver skill/experience	4.56 (0.09)	4.20 (0.17)	4.44 (0.10)	1.67	NS
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>					
Type of vehicle being used	4.64 (0.09)	4.29 (0.14)	4.32 (0.15)	2.80	NS
Presence of a cover on top of the trailer	3.69 (0.17)	3.29 (0.23)	3.39 (0.18)	1.50	NS
Type of flooring	4.64 (0.09)	4.29 (0.16)	4.54 (0.10)	2.03	NS
Stocking density	4.58 (0.09) <sup>ab</sup>	4.24 (0.14) <sup>a</sup>	4.71 (0.09) <sup>b</sup>	4.45	*
Time of day when transporting	4.25 (0.17)	4.10 (0.18)	4.44 (0.11)	0.96	NS
Ventilation	4.64 (0.09) <sup>b</sup>	4.10 (0.15) <sup>a</sup>	4.46 (0.12) <sup>ab</sup>	4.94	*
Presence of workers with birds	4.64 (0.09)	4.29 (0.16)	4.29 (0.14)	2.82	NS
Driver skill/experience	4.75 (0.08) <sup>b</sup>	4.33 (0.13) <sup>a</sup>	4.61 (0.09) <sup>ab</sup>	4.68	*

Degrees of freedom varied between 2; 75 and 2; 83

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

When considering factors related to human interaction with ostriches, the perceived importance of extensive human presence/bonding from an early age, the familiarity of birds



with specific handlers and regular handling and interaction with birds were independent of the income category of the respondent ( $P>0.05$ ; Table 4.5.4.4).

Income level did, however, influence participants' perceptions regarding the likeliness that improved welfare would also improve product quality. For all products (i.e. meat, leather and feathers) participants in the low-income category allocated higher scores compared to the scores of participants in the middle income category ( $P<0.05$ ; Table 4.5.4.4). Interestingly, the perceived importance of implementing a formal welfare protocol for the commercial production of ostriches, and the likeliness that farmers would follow such a protocol if it was implemented was not influenced by the participants' level of income ( $P>0.05$ ; Table 4.5.4.4).

*Table 4.5.4.4 The effect of income level on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived importance/likeliness of welfare factors pertaining to ostrich rearing, product quality and implementation of a welfare protocol, scored on a scale of 1 to 5 from least to most important/likely*

	Low income Mean (s. e.)	Middle income Mean (s. e.)	High income Mean (s. e.)	F-value	Significance
<b>The importance of the following factors when ostriches are reared for their well-being:</b>					
Extensive human presence/bonding from a young age	4.17 (0.13)	3.76 (0.18)	4.07 (0.16)	1.60	NS
Familiarity of birds with specific handlers	3.91 (0.19)	3.43 (0.16)	3.75 (0.15)	2.88	NS
Regular handling and interaction with birds	3.97 (0.18)	3.85 (0.20)	4.11 (0.14)	0.54	NS
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following:</b>					
Meat	4.43 (0.14) <sup>b</sup>	3.62 (0.19) <sup>a</sup>	4.11 (0.20) <sup>ab</sup>	6.90	**
Leather	4.53 (0.14) <sup>b</sup>	3.76 (0.22) <sup>a</sup>	4.11 (0.22) <sup>ab</sup>	5.94	**
Feathers	4.43 (0.14) <sup>b</sup>	3.48 (0.2) <sup>a</sup>	3.93 (0.21) <sup>ab</sup>	8.68	**
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches:</b>	3.73 (0.21)	3.71 (0.23)	4.17 (0.13)	1.20	NS
<b>The likeliness that farmers will follow such a protocol if it were to be implemented:</b>	3.41 (0.19)	3.38 (0.23)	3.69 (0.19)	0.80	NS

Degrees of freedom varied between 2; 75 and 2; 83

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

#### 4.5.5 The effect of province of residence of farmers and secondary stakeholders

Upon questioning with regards to the perceived welfare impact of methods used to incubate and hatch ostrich chicks, no significant differences were observed between participants from different provinces ( $P>0.05$ ; Table 4.5.5.1). However, when asked about the welfare impact of rearing methods used in the commercial ostrich industry, participants residing in provinces where ostrich farming is uncommon, gave lower scores for the rearing chicks in an extensive artificial system compared to those residing in common ostrich farming areas ( $P<0.05$ ; Table 4.5.5.1). No other effect of province of residence was noted for perceptions regarding other rearing systems.

*Table 4.5.5.1 The effect of province of residence on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry, scored on a scale of 1 to 5 from most negative to positive impact*

	Traditional ostrich farming provinces Mean (s. e.)	Other provinces Mean (s. e.)	F-value	Significance
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>				
Natural incubation and hatching with breeder birds	3.77 (0.11)	3.33 (0.55)	0.42	NS
Artificial incubation and hatching without human assistance	3.28 (0.10)	3.22 (0.49)	0.00	NS
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	3.78 (0.10)	3.78 (0.32)	0.00	NS
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	3.31 (0.11)	3.22 (0.46)	0.03	NS
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>				
Natural rearing with breeder birds without human assistance	3.60 (0.11)	3.33 (0.50)	0.12	NS
Natural rearing with breeder birds without human assistance	3.87 (0.09)	3.44 (0.34)	1.49	NS
Artificial rearing in extensive systems (pasture-based systems)	3.63 (0.09)	2.56 (0.34)	8.83	**
Artificial rearing in semi-extensive systems	3.58 (0.10)	2.89 (0.31)	3.82	NS
Artificial rearing in intensive systems (dry runs/feedlots)	3.57 (0.11)	2.78 (0.49)	3.12	NS

Degrees of freedom varied between 1; 103 and 1; 113

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

Province of residence had no significant influence on the scores allocated with regard to the impact of toenail clipping practices on the welfare of ostriches ( $P>0.05$ ; Table 4.5.5.2). However, province of residence influenced the perceived impact of all feather harvesting methods listed, with the exception of feather clipping ( $P<0.05$ ; Table 4.5.5.2). Feather plucking were perceived as having a strong negative welfare impact by participants from provinces where ostrich farming is not typically practiced ( $P<0.01$ ). These participants also scored the impact of no feather harvesting more positively than those residing in provinces where ostrich farming is common ( $P<0.05$ ).

*Table 4.5.5.2 The effect of provincial distribution on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of management processes in the ostrich industry scored on a scale of 1 to 5 from most negative to positive impact*

	Traditional ostrich farming provinces Mean (s. e.)	Other provinces Mean (s. e.)	F-value	Significance
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>				
No toenail clipping	2.81 (0.12)	3.56 (0.47)	2.76	NS
Toenail clipping with cauterization	2.46 (0.12)	2.89 (0.45)	0.99	NS
Toenail clipping without cauterization	3.50 (0.12)	2.78 (0.52)	2.17	NS
Declawing/permanent removal of the nail and part of the toe	2.46 (0.14)	1.78 (0.32)	1.75	NS
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.82 (0.04)	5.00 (0.00)	1.98	NS
<b>Impact of the method of feather harvesting on the well-being of birds:</b>				
Feather plucking	3.05 (0.12)	1.78 (0.40)	8.31	**
Feather clipping	3.30 (0.10)	2.56 (0.53)	3.40	NS
Clipping of white feathers, plucking of other feathers	3.38 (0.12)	2.22 (0.36)	7.15	*
No feather harvesting	2.69 (0.14)	3.78 (0.40)	4.67	*
<b>Impact of restraining method used on the well-being of birds:</b>				
No devices used/man held	2.84 (0.13)	2.89 (0.48)	0.03	NS
Hooks	3.36 (0.11)	2.22 (0.32)	8.72	*
Triangular crush	3.48 (0.11)	2.89 (0.35)	3.03	NS
Hoods	4.00 (0.10)	3.11 (0.42)	4.71	*

Degrees of freedom varied between 1; 103 and 1; 113

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

Restraining methods that were influenced by provincial distribution of participants included the use of hooks and hoods, where in both instances participants from provinces that commonly farm ostriches allocated a significantly higher score than those outside these regions ( $P < 0.05$ ; Table 4.5.5.2). However, participants from the different provinces did not seem to differ in their perceptions of the welfare impact of any other restraining method used ( $P > 0.05$ ).

Province of residence did not influence participants' perception in terms of the importance of the rapid treatment of sick or injured birds, nor did it influence the perception of any factors listed regarding the transportation of ostrich chicks ( $P > 0.05$ ; Table 4.5.5.3). Participants' opinion of the importance of a cover on top of the vehicle/trailer used for transporting juvenile or slaughter birds did however differ, where participants from provinces that do not commonly farm ostriches allocated higher scores of importance than those living in provinces associated with ostrich farming ( $P < 0.05$ ).

*Table 4.5.5.3 The effect of provincial distribution on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare importance of transport factors in the ostrich industry scored on a scale of 1 to 5 from least to most importance*

	Traditional ostrich farming provinces Mean (s. e.)	Other provinces Mean (s. e.)	F-value	Significance
<b>The importance of the following factors for the well-being of chicks when transported:</b>				
Type of vehicle being used	4.13 (0.09)	4.44 (0.34)	1.90	NS
The use of crates	4.20 (0.08)	4.33 (0.33)	0.67	NS
Stocking density	4.51 (0.06)	4.44 (0.34)	0.13	NS
Use of mats in crates	4.47 (0.06)	4.44 (0.34)	0.23	NS
Time of day when transporting	4.33 (0.08)	4.44 (0.34)	0.46	NS
Ventilation	4.54 (0.06)	4.56 (0.34)	0.64	NS
Protection against the elements	4.46 (0.07)	4.56 (0.34)	1.01	NS
Driver skill/experience	4.33 (0.07)	4.44 (0.34)	0.79	NS
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>				
Type of vehicle being used	4.44 (0.07)	4.44 (0.34)	0.28	NS
Presence of a cover on top of the trailer	3.44 (0.10)	4.33 (0.33)	6.85	*
Type of flooring	4.51 (0.06)	4.63 (0.18)	0.12	NS
Stocking density	4.48 (0.06)	4.44 (0.34)	0.18	NS
Time of day when transporting	4.26 (0.08)	4.75 (0.16)	2.58	NS
Ventilation	4.40 (0.07)	4.88 (0.13)	3.74	NS
Presence of workers with birds	4.50 (0.06)	4.63 (0.18)	0.15	NS
Driver skill/experience	4.59 (0.06)	4.88 (0.13)	1.90	NS

Degrees of freedom varied between 1; 103 and 1; 113

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

The province of residence had no significant effect on the perceived importance of extensive human presence/bonding from an early age, familiarity of birds with specific handlers, or regular handling and interaction with birds ( $P > 0.05$ ; Table 4.5.5.4). When considering the likeliness that improved welfare would improve the quality of meat, leather and feathers produced by ostriches, participants from provinces commonly associated with ostrich farming allocated a significantly higher score to the likeliness that improved welfare would improve leather quality than participants from other provinces ( $P < 0.05$ ; Table 4.5.5.4). However, participants' perceptions of the importance of implementing a formal welfare protocol for commercial ostrich production and the likeliness that farmers would follow such a protocol

should it be implemented were not influenced by their province of residence ( $P>0.05$ ; Table 4.5.5.4).

*Table 4.5.5.4 The effect of provincial distribution on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived importance/likeliness of welfare factors related to ostrich rearing, product quality and the implementation of a welfare protocol, scored on a scale of 1 to 5 from least to most important/likely.*

	Traditional ostrich farming provinces Mean (s. e.)	Other provinces Mean (s. e.)	F-value	Significance
<b>The importance of the following factors when ostriches are reared for their well-being</b>				
Extensive human presence/bonding from a young age	4.00 (0.08)	3.75 (0.49)	0.06	NS
Familiarity of birds with specific handlers	3.73 (0.10)	4.25 (0.25)	2.28	NS
Regular handling and interaction with birds	3.98 (0.09)	3.86 (0.40)	0.07	NS
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following</b>				
Meat	4.14 (0.09)	4.38 (0.32)	0.50	NS
Leather	4.31 (0.09)	3.38 (0.42)	6.71	*
Feathers	4.21 (0.09)	3.50 (0.46)	3.03	NS
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches</b>	3.76 (0.11)	4.38 (0.26)	2.10	NS
<b>The likeliness that farmers will follow such a protocol if it were to be implemented</b>	3.47 (0.11)	3.63 (0.46)	0.25	NS

Degrees of freedom varied between 1; 103 and 1; 113

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

#### 4.5.6 The effect of dietary preference of farmers and secondary stakeholders

Dietary preference had no significant effect on participants' perceptions with regards to most factors investigated ( $P > 0.05$ ; Table 4.5.6.1, Table 4.5.6.2, Table 4.5.6.3 and 4.5.6.2).

*Table 4.5.6.1 The effect of dietary preference on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry, scored on a scale of 1 to 5 from most negative to positive impact*

	Preference for meat Mean (s. e.)	No preference Mean (s. e.)	Vegetarian Mean (s. e.)	F-value	Significance
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>					
Natural incubation and hatching with breeder birds	3.83 (0.16)	3.72 (0.15)	5.00 (0.00)	0.82	NS
Artificial incubation and hatching without human assistance	3.17 (0.14)	3.29 (0.14)	4.00 (0.00)	0.61	NS
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	3.72 (0.14)	3.75 (0.12)	3.00 (0.00)	0.36	NS
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	3.08 (0.16)	3.33 (0.15)	4.00 (0.00)	1.12	NS
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>					
Natural rearing with breeder birds without human assistance	3.44 (0.16)	3.59 (0.14)	5.00 (0.00)	1.06	NS
Natural rearing with breeder birds without human assistance	3.80 (0.13)	3.98 (0.11)	4.00 (0.00)	0.45	NS
Artificial rearing in extensive systems (pasture-based systems)	3.51 (0.14)	3.74 (0.12)	1.00 (0.00)	2.30	NS
Artificial rearing in semi-extensive systems	3.51 (0.13)	3.61 (0.12)	2.00 (0.00)	1.35	NS
Artificial rearing in intensive systems (dry runs/feedlots)	3.51 (0.18)	3.48 (0.14)	1.00 (0.00)	1.47	NS

Degrees of freedom varied between 2; 103 and 2; 113

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$



*Table 4.5.6.2 The effect of diet on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare impact of management processes in the ostrich industry scored on a scale of 1 to 5 from most negative to positive impact*

	Preference for meat Mean (s. e.)	No preference Mean (s. e.)	Vegetarian Mean (s. e.)	F-value	Significance
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>					
No toenail clipping	2.74 (0.18)	3.02 (0.16)	5.00 (0.00)	1.78	NS
Toenail clipping with cauterization	2.49 (0.17)	2.48 (0.15)	3.00 (0.00)	0.17	NS
Toenail clipping without cauterization	3.48 (0.17)	3.43 (0.16)	3.00 (0.00)	0.17	NS
Declawing/permanent removal of the nail and part of the toe	2.43 (0.20)	2.36 (0.18)	1.00 (0.00)	0.60	NS
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.78 (0.06)	4.86 (0.04)	5.00 (0.00)	0.66	NS
<b>Impact of the method of feather harvesting on the well-being of birds:</b>					
Feather plucking	3.02 (0.18)	2.75 (0.16)	1.00 (0.00)	1.79	NS
Feather clipping	3.52 (0.14)	3.09 (0.14)	1.00 (0.00)	3.89	NS
Clipping of white feathers, plucking of other feathers	3.42 (0.18)	3.05 (0.15)	1.00 (0.00)	2.63	NS
No feather harvesting	2.69 (0.20)	2.95 (0.19)	5.00 (0.00)	1.45	NS
<b>Impact of restraining method used on the well-being of birds:</b>					
No devices used/man held	2.68 (0.17)	2.98 (0.16)	2.00 (0.00)	1.19	NS
Hooks	3.25 (0.16)	3.17 (0.15)	1.00 (0.00)	1.42	NS
Triangular crush	3.41 (0.15)	3.41 (0.15)	2.00 (0.00)	0.98	NS
Hoods	4.00 (0.15)	3.78 (0.13)	4.00 (0.00)	0.90	NS

Degrees of freedom varied between 2; 103 and 2; 113

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

*Table 4.5.6.3 The effect of diet on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived welfare importance of transport factors in the ostrich industry scored on a scale of 1 to 5 from least to most importance*

	Preference for meat Mean (s. e.)	No preference Mean (s. e.)	Vegetarian Mean (s. e.)	F-value	Significance
<b>The importance of the following factors for the well-being of chicks when transported:</b>					
Type of vehicle being used	4.00 (0.12)	4.27 (0.12)	5.00 (0.00)	3.16	NS
The use of crates	4.15 (0.10)	4.29 (0.11)	4.00 (0.00)	0.99	NS
Stocking density	4.40 (0.09)	4.61 (0.07)	5.00 (0.00)	2.05	NS
Use of mats in crates	4.34 (0.10)	4.53 (0.08)	5.00 (0.00)	1.51	NS
Time of day when transporting	4.15 (0.13)	4.48 (0.09)	5.00 (0.00)	2.37	NS
Ventilation	4.47 (0.09)	4.62 (0.08)	5.00 (0.00)	1.29	NS
Protection against the elements	4.33 (0.12)	4.56 (0.08)	5.00 (0.00)	1.04	NS
Driver skill/experience	4.26 (0.12)	4.42 (0.08)	5.00 (0.00)	0.68	NS
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>					
Type of vehicle being used	4.36 (0.10)	4.49 (0.08)	5.00 (0.00)	0.83	NS
Presence of a cover on top of the trailer	3.26 (0.14)	3.65 (0.13)	5.00 (0.00)	2.82	NS
Type of flooring	4.54 (0.08)	4.49 (0.08)	5.00 (0.00)	0.39	NS
Stocking density	4.49 (0.09)	4.50 (0.09)	5.00 (0.00)	0.36	NS
Time of day when transporting	4.27 (0.13)	4.34 (0.09)	5.00 (0.00)	0.43	NS
Ventilation	4.42 (0.09)	4.44 (0.09)	5.00 (0.00)	0.47	NS
Presence of workers with birds	4.54 (0.09)	4.38 (0.09)	5.00 (0.00)	1.44	NS
Driver skill/experience	4.56 (0.08)	4.63 (0.07)	5.00 (0.00)	0.65	NS

Degrees of freedom varied between 2; 103 and 2; 113

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

However, vegetarian/vegan participants scored the importance of implementing a formal welfare protocol for the commercial production of ostriches lower than those that indicated no dietary preference ( $P < 0.05$ ; Table 4.5.6.4).

*Table 4.5.6.4 The effect of diet on scores allocated by 31 farmers and 96 stakeholders with regards to the perceived importance/likeliness of welfare factors pertaining to rearing of ostriches, product quality and implementation of a welfare protocol, scored on a scale of 1 to 5 from least to most important/likely.*

	Preference for meat Mean (s. e.)	No preference Mean (s. e.)	Vegetarian Mean (s. e.)	F-value	Significance
<b>The importance of the following factors when ostriches are reared for their well-being:</b>					
Extensive human presence/bonding from a young age	3.88 (0.12)	4.05 (0.11)	4.00 (0.00)	0.70	NS
Familiarity of birds with specific handlers	3.61 (0.15)	3.90 (0.11)	4.00 (0.00)	1.14	NS
Regular handling and interaction with birds	3.86 (0.13)	4.11 (0.11)	4.00 (0.00)	1.35	NS
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following:</b>					
Meat	4.08 (0.14)	4.31 (0.11)	3.00 (0.00)	1.68	NS
Leather	4.31 (0.15)	4.24 (0.11)	3.00 (0.00)	1.55	NS
Feathers	4.10 (0.15)	4.18 (0.11)	3.00 (0.00)	0.87	NS
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches:</b>	3.53 (0.16) <sup>ab</sup>	4.14 (0.12) <sup>b</sup>	3.00 (0.00) <sup>a</sup>	5.73	**
<b>The likeliness that farmers will follow such a protocol if it were to be implemented:</b>	3.30 (0.16)	3.71 (0.13)	4.00 (0.00)	1.99	NS

Degrees of freedom varied between 2; 103 and 2; 113

<sup>a, b</sup> Mean values with different superscripts differed significantly

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

There was however no significant difference observed for the likeliness that farmers would follow such a protocol once implemented between participants with different dietary preferences ( $P > 0.05$ ; Table 4.5.6.4).

## 4.6 Ostrich farmers versus secondary stakeholders' perceptions of the welfare impacts of production and management practices implemented

Ostrich farmers and secondary stakeholders in the ostrich industry allocated similar scores of perceived welfare impact of methods used to incubate and hatch ostrich chicks, to rear ostrich chicks ( $P>0.05$ ; Table 4.6.1) and the impact of toenail clipping practices (Table 4.6.2).

*Table 4.6.1 Differences in perceptions between farmers and stakeholders in the ostrich industry with regards to the perceived welfare impact of incubation, hatching and rearing practices in the ostrich industry scored on a scale of 1 to 5 from most negative to positive impact*

	Farmers Mean (s. e.) (n=31)	Stakeholders Mean (s. e.) (n=96)	F value	Significance
<b>Impact of incubation and hatching methods on the well-being of ostrich chicks:</b>				
Natural incubation and hatching with breeder birds	3.55 (0.23)	3.84 (0.12)	1.38	NS
Artificial incubation and hatching without human assistance	3.26 (0.21)	3.22 (0.11)	0.00	NS
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	4.03 (0.18)	3.66 (0.10)	3.23	NS
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	3.45 (0.23)	3.17 (0.12)	1.13	NS
<b>Impact of rearing methods on the well-being of ostrich chicks:</b>				
Natural rearing with breeder birds without human assistance	3.62 (0.20)	3.49 (0.13)	0.14	NS
Natural rearing with breeder birds without human assistance	3.84 (0.20)	3.86 (0.09)	0.01	NS
Artificial rearing in extensive systems (pasture-based systems)	3.61 (0.21)	3.58 (0.10)	0.08	NS
Artificial rearing in semi-extensive systems	3.57 (0.21)	3.51 (0.10)	0.17	NS
Artificial rearing in intensive systems (dry runs/feedlots)	3.74 (0.25)	3.40 (0.12)	1.92	NS

Degrees of freedom varied between 2; 103 and 2; 113

Significance: NS = Not Significant; \* =  $P<0.05$ ; \*\* =  $P<0.01$  and \*\*\* =  $P<0.0001$

*Table 4.6.2 Differences in perceptions between farmers and stakeholders in the ostrich industry with regards to the perceived welfare impact of management processes in the ostrich industry scored on a scale of 1 to 5 from most negative to positive impact*

	Farmers Mean (s. e.) (n=31)	Stakeholders Mean (s. e.) (n=96)	F value	Significance
<b>Impact of toenail clipping practices on the well-being of ostrich chicks:</b>				
No toenail clipping	2.60 (0.22)	2.98 (0.14)	1.72	NS
Toenail clipping with cauterization	2.31 (0.21)	2.51 (0.13)	0.33	NS
Toenail clipping without cauterization	3.62 (0.25)	3.37 (0.13)	1.12	NS
Declawing/permanent removal of the nail and part of the toe	2.44 (0.26)	2.33 (0.15)	0.28	NS
<b>Importance of the rapid treatment of sick/injured birds:</b>	4.84 (0.07)	4.83 (0.04)	0.01	NS
<b>Impact of the method of feather harvesting on the well-being of birds:</b>				
Feather plucking	3.20 (0.19)	2.75 (0.14)	3.32	NS
Feather clipping	3.54 (0.13)	3.14 (0.13)	2.89	NS
Clipping of white feathers, plucking of other feathers	3.73 (0.19)	3.01 (0.14)	8.71	*
No feather harvesting	2.24 (0.25)	3.00 (0.16)	5.97	*
<b>Impact of restraining method used on the well-being of birds:</b>				
No devices used/man held	3.28 (0.19)	2.67 (0.14)	5.36	*
Hooks	3.39 (0.18)	3.14 (0.13)	1.06	*
Triangular crush	3.67 (0.16)	3.34 (0.13)	1.80	NS
Hoods	4.11 (0.20)	3.82 (0.11)	2.13	NS

Degrees of freedom varied between 2; 103 and 2; 113

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Farmers and secondary stakeholders did, however, differ in their perceptions towards the welfare impact of feather harvesting practices (Table 4.6.2). Ostrich farmers' scores indicated a more positive perception of the welfare impact of clipping white feathers and plucking other feathers than those allocated by secondary stakeholders ( $P < 0.05$ ). In contrast to this, scores allocated by farmers on the welfare impact of no feather harvesting were lower than those of secondary stakeholders ( $P < 0.05$ ). Furthermore, farmers rated the welfare implication of not using any devices/using only man-held restraint higher than secondary stakeholders ( $P < 0.05$ ).

Regarding the transportation of ostrich chicks, no difference of opinion was observed between ostrich farmers and secondary stakeholders in the industry for the welfare impact of all the factors listed ( $P > 0.05$ ; Table 4.6.3). There was however a significant difference between

farmers' and stakeholder' perceptions of the importance of the presence of workers with birds when transporting juveniles or slaughter birds ( $P < 0.05$ ; Table 4.6.3). Farmers scored the importance thereof significantly higher than secondary stakeholders. No further significant differences were observed between categories related to other factors in terms of the transportation of juveniles or slaughter birds.

*Table 4.6.3 Differences in perceptions between farmers and stakeholders in the ostrich industry with regards to the perceived welfare importance of transport factors in the ostrich industry scored on a scale of 1 to 5 from least to most importance*

	Farmers Mean (s. e.) (n=31)	Stakeholders Mean (s. e.) (n=96)	F value	Significance
<b>The importance of the following factors for the well-being of chicks when transported:</b>				
Type of vehicle being used	4.17 (0.19)	4.16 (0.09)	0.18	NS
The use of crates	4.39 (0.15)	4.16 (0.08)	3.01	NS
Stocking density	4.57 (0.09)	4.50 (0.07)	0.01	NS
Use of mats in crates	4.63 (0.09)	4.39 (0.08)	2.09	NS
Time of day when transporting	4.48 (0.13)	4.29 (0.09)	0.96	NS
Ventilation	4.60 (0.10)	4.54 (0.07)	0.07	NS
Protection against the elements	4.50 (0.13)	4.45 (0.08)	0.08	NS
Driver skill/experience	4.36 (0.16)	4.35 (0.08)	0.10	NS
<b>The importance of the following factors for the well-being of juvenile/slaughter birds when transported:</b>				
Type of vehicle being used	4.48 (0.12)	4.43 (0.08)	0.09	NS
Presence of a cover on top of the trailer	3.37 (0.21)	3.56 (0.11)	0.43	NS
Type of flooring	4.65 (0.10)	4.47 (0.07)	1.72	NS
Stocking density	4.57 (0.10)	4.47 (0.07)	0.22	NS
Time of day when transporting	4.42 (0.14)	4.26 (0.09)	0.80	NS
Ventilation	4.33 (0.13)	4.47 (0.07)	1.00	NS
Presence of workers with birds	4.74 (0.09)	4.37 (0.07)	8.24	*
Driver skill/experience	4.74 (0.09)	4.56 (0.06)	2.71	NS

Degrees of freedom varied between 2; 103 and 2; 113

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

Similarly no significant differences were observed in terms of ostrich farmers' and secondary stakeholders' perceptions of the welfare importance of extensive human presence/bonding from an early age, familiarity of birds with specific handlers or the regular handling and interaction with birds ( $P > 0.05$ ; Table 4.6.4). There was also no difference in the perceived likeliness that improved welfare of farmed ostriches would improve product quality for meat, leather or feather products. However, ostrich farmers and secondary stakeholders in the

ostrich industry differed in their perceptions of the importance of implementing a formal welfare protocol for the commercial production of ostriches as secondary stakeholders allocated higher scores than farmers ( $P < 0.05$ ; Table 4.6.4). However, no difference was found between the perceptions of farmers and stakeholders with regards to the likelihood that farmers would follow a formal welfare protocol if it was implemented on their farms, with scores between 3.46 and 3.65 (Table 4.6.4).

*Table 4.6.4 Differences in perceptions between farmers and stakeholders in the ostrich industry with regards to the perceived importance/likeliness of welfare factors pertaining to rearing of ostriches, product quality and implementation of a welfare protocol, scored on a scale of 1 to 5 from least to most important/likely*

	Farmers Mean (s. e.) (n=31)	Stakeholders Mean (s. e.) (n=96)	F value	Significance
<b>The importance of the following factors when ostriches are reared for their well-being:</b>				
Extensive human presence/bonding from a young age	4.20 (0.13)	3.91 (0.10)	2.08	NS
Familiarity of birds with specific handlers	3.80 (0.17)	3.76 (0.10)	0.00	NS
Regular handling and interaction with birds	4.10 (0.17)	3.93 (0.10)	1.02	NS
<b>The likeliness that improved well-being of farmed ostriches will increase the product quality of the following:</b>				
Meat	3.97 (0.19)	4.25 (0.10)	1.82	NS
Leather	4.23 (0.17)	4.25 (0.10)	0.03	NS
Feathers	4.13 (0.19)	4.13 (0.10)	0.06	NS
<b>The importance of the implementation/use of a formal welfare protocol on ostrich farms to ensure the well-being of ostriches:</b>	3.39 (0.24)	3.97 (0.10)	4.15	*
<b>The likeliness that farmers will follow such a protocol if it were to be implemented:</b>	3.65 (0.19)	3.46 (0.12)	0.52	NS

Degrees of freedom varied between 2; 103 and 2; 113

Significance: NS = Not Significant; \* =  $P < 0.05$ ; \*\* =  $P < 0.01$  and \*\*\* =  $P < 0.0001$

#### 4.7 Preferences of ostrich farmers and secondary stakeholders in terms of production and management practices used in the industry.

In terms of methods of incubation and hatching of ostrich chicks the most preferred method tended to be artificial incubation and hatching with human assistance only when necessary (Table 4.7). A quarter of farmers preferred the artificial incubation and hatching with regular human assistance. Only a minor percentage of both farmers and secondary stakeholders indicated a preference for artificial incubation without human assistance. While an intermediate amount of farmers and stakeholders preferred natural incubation and hatching with breeders, no significant differences were observed between farmers and stakeholders for their preference related to the incubation and hatching of ostriches ( $P > 0.05$ ).

A large proportion of both farmers and secondary stakeholders in the industry indicated their preference for using more than one rearing method in combination with another. In contrast only a small number of participants seemed to prefer natural rearing with breeders with and without human assistance. Overall, the minority of both farmers and secondary stakeholders indicated their preference for artificial rearing in extensive, pasture-based systems. When comparing the preference for natural versus artificial rearing it was evident that farmers were less inclined to prefer natural rearing practices than stakeholders (0.25 vs 0.50;  $\chi^2 = 4.51$ ;  $P = 0.03$ ).



*Table 4.7.1 Preferences of farmers and stakeholders in the ostrich industry with regards to management and production practices currently implemented in the industry (showed as a percentage)*

	Farmers (%) N = 31	Stakeholders (%) N = 69
<b>Preferred method of incubation and hatching methods of ostrich chicks:</b>		
Natural incubation and hatching with breeder birds	9.68	16.67
Artificial incubation and hatching without human assistance	6.45	4.17
Artificial incubation and hatching with human assistance only when necessary (chicks are assisted only when they fail to hatch on their own)	48.39	41.67
Artificial incubation and hatching with regular human assistance (eggs are cracked/chicks assisted as a rule)	25.81	16.67
Combination of natural and artificial incubation and hatching methods	9.68	20.83
<b>Preferred rearing method of ostrich chicks:</b>		
Natural rearing with breeder birds without human assistance	6.45	12.50
Natural rearing with breeder birds with human assistance	12.90	22.92
Artificial rearing in extensive systems (pasture-based systems)	6.45	7.29
Artificial rearing in semi-extensive systems	32.26	14.58
Artificial rearing in intensive systems (dry runs/feedlots)	16.13	11.46
Combination of natural and artificial rearing methods	25.81	31.25
<b>Preferred method of toenail clipping of ostrich chicks:</b>		
No toenail clipping	16.13	15.63
Toenail clipping without cauterization	0.00	7.29
Toenail clipping with cauterization	61.29	36.46
Declawing/permanent removal of the nail and part of the toe	0.00	3.13
Neutral/undecided	22.58	37.50
<b>Preferred frequency of visual inspection of birds:</b>		
Twice daily	32.26	16.67
Daily	58.06	46.88
Every other day	0.00	9.38
Weekly	3.23	17.71
Less than once a week	3.23	4.17
<b>Preferred mode of action for terminally ill/injured birds:</b>		
Contact veterinarian	22.58	32.29
Euthanasia	35.48	38.54
Culling	16.13	10.42
Other	25.81	18.75
<b>Preferred method of feather harvesting:</b>		
Feather plucking	45.16	30.21
Feather clipping	16.13	25.00
Clipping of white feathers, plucking of other feathers	25.81	25.00
No feather harvesting	0.00	4.17
Neutral/undecided	12.90	15.63
<b>Preferred method of restraining birds:</b>		
No devices used/man held	6.45	8.33
Hooks	25.81	19.79
Triangular crush	3.23	14.58
Hoods	19.35	18.75
Other	6.45	11.46
Combination of hooks, triangular crush and hoods	38.17	27.08

In terms of toenail clipping practices, the majority of farmers indicated their preference for toenail clipping with cauterization. Similarly, about a third of stakeholders also showed their preference for this practice. Less than 20% of both farmers and stakeholders preferred that toenails should not be clipped. No farmers indicated a preference for either toenail clipping without cauterization nor declawing/permanent removal of the toenail, while a small proportion of secondary stakeholders preferred these toenail clipping practices. A large proportion of farmers and stakeholders indicated neutral/undecided preferences in terms of toenail clipping of ostrich chicks. Farmers were however more likely to practice welfare accepted toenail clipping methods in comparison to stakeholders (1.00 vs 0.83;  $\text{Chi}^2 = 4.54$ ;  $P = 0.03$ ).

When asked to indicate their preference with regards to the frequency of visual inspection of birds, the majority of farmers and secondary stakeholders selected daily inspection. No farmers indicated a preference for visual inspection only every second day and less than 3% of farmers indicated a preference for weekly inspection (Table 4.7). A larger proportion of stakeholders had a preference for less than daily visual inspection when compared to commercial ostrich farmers (0.33 vs 0.07,  $\text{Chi}^2 = 7.87$ ;  $P = 0.005$ ).

The most common mode of action for terminally ill or injured birds was indicated as euthanasia by both farmers and secondary stakeholders. In contrast, the minority of farmers and stakeholders preferred culling animals (slaughtering/killing in welfare conscious ways) that are injured or suffering (Table 4.7). About a quarter to one third of farmers and stakeholders, respectively, indicated their preference for contacting a veterinarian. No significant differences between farmers and stakeholders were noted ( $P > 0.05$ ).

Feather plucking was the method of choice for both farmers and stakeholders (45.16% vs. 30.21%, respectively) with regards to feather harvesting. Both groups also tended to allocate their preferences to feather clipping only and to the practice of clipping white feathers, while plucking the other feathers as a second method of choice (Table 4.7). No feather harvesting was the least preferred choice as only 4.17% of secondary stakeholders and no farmers indicated their preference for this practice. Interestingly, 12.90% and 15.63% of farmers and stakeholders, respectively, were undecided on this matter.

Pertaining to restraining methods, both farmers and secondary stakeholders tended to prefer a combination of hooks, hoods and the triangular crush (38.71% vs 27.08%). The least preferred method amongst farmers was the use of a triangular crush only, with only 3.23%, in contrast with the 14.58% of stakeholders who preferred this method. The least preferred method of restraint was handling without any devices (man-held) for both farmers and stakeholders. Less than 20% of ostrich farmers and secondary stakeholders indicated their preference for the use of hoods only, while around 10% of farmers and stakeholders indicated their preference of other methods of restraint.

## 4.8 Farmers' likeliness to observe injuries and stress behaviours on-farm

Farmers were asked to score the likeliness of injuries occurring during handling ostriches, moving them between camps and during transportation (Table 4.8). The highest mean scores were allocated to injuries occurring during transportation ( $3.13 \pm 0.23$ ) and handling ( $2.90 \pm 0.22$ ) with a slightly lower score allocated to injuries occurring while moving birds between camps ( $2.63 \pm 0.22$ ). All mean scores allocated to the likeliness of injuries occurring ranged from 1.0 to 5.0 (not likely to very likely).

Furthermore, farmers were asked to score the likeliness of observing stress behaviours during two scenarios; (1) birds are moved to different camps and (2) birds are moved to holding or loading camps before transportation. It was reported that a higher likeliness of birds running up and down was observed when birds are moved to different camps when compared to pre-transport camps.

*Table 4.8.1 Mean scores allocated by 31 ostrich farmers with regard to observed injuries and stress behaviour during handling and translocation of ostriches, scored on a scale of 1 to 5 (least to most likely)*

	Mean (s. e.)	Range
<b>The likeliness of birds to be injured during the following:</b>		
Handling	2.90 (0.22)	1-5
Moving between camps	2.63 (0.22)	1-5
Transportation	3.13 (0.23)	1-5
<b>The likeliness of birds to show the following behaviour when moved to different camps:</b>		
Running up and down	3.23 (0.19)	1-5
Spinning/dancing/twirling	3.60 (0.19)	1-5
Vocalization	2.43 (0.22)	1-5
Kicking/hissing at each other	3.03 (0.22)	1-5
Trampling each other	2.07 (0.20)	1-5
Stop feeding	2.35 (0.20)	1-5
Stop drinking	2.10 (0.20)	1-5
<b>The likeliness of birds to show the following behaviour when moved to holding/loading camps before transportation:</b>		
Fearfulness	2.43 (0.22)	1-5
Running up and down	2.52 (0.24)	1-5
Spinning/dancing/twirling	2.97 (0.21)	1-5
Vocalization	2.43 (0.21)	1-5
Kicking/hissing at each other	2.63 (0.21)	1-5
Trampling each other	2.23 (0.21)	1-5
Climbing on top of each other	2.10 (0.20)	1-5

# **Chapter 5**

## **Discussion**

## 5.1 Knowledge, welfare perceptions and buying decisions of consumers, farmers and secondary stakeholders in the ostrich industry

### 5.1.1 Knowledge of commercial ostrich farming

The results of this study illustrated a clear lack of knowledge amongst consumers with regards to the commercial production of ostriches. Specifically, women, the youth, tertiary educated persons, vegetarians, participants with high income levels and persons residing in provinces where ostrich farming is unknown were less informed about the ostrich industry as a whole. This lack of knowledge may be attributed to the fact that a very small percentage of citizens are actively involved in the agriculture sector, as well as the small scale and confinement of the industry to specific regions in South Africa. These results are consistent with those found by Bir *et al.* (2019) who showed that the large percentage of citizens in the U.S. that are not involved in the agricultural sector have limited understanding and knowledge of food production processes.

Those unfamiliar with the agricultural sector often have little exposure to and understanding of either food production systems or farmed animal welfare in general (Knight and Barnett, 2008; Vizzier *et al.*, 2016). In that sense, Bir *et al.* (2019) have highlighted that a lack of knowledge is often combined with negative emotional attributes to management and production practices, which can be further exacerbated by social media and advertisements. As a result, misconceptions due to poor knowledge of practices implemented in some livestock industries have led to acceptance by the general public that inadequate and potentially harmful techniques are used in artificial or highly intensified production systems, such as in the case of the slaughter of poultry, where stunning techniques were shown to be perceived as inadequate by the public (Erian and Phillips, 2017).

Hence, a proper understanding of the public's viewpoint in terms of animal welfare could be used to inform the public about the efforts and actions that are undertaken to ensure that the welfare of production animals is improved (Vanhonacker *et al.*, 2012), since consumers place high value on the transparency of livestock industries.

### 5.1.2 The welfare importance and impact of husbandry practices

Consumers, especially women, the youth, vegetarians, highly educated persons, participants earning high incomes and those residing in provinces outside the common ostrich farming areas placed a greater importance on 'natural production' aspects of commercial ostrich farming (i.e. providing an environment to ostriches which closely resemble natural living under 'wild' circumstances). Aspects supporting this line of thinking include emphasis on limited stress, absence of pain, freedom to exhibit natural behaviour, freedom of movement and environmental enrichment. Similarly, Ingenbleek *et al.* (2013) highlighted that welfare conscious consumers more often resided in wealthy areas of Northwest Europe and that these consumers were also more abundantly young professionals. In a previous study it has also been shown that consumers earning a low income were less concerned with the welfare of animals (Bir *et al.*, 2019).

The ability of animals to feel emotions or pain is central to the idea of animal welfare (Bir *et al.*, 2019), which is an important factor in consumers' viewpoint as seen in this study. Perceptions of the emotions of animals may, however, not be the sole predictor of participants' welfare preferences. Women and possibly vegetarians might be more emotionally responsive towards animal well-being, which might in turn influence their buying decisions and the perceptions and opinions they form about the farm animal industries. It should also be



considered that people from different origins/backgrounds/regions tend to view subjects with different attitudes as a result of differences in their economic and social status (You *et al.*, 2014). Similarly to the results of the present study, Musto *et al.* (2016) reported that the general public tend to have a more positive perception about farming systems that are alternatively organic or free range as opposed to 'classic' industrialised farming systems.

As seen in the responses from the present study, this perceived "naturalness" is believed to accompany acceptable welfare standards (Bir *et al.*, 2019) as it is often believed that the most welfare conscious systems are those resembling natural free-living environments under which animals would occur in 'wild' circumstances. This was specifically true in the present study amongst women, an attribute which may be attributed to their mothering instincts and the youth which are more readily influenced by social media as a result of high exposure to advertisements, etc. These results are consistent with notions that consumers often have a generally positive view of alternative (free-range/organic) animal production systems as highlighted by Bir *et al.* (2019). Vanhonacker *et al.* (2008) also mentioned the strong difference in perception between consumers and farmers regarding alternative farming systems and aspects related to engaging in natural behaviour. It is therefore important to use marketing strategies to address consumer concerns and to inform the public about welfare aspects that they might be unaware of (Vanhonacker *et al.*, 2012).

Basic feed, water and health needs appeared to be highly prioritised by all participants, especially farmers and persons with low income. The latter groups tended to highlight the importance of water quality and body condition. This might be due to the fact that farmers and low-income people, commonly employed in the agricultural sector, consider these aforementioned basic needs as key requisites for production, also with welfare implications. This perception is founded in the fact that animals with compromised basic needs are unlikely

to perform or produce well in any system. These basic needs are also easy to supply and directly improves outputs, which farmers might link to acceptable welfare. The norms expressed by farmers in a previous study by Vanhonacker *et al.* (2008) showed that farmers primarily relate good welfare to good health. Therefore, if an animal eats and grows well- it should be in a state of good welfare. In a study on turkey farming, poor nutrition and illness was ranked among the highest greatest challenges, while space for movement, heat and veterinary wellness were also ranked as highly important (Bir *et al.*, 2019). This general perception is likely to be true for other livestock species as well. Consumers furthermore have been demonstrated to have the most negative views of aspects related to lack of available space, inability to engage in natural behaviour, transport, slaughter and suffering (Vanhonacker *et al.*, 2008).

Frequent visual inspection of birds was important to older participants and those with tertiary education. Older participants might have more experience in the farming sector and in the period before mechanisation and automation of farming systems. It could be surmised that farmers then had to more frequently inspect their flocks to ensure that the animals' needs were met.

Vegetarians indicated that they thought regular handling had a negative influence on welfare, which may relate to their limited knowledge of handling practices in ostrich farming environments (as reported in this study). However, this result could also partly be due to the small sample size of vegetarians amongst participants. On the contrary, farmers classified regular handling as highly important. Young participants scored the importance of preventative medication high with regards to the well-being of farmed ostriches. This contradicts the recent movement away from the use of antibiotics and medicines to prevent illness and disease rather than reactive care.

Manually assisting chicks to hatch were perceived to be less important for the well-being of ostriches by tertiary educated participants, while farmers on the other hand, rated this practice as very important. This could perhaps be attributed to the fact that farmers may perceive the need to interfere to ensure that the maximum number of chicks is successfully hatched. In the process chicks are likely to be prevented from suffering and or dying while struggling to hatch. Other participants that are unfamiliar with the hatching process may just view human interference as a hazardous practice that negatively impact on the welfare of animals.

Participants residing in provinces where ostrich farming is not typically practiced viewed human rearing of chicks in a negative light, which could again be attributed to the lack of knowledge or exposure to the industry. The global movement towards “natural rearing” could reinforce this viewpoint. Consumers tend to believe that intensive production systems are unnatural and therefore not safe (You *et al.*, 2014). This viewpoint is understandable in the sense that wild animals are perceived to have lived and survived as they were destined to before production systems with human interference were implemented. It may therefore be generally accepted that the natural environment may be optimal.

Consumers, women, the youth and participants with moderate income levels placed a high importance on the level of stockmen skills when working with ostriches. Stockmen’s skilfulness and familiarity with birds in terms of anatomy, behaviour, welfare, handling, transport and health standards and detecting signs of disease and stress is emphasized in various guidelines for ethical ostrich farming in different countries (AWAC, 1998; SAOBC, 2013). Studies have demonstrated that stockmen that are familiar with the basic biology and

stress behaviours of a species could alleviate problems associated with transportation, amongst others (Grandin, 1997; Hoffman and Lambrechts, 2011).

### 5.1.3 Welfare perceptions

The welfare of commercially farmed ostriches has been shown to be highly valued by specifically women and vegetarians/vegans in the present study. Similarly, logit models in previous studies have shown that being female improves the likelihood of being concerned about the well-being of animals (Vanhonacker *et al.*, 2008; Bir *et al.*, 2019).

The importance of the welfare of slaughter animals for product quality was highly valued by farmers participating in the present study. Buying decisions are often influenced by cues – such as labels about product quality, product origin and sustainability (Marian and Thøgersen, 2013; Bir *et al.*, 2019). For instance, Bir *et al.* (2019) showed that the value of animal welfare when buying animal products is generally considered highly important by women, vegetarians and the youth. Studies have also shown that vegetarians are generally more concerned about the welfare of animals than non-vegetarians (De Becker and Hudders, 2015). This might be for obvious reasons, since it is generally accepted that vegetarians choose to follow a vegetarian lifestyle based on their welfare concerns pertaining to production animals.

Implementation of a formal welfare protocol for commercial ostrich production was highly valued by consumers and to a lower extent by secondary stakeholders in the industry. In contradiction with the present study, Ingenbleek *et al.* (2013) showed that stakeholders in Europe were willing to claim ownership of product brands that were specifically welfare conscious in an attempt to strengthen consumers' trust in their brands. However, farmers in

the present study appeared to understand the value of implementing a formal welfare protocol due to the realisation of the importance of consumer reassurance. Some sort of certification for ostrich products to ensure market access follows naturally. Women, the youth and participants residing in provinces unfamiliar with ostrich farming also recognised the importance of the implementation of a formal welfare protocol. An increasing global trend is seen for targeted advertisement and awareness protocols that concentrate on an audience with a large influence, such as women (as main buyers of products) or the youth (as prospective consumers). These audiences might be easily accessible and readily influenced by the media. Women/the youth might make easy targets for marketing ostrich products as they are not well informed about the industry (as seen in the results of the present study) as well as the benefits and value of ostrich products. These attributes may enhance their susceptibility to be influenced by the media. It is believed that a person's norms, values and beliefs are less susceptible to change than their factual knowledge (Aarts and Te Velde, 2001). Consumers' perception about farmers could therefore easily be influenced by advertisements (Boogaard *et al.*, 2006). Misinformation or the absence of knowledge can therefore damage farmers' image related to welfare standards.

Paradoxically, participants were in favour of welfare conscious products, but not willing to buy or pay more for such commerce. It follows that, even though participants might seem to be concerned about the welfare of production animals, they might not always turn this into effective actions, such as physically paying more money for products that stem from a welfare conscious production line. The comparison of consumers with farmers and stakeholders emphasises the discrepancy noted above. Consumer willingness to pay could potentially have been transferred to farmers as a financial incentive to improve animal welfare on-farm (Ingenbleek *et al.*, 2013), yet South African consumers do not seem to show this attribute.

Consumers' welfare interest may likely influence their future meat consumption (Henchion *et al.*, 2014), which might lead to consumers perceiving animal welfare as an integral component of product quality and a key to informed buying decisions. Consumers should however bear in mind that marketing reassurances comes at a cost to farmers and the industry in general. This may constrain production efforts if overhead farming costs increase to such extents that farmers are forced to give up their livelihoods (McGlone, 2001).

## 5.2 The views and opinions of farmers and stakeholders in terms of the welfare impact of ostrich production and management practices

### 5.2.1 Perceptions around general husbandry practices

Generally, the perceptions of farmers in terms of the intensification of production processes are positive. In terms of incubation and hatching methods used in the industry, farmers and stakeholders with low incomes viewed artificial incubation and hatching with human assistance only when necessary in a positive light with reference to the well-being of ostriches. This might be related to the assumption that people with higher incomes might be more inclined to view less invasive husbandry practices as welfare friendly as opposed to more natural practices.

Intensive rearing of ostriches in feedlot systems was perceived to have a negative impact on the well-being of ostriches by women, while men viewed this in a neutral light. Semi-intensive and extensive rearing systems were perceived to have a positive impact on the welfare of farmed ostriches overall, as reflected by overall mean scores higher than 3. This also relates to the 'natural rearing' concept in which intensive systems are believed to restrict animals in ways that impair their welfare as a result of restricted movement and an inability to exhibit natural behaviour repertoires. Generally, farmers perceive the welfare of farmed animals in a more positive light than consumers, especially once related to production factors (i.e. growth and feed conversion efficiency) which are often realised (Vanhonacker *et al.*, 2008).

### 5.2.2 Husbandry practices perceived to compromise the welfare of farmed ostriches

Common husbandry practices implemented in the ostrich industry have recently come under speculation as being counterproductive to the welfare of farmed ostriches (i.e. toenail clipping, feather harvesting and restraint of ostriches when they are handled). Ostrich farmers cared more about welfare conscious management and production practices than secondary stakeholders in the industry. Stakeholders generally indicated their preference towards practices that potentially compromise the welfare of ostriches such as culling in contrast to euthanasia, declawing in contrast to no toenail clipping. This was especially observed with reference to toenail clipping of ostriches, which is a practice implemented as a preventative measure to protect ostriches from severe injuries and skin damage. Not removing the toenails was perceived to have a slightly negative impact on the welfare of farmed ostriches, as indicated by a mean score of  $2.88 \pm 0.12$ . However, clipping with cauterization and declawing were both perceived even more negatively ( $2.46 \pm 0.11$  and  $2.35 \pm 0.13$ , respectively). Both management practices are generally perceived to negatively influence the welfare of ostriches exposed to these practices. The heat used for cauterization could arguably cause unnecessary pain. Men indicated their perceptions of toenail clipping without cauterisation as having a more positive effect on the welfare of ostriches than women.

Declawing entails permanent removal of the nail and as such a part of the toe, namely the growth point or nailbed, is also removed. Interestingly, young participants' scores for the impact of declawing were close to 3, indicating that they were neutral with reference to the effect on the well-being of ostriches. This is surprising as declawing is an extremely controversial practice. Young participants who are influenced by the media would be expected to be completely against this practice. Participants with high income levels also scored the declawing of ostriches significantly more positive than those with lower incomes. However, since this practice is no longer practiced in the industry, it could be that many participants were



not familiar with the practice and therefore could not formulate a specific opinion. This is probably adequate evidence that this practice has been successfully and completely phased out.

Different opinions about feather harvesting were observed throughout this study. The absence thereof was perceived as having a negative impact by farmers and by participants residing in provinces historically known for ostrich farming. This perception might originate from the fact that a lot of potential money is earned through feather sales. Harvesting the feathers synchronize development of feathers for the new crop, which increases income even more by improving feather future quality and consistency. Participants residing in provinces that are not exposed to ostrich farming rated the welfare impact of no feather harvesting as positive. In contrast, the plucking of feathers was viewed as having a severely negative impact by participants that reside outside of traditionally ostrich areas. Their mean scores indicated that their perception was that any harvesting of feathers (plucking or clipping) had a negative impact. These results echo the global perception and social tendency towards banning feather harvesting from live birds. A combination of clipping and plucking was rated the highest by farmers, as having a positive impact on the welfare of ostriches, while participants with higher income levels and those residing in provinces not typically known for ostrich farming rated this practice as one that negatively influences ostrich well-being.

Farmers perceived all the restraining methods as having a positive impact on the birds' well-being. Participants younger than 50 years of age had a negative perception regarding man-held restraint, without the use of any devices. The use of hooks and hoods to restrain ostriches was perceived more negatively by tertiary educated and higher earning respondents, as well as by participants from provinces not traditionally known for ostrich production. However, participants from provinces where ostrich farming is commonly practiced considered the use

of hooks and hoods as beneficial to the well-being of ostriches. Bejaei and Cheng (2014) reported that most producers are not familiar with the effects of different ostrich handling and restraining techniques and their preference was based on their experience and the availability of equipment. The South African Ostrich Business Chamber (2013) listed hooding of ostriches as a suggested restraining method for ostriches over six months of age. However, it must be conceded that this practice could possibly have disorientating effects (Bejaei and Cheng, 2014). Farmers had a high preference for this method of restraint, which might be due to the practical implementation thereof which they are thoroughly familiar with. It is common practice to hood birds as most farmers believe that it calms birds down when handling them for routine management purposes (personal experience).

Transportation was previously identified as one of the main factors influencing the welfare of ostriches (Mitchell, 1999; Wotton and Hewitt, 1999). Results of this study show that women are more concerned about adequate transportation equipment, adequate ventilation and stocking density as well as time of day ostriches are transported than men. It was also shown that participants with low income tend to value adequate equipment (i.e. the use of mats and crates) and ventilation more than other participants. Inadequacies during transport and pre-transport handling can cause substantial losses, including feather loss, bruises, cuts and injuries that can result in reduced product quality and downgrading of skins, which significantly decreases income (Hoffman and Lambrechts, 2011). Bruised muscles may also be unfit for human consumption, while extreme transport conditions may result in the death of animals.

When transporting juveniles or slaughter birds, women valued the importance of adequate flooring, stocking density and ventilation more than men. Farmers place greater importance on the presence of workers with birds during transportation, while low income participants valued driver skill/ability. This might indicate differences in perceptions as to where the

responsibility for the welfare of the birds lies. Bejaei and Cheng (2014) found that trailer design had a significant effect on ostrich welfare and transportation losses, while recommendations to minimise stress include adequate ventilation, closed sides and low light levels (Mitchell, 1999; Hoffman and Lambrechts, 2011). High mean scores assigned for the importance of type of vehicle, flooring and ventilation show that the perceptions of respondents were consistent with these recommendations.

### 5.2.3 Perceptions of general ostrich welfare

Older participants, those that earn a low income and those residing in provinces familiar with ostrich farming placed high importance on the welfare of ostriches to improve product quality. Buying decisions is influenced by product quality and therefore consumer concerns related to animal welfare in the production of animal or animal-derived products should be considered to improve marketability of animal derived products. Consumers prefer high quality products as this drives their willingness to pay a premium for quality products. Product quality can be related not only to physical attributes, but also towards packaging, nutritional quality etc. Consumers will not buy products unless they meets their standards.

The results of this study showed that ostrich farmers prefer artificial rearing practices compared to stakeholders, who tend to prefer natural rearing methods. Stakeholders are therefore better aligned with consumers' perceptions regarding husbandry practices, while farmers might see the need for maximal production to supply adequate amounts of food for the ever-growing consumer population or for profit.

Farmers preferred daily or twice daily inspection of their birds, while stakeholders viewed less frequent visual inspections as still acceptable. Bejaei and Cheng (2014) reported that most producers spend copious amounts of time with their birds. It is, however, commonly accepted that the central point of the farming system is the productive animal itself for farmers. Their propensity to regularly observe animals in production systems and to be attentive to them in order to note problems/injuries or illness should be viewed against this background (Dockes and Kling-Eveillard, 2006). Regular interaction with ostriches is deemed important to get them accustomed to humans and handling practices to minimize injuries and reduce stress (Muvhali *et al.*, 2018). Stakeholders might not share this view as frequent visual inspection and handling are time-consuming, without directly influencing production outputs. Dockes and Kling-Eveillard (2006) also showed that there are definite differences between farmers' and stakeholders' perceptions in the farming industry, even though they do share some ideas, such as the consideration or belief that animals are sentient beings.

### 5.3 Problem areas as identified by ostrich farmers

Farmers reported the highest likeliness of injuries to occur before or during transportation of ostriches. This might be due to rough or inexperienced handlers or hastiness while moving birds for transport. However, injuries related to transport are also often a result of stress, hence it is advised that handlers should always be with birds when transported, to monitor them and provide help if needed, to minimise losses (Hoffman and Lambrechts, 2011). Ostriches are also much more prone to injuries due to a high centre of gravity and only two legs on which they have to balance during transportation, added to their wild demeanour.

The low level of domestication and difficulty to handle also contributes to high losses during handling/transportation (Bejaei and Cheng, 2014). Mitchell (1999) and Hoffman and Lambrechts (2011) reported that when ostriches are in regular contact with their handlers, they become accustomed to their handling style and are less stressed than birds not accustomed to handling. Injuries and problems associated with transportation could also very well be due to inadequate equipment or a lack of knowledge by transporters and/or handlers. Other factors, such as time of day when transportation takes place are also extremely important; specifically, in the Klein Karoo area (where the majority of ostriches are farmed with in South Africa), where extreme temperatures often occur.

Furthermore, farmers that participated in this study indicated that birds were likely to show stress behaviour when moved between camps. Behaviours such as running up and down along fences, aggressive behaviour towards other birds and pacing, twirling and spinning have all been likely observed as indicated by the responses of farmers participating in this study. Studies have reported that welfare issues arise when birds from different social groups are mixed in new environments (Schaefer *et al.*, 1988; Grandin, 1997). Ostriches have an

established hierarchy that prevents excessive fighting. When new groups are formed, the disrupted hierarchy causes fighting, stress-induced disorders and possible injuries (Warris, 2010; Bejaei and Cheng, 2014).

## **Chapter 6**

### **Conclusions**

## 6.1 General conclusions

A substantial lack of knowledge by the public and consumers of production and management processes of commercial ostrich farming was one of the most significant outcomes of this study. Knowledge or the lack thereof, plays an important role in the public's perception. Unfortunately, uninformed persons' decision-making is easily influenced by third parties, which might result in a falsely created negative perception of an industry.

From the present study it was clear that there was a definite shift towards preferences for natural farming methods as opposed to conventional intensive factory-like production systems. This might influence how the public perceives the realised welfare in certain production systems. Women are more often concerned with the welfare of production animals, as shown in the present study, and as the main household buyer in many instances, they determine the market for such products. Their buying decisions are influenced by their perceptions of industry practices and methods in place to ensure animal welfare and product safety. It is therefore important for the commercial ostrich farming industry to avail products that meet the demands of consumers and comply with regulations to provide welfare and production reassurances demanded by consumers in an attempt to ensure success. Furthermore, the industry should strive to inform consumers about production processes to potentially alleviate the discordance between consumers and farmers. It is assumed to be possible to improve public perceptions and concerns by providing consumers with scientific facts and the correct information about products and production practices (Vanhonacker *et al.*, 2012). The results from the present study thus provides a proper conception of consumers' view of welfare in the ostrich industry and could be used to inform consumers in a transparent and understandable manner.



Factors such as the absence of pain, limited stress and an ability to express natural behaviour was highlighted as a main concern for many consumers. Consumer demand does not only dictate the nutritional or health status of their food choice but also the sustainability of the products they buy as well as an insight in the production systems (Miranda-de la Lama, 2017). As consumers increasingly become aware of production systems, their buying preferences change towards the systems they prefer to be implemented in the industry. The demand for such products therefore is expected to increase. Consumers demand high quality, ethically produced products but also place value sustainable production practices and the traceability of products. Hence, this could potentially exert additional strain on the marketing and export of locally produced ostrich products. When the welfare of production animals is conceptualised, it is important to incorporate the concerns, demands and opinions of consumers and the public (Vanhonacker *et al.*, 2013). Rushen (2003) also emphasized the importance of correlating research and societal views, values and norms of animal welfare. Hence, scientifically based standard operating procedures for the ostrich industry are needed to improve the welfare of farmed ostriches and continuously grow the industry.

In addition, most participants also felt that stockmen should be knowledgeable when working with ostriches and that their level of skill and experience plays a determining role in the welfare of commercially farmed ostriches. Generally, consumers demonstrated a positive view of the current state of welfare in the ostrich industry and farmers also showed a positive outlook on the importance of welfare specifically in relation to product quality (thereby ensuring better economic returns). Consumers also indicated a need for the implementation of a formal welfare protocol in the commercial ostrich industry. In parallel to this, farmers clearly are moving towards artificial production systems as a means of increasing production, something which consumers may not support. The results of the present study, however, showed that

ostrich farmers are welfare conscious when it comes to toenail clipping practices while stakeholders seemed to be more inclined to pursue high production outputs.

Several factors have been identified as potential welfare problems – from both the public and farmers/stakeholders in the industry. These include artificial hatching and rearing systems, handling and restraint of ostriches as well as transportation. These problem areas need to be investigated and addressed in future studies. Studies on the welfare and production influences of these practices need to be developed, in terms of comparing these production and management practices as well as their impacts in different farming environments. The latter might prove difficult as no standard ostrich production system is followed by ostrich farmers, not even within a specific region. This indicates a requirement for auditable welfare and production indicators tailored to a variety of farming systems to ease the process of determining potential impacts and influences of identified production and management practices.

Auditable welfare indicators of animal welfare will need to be incorporated in the production process to allow the industry to provide consumers with the required assurances pertaining to ethical and sustainable ostrich production to ensure the viability of the industry. This study highlighted various welfare concerns that consumers, farmers and stakeholders consider as important, as well as potential welfare problem areas within production systems, as a result of management practices. A list of potential welfare indicators and measures has thus been drafted as part of the recommendations flowing from the present study (Table 6.1). These welfare measures have been tailored to fit ostrich farming systems and could potentially be used as a platform for the development of formal welfare protocols for the ostrich industry to aid in the monitoring and improvement of the welfare status of farmed birds (see appendix G). This will also allow for the development of welfare indicators that can be audited for

certification purposes as well as providing consumers with an assurance and guarantee that products originate from a welfare conscious production system.

As such, the present study emphasizes the need for a ‘Code of best practices for ostrich farming and production systems’.

*Table 6.1 Preliminary ostrich specific welfare measures and indicators to assist the on-farm assessment of commercially farmed ostriches*

Welfare principle	Welfare criteria	Measure
Good feeding	Absence of prolonged hunger	<ul style="list-style-type: none"> <li>• Access to feed</li> <li>• Body condition score</li> </ul>
	Absence of prolonged thirst	<ul style="list-style-type: none"> <li>• Access to water</li> </ul>
Good housing/facilities	Comfort when resting	<ul style="list-style-type: none"> <li>• Plumage cleanliness</li> <li>• Panting</li> </ul>
	Thermal comfort	<ul style="list-style-type: none"> <li>• Huddling</li> <li>• Activity level</li> <li>• Thermoregulation support</li> </ul>
	Ease of movement	<ul style="list-style-type: none"> <li>• Stocking density</li> <li>• Mobility</li> </ul>
	Freedom of movement	<ul style="list-style-type: none"> <li>• Outdoor access</li> <li>• Housing facilities</li> <li>• Handling facilities</li> </ul>
	Appropriate facilities	<ul style="list-style-type: none"> <li>• Floor quality/cleanliness in chick houses</li> <li>• Air quality/ventilation in chick houses</li> <li>• Enrichment measures</li> </ul>
Good health	Absence of injuries	<ul style="list-style-type: none"> <li>• Leg deformities</li> <li>• Injuries</li> <li>• Bruises</li> <li>• On-farm mortalities</li> <li>• On-farm culls</li> <li>• Diarrhoea</li> </ul>
	Absence of disease	<ul style="list-style-type: none"> <li>• Skin infections</li> <li>• Respiratory problems</li> <li>• Prolapse</li> <li>• Parasites</li> <li>• Symptoms of ill health</li> </ul>
	Absence of pain induced by management	<ul style="list-style-type: none"> <li>• Toenail clipping</li> <li>• Feather collection</li> <li>• Use of beak rings</li> <li>• Method of identification</li> </ul>
Appropriate behaviour	Expression of social behaviours	<ul style="list-style-type: none"> <li>• Sexual behaviour</li> <li>• Dust bathing</li> <li>• Grooming</li> </ul>
	Expression of other behaviours	<ul style="list-style-type: none"> <li>• Exploratory behaviour</li> <li>• Abnormal behaviour</li> <li>• Stress behaviour</li> <li>• Aggressive behaviour</li> </ul>

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Reaction to human-interaction	<ul style="list-style-type: none"> <li>• Avoidance distance test</li> <li>• Fear test</li> <li>• Handling practices</li> </ul>
Positive emotional state	<ul style="list-style-type: none"> <li>• Novel object test</li> <li>• Qualitative Behavioural Assessment</li> </ul>

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## 6.2 Future directions

Attempts should be made to improve informing the public about production practices related to the ostrich industry and how these affect the welfare of the animals to potentially reduce the discordance between consumers and farmers/stakeholders. Scientific facts could be communicated to the public to better align consumer and farmer concerns about welfare indicators and the necessary legislation or policies needed to ensure that farmed ostriches thrive in farming environments that are provided with adequate welfare measures. These attempts could include marketing strategies that promote the welfare-friendliness of ostrich products in terms of labelling. Alternatively, consumers could be made aware of welfare aspects they are unfamiliar with (i.e. toenail clipping) and then further assured that products adhere to the rules and regulations surrounding these welfare issues or are completely free from these aspects.

The present study identified the need for future research to determine the relationships between knowledge and ostrich-specific production practices and perceptions of welfare. The potential discord between practices farmers should ideally adhere to and the familiar practices they implement themselves should be explored. It follows from the present study that a lack of knowledge or exposure to different husbandry practices might influence preferences and perceptions in terms of production practices and their potential welfare impacts in the important consumer category. Since the ostrich industry is a relatively small and closed industry, exposure to updated or different husbandry practices might not be readily accepted.

Future studies should also aim to compare the impact of handling practices on the welfare of ostriches and the influence thereof on product quality to determine best practice methods (Bejaei and Cheng, 2014). Such studies should assess putative improved handling techniques in an attempt to improve and promote the welfare of farmed ostriches.

The attitudes of farmers versus secondary stakeholders could be explored deeper, in terms of welfare conscious practices implemented in the industry as it was clear from the present study that these two categories did not necessarily share the same views and opinions about animal welfare in general. Secondary stakeholders' inputs often determine production practices as they are first exposed to consumer preferences. They thereby provide feedback to farmers as to the prerequisites for products adhering to consumer specifications. It is evident that consensus should be reached between these role-players to ensure industry success pertaining to a mutually accepted ostrich welfare protocol.

## **Chapter 7**

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## Appendix A

Questionnaire for Consumers (English Version)

# Farmed Ostrich Welfare Perceptions

Farmed animal welfare is becoming increasingly important and we would like your opinion for a study in the ostrich industry.

This study is part of ongoing research between the University of Stellenbosch and the Western Cape Department of Agriculture in South Africa, aimed at evaluating the well-being of farmed ostriches.

Your participation in this study is entirely voluntary and you are free to decline to participate. Participation and therefore responses to this questionnaire will be kept anonymous and entirely confidential. You are free to withdraw from the study at any point without any consequences. By completing this questionnaire you voluntarily agree to participate in this study.

**Please return all Questionnaires to [ostrichsurvey@gmail.com](mailto:ostrichsurvey@gmail.com)**

**SECTION A (Mark with an X)**

<b>1</b>	<b>Age</b>	<20	20-35	36-50	51-65	>65	
<b>2</b>	<b>Gender</b>	Male	Female	Prefer not to say	Other		
<b>3</b>	<b>Highest level of education</b>	Unschool	Primary school	Secondary/High school	Tertiary (College/ University)		
<b>4</b>	<b>Occupation: please specify</b>						
<b>5</b>	<b>Income level</b>	<R50 000 per year	R50 000- R200 000 per year	R200 000-R400 000 per year	R400 000-R600 000 per year	>R600 000 per year	Undisclosed
<b>6</b>	<b>Country/Province of residence: please specify</b>						
<b>7</b>	<b>Dietary preference</b>	No preference	Preference for meat	Vegetarian	Vegan	Other (specify) _____	

**SECTION B (Mark with an X)**

1	<b>How would you rate your understanding of the following ostrich production and management procedures?</b>	<i>Poor/ No knowledge</i>	<i>Limited</i>	<i>Moderate</i>	<i>Knowledgeable</i>	<i>Very knowledgeable</i>
	General ostrich husbandry					
	Transportation of ostriches					
	Handling of ostriches					
	Artificial incubation of eggs					
	Human rearing of chicks					
2	<b>How important do you consider the following factors for the well-being of ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Feed availability					
	Feed quality					
	Water availability					
	Water quality					
	Chick housing					
	Shelters in outside camps					
	Stocking density					
	Body condition of ostriches					
	Internal parasites					
	External parasites					
	Limited stress					
	Absence of pain					
	Ability to exhibit natural behaviour					
	Freedom of movement					
	Environmental enrichment					

<b>3</b>	<b>How important do you consider the following management and production practises for the well-being of ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Manually assisting chicks to hatch					
	Human rearing of chicks (as opposed to natural rearing of chicks by breeding birds)					
	Frequent visual inspection of ostriches					
	Regular handling of ostriches					
	Stockmanship skill/experience					
	Type of vehicle/trailer used for transporting ostriches					
	Isolation of sick/injured birds					
	Preventative medication					
<b>4</b>	<b>How important do you think it is that people involved in ostrich production are knowledgeable with regards to the following?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Anatomy of ostriches					
	Behaviour of ostriches					
	Detecting signs of stress in ostriches					
	Detecting signs of disease/illness in ostriches					
	Handling and restraining of ostriches					
	Transporting of ostriches					
<b>5</b>	<b>How important do you consider the following?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	The welfare of farmed ostriches					
	The welfare of slaughter animals for product quality					
	Animal welfare when buying animal products					
	Implementing a formal welfare protocol for the production of ostriches (meat, leather, feathers)					

<b>6</b>	<b>How likely are you to:</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Buy a product that originates from a welfare conscious farm rather than a product from a welfare neutral farm?					
	Pay more for a product that originates from a welfare conscious farm and production line?					
<b>7</b>	<b>Any additional comments?</b>					

Thank you for your participation in this study

For any queries or feedback please don't hesitate to contact Monique Snyders- email [ostrichsurvey@gmail.com](mailto:ostrichsurvey@gmail.com)

## Appendix B

Questionnaire for Stakeholders (English Version)

# Farmed Ostrich Welfare Perceptions

Farmed animal welfare is becoming increasingly important and we would like your opinion for a study in the ostrich industry.

This study is part of ongoing research between the University of Stellenbosch and the Western Cape Department of Agriculture in South Africa, aimed at evaluating the well-being of farmed ostriches.

Your participation in this study is entirely voluntary and you are free to decline to participate. Participation and therefore responses to this questionnaire will be kept anonymous and entirely confidential. You are free to withdraw from the study at any point without any consequences. By completing this questionnaire you voluntarily agree to participate in this study.

**Please return all Questionnaires to [ostrichsurvey@gmail.com](mailto:ostrichsurvey@gmail.com)**



**SECTION A (Mark with an X)**

<b>1</b>	<b>Age</b>	<20	20-35	36-50	51-65	>65	
<b>2</b>	<b>Gender</b>	Male	Female	Prefer not to say	Other		
<b>3</b>	<b>Highest level of education</b>	Unschool ed	Primary school	Secondary/High school	Tertiary (College/ University)		
<b>4</b>	<b>Occupation: please specify</b>						
<b>5</b>	<b>Income level</b>	<R50 000 per year	R50 000- R200 000 per year	R200 000-R400 000 per year	R400 000-R600 000 per year	>R600 000 per year	Undisclosed
<b>6</b>	<b>Country/Province of residence: please specify</b>						
<b>7</b>	<b>Dietary preference</b>	No preference	Preference for meat	Vegetarian	Vegan	Other (specify) _____	

**SECTION B (Mark with an X)**

I	<b>How would you rate your understanding of the following ostrich production and management procedures?</b>	<i>Poor/ No knowledge</i>	<i>Limited</i>	<i>Moderate</i>	<i>Knowledgeable</i>	<i>Very knowledgeable</i>
	General ostrich husbandry					
	Transportation of ostriches					
	Handling of ostriches					
	Artificial incubation of eggs					
	Artificial chick rearing					



2	<b>How important do you consider the following factors for the well-being of ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Feed availability					
	Feed quality					
	Water availability					
	Water quality					
	Chick housing					
	Shelters in outside camps					
	Stocking density					
	Body condition of ostriches					
	Internal parasites					
	External parasites					
	Limited stress					
	Absence of pain					
	Ability to exhibit natural behaviour					
	Freedom of movement					
	Environmental enrichment					
3	<b>How important do you consider the following management and production practises for the well-being of ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Manually assisting chicks to hatch					
	Human rearing of chicks (as opposed to natural rearing of chicks by breeding birds)					
	Frequent visual inspection of ostriches					
	Regular handling of ostriches					
	Stockmanship skill/experience					
	Type of vehicle/trailer used for transporting ostriches					
	Isolation of sick/injured birds					
	Preventative medication					

<b>4</b>	<b>How important do you think it is that people involved in ostrich production are knowledgeable with regards to the following?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Anatomy of ostriches					
	Behaviour of ostriches					
	Detecting signs of stress in ostriches					
	Detecting signs of disease/illness in ostriches					
	Handling and restraining of ostriches					
	Transportation of ostriches					
<b>5</b>	<b>How important do you consider the following?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	The welfare of farmed ostriches					
	The welfare of slaughter animals for product quality					
	Animal welfare when buying animal products					
	Implementing a formal welfare protocol for the production of ostriches (meat, leather, feathers)					
<b>6</b>	<b>How likely are you to:</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Buy a product that originates from a welfare conscious farm rather than a product from a welfare neutral farm?					
	Pay more for a product that originates from a welfare conscious farm and production line?					

**SECTION C (Mark with an X, answers are not limited to one option)**

<b>1</b>	<b>Please specify your role in the ostrich industry (processor, researcher, farm worker etc.)</b>					
<b>2</b>	<b>What method of incubation do you prefer to be used in the industry?</b>	<i>Natural incubation and hatching with breeder birds</i>	<i>Artificial incubation and hatching without human assistance</i>	<i>Artificial incubation with human assisted hatching only when necessary (chicks are assisted only when they can't hatch on their own)</i>	<i>Artificial incubation with regular human assisted hatching (eggs are cracked/assisted to hatch)</i>	<i>Neutral / undecided</i>
<b>3</b>	<b>How would you rate the impact of the following on the well-being of the hatched chick?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral / no impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	Natural incubation and hatching with breeder birds					
	Artificial incubation and hatching without human assistance					
	Artificial incubation with human assisted hatching only when necessary (chicks are assisted when they can't hatch on their own)					
	Artificial incubation with regular human assisted hatching (eggs are cracked/assisted to hatch)					
<b>4</b>	<b>What method of chick rearing would you prefer to be used in the industry?</b>	<i>Natural rearing with breeding birds without human assistance</i>	<i>Natural rearing with breeding birds with human assistance</i>	<i>Artificial rearing in extensive systems (pastures)</i>	<i>Artificial rearing in semi-extensive systems</i>	<i>Artificial rearing in intensive systems (dry runs/feedlots)</i>

<b>5</b>	<b>How would you rate the impact of the following rearing methods on the well-being of hatched chicks?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral / No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	Natural rearing with breeding birds without human assistance					
	Natural rearing with breeding birds with human assistance					
	Artificial rearing in extensive systems (pastures)					
	Artificial rearing in semi-extensive systems					
	Artificial rearing in intensive systems (dry runs/feedlots)					
<b>6</b>	<b>What method of toenail clipping would you prefer to be used in the industry?</b>	<i>No clipping</i>	<i>Toenail clipping without cauterization</i>	<i>Toenail clipping with cauterization</i>	<i>Declawing (permanent removal of nail)</i>	<i>Neutral/ undecided</i>
<b>7</b>	<b>How would you rate the impact of the following practises on the well-being of hatched chicks?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral / No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	No toenail clipping					
	Toenail clipping without cauterization					
	Toenail clipping with cauterization					
	Declawing (permanent removal of the nail)					
<b>8</b>	<b>How often would you prefer visual inspection of chicks/birds take place in the industry with regards to body condition/signs of injuries/distress/illness?</b>	<i>Twice daily</i>	<i>Daily</i>	<i>Every other day</i>	<i>Weekly</i>	<i>Less than once a week</i>
<b>9</b>	<b>How important would you consider the rapid treatment of sick/injured birds in the industry?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
<b>10</b>	<b>What mode of action for terminally ill/injured chicks/birds would you prefer to be used in the industry?</b>	<i>Contact veterinarian</i>	<i>Euthanasia-painless killing</i>	<i>Culling- selective slaughter</i>	<i>Other (specify)</i> _____	
<b>11</b>	<b>What method of feather harvesting would you prefer to be used in the industry?</b>	<i>Feather plucking</i>	<i>Feather clipping</i>	<i>Clipping of white feathers, plucking of other feathers</i>	<i>No feather harvesting</i>	<i>Other (specify)</i> _____ _____

<b>12</b>	<b>How would you rate the impact of the following methods of feather harvesting on the well-being of ostriches?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral / No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	Feather plucking					
	Feather clipping					
	Clipping of white feathers, plucking of other feathers					
	No feather harvesting					
<b>13</b>	<b>What method of restraint would you prefer to be used in the industry?</b>	<i>No devices used / man held</i>	<i>Hooks</i>	<i>Crush</i>	<i>Hoods</i>	<i>Other (specify)</i> _____ _____
<b>14</b>	<b>How would you rate the following restraining methods' impact on the well-being of ostriches</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	No devices used/man held					
	Hooks					
	Crush					
	Hoods					
<b>15</b>	<b>When chicks are transported how important do you consider the following for the well-being of the chicks?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Type of vehicle being used					
	The use of crates					
	Stocking density in crates					
	Use of mats in crates					
	Time of day					
	Ventilation					
	Protection against the elements					
	Driver skill/experience					

<b>16</b>	<b>When juvenile/slaughter birds are being transported how important do you consider the following for the well-being of the birds?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Type of vehicle being used					
	Presence of a cover on top					
	Type of flooring					
	Stocking density					
	Time of day					
	Ventilation					
	Presence of workers with the birds					
	Driver skill/experience					
<b>17</b>	<b>How important do you consider the following factors when ostriches are reared?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Extensive human presence/bonding from a young age					
	Familiarity of birds with specific handlers					
	Regular handling and interaction with birds					
<b>18</b>	<b>How likely do you consider improving the welfare of farmed ostriches to increase product quality and therefore income with regards to the following?</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Meat					
	Leather					
	Feathers					
<b>19</b>	<b>How important do you consider the implementation/use of a formal welfare protocol on ostrich farms, to ensure the well-being of the ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
<b>20</b>	<b>How likely do you think farmers would follow such a protocol if they were implemented on farms?</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>

21	<b>Any additional comments?</b>	
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Thank you for participating in this study.

For any queries or feedback please don't hesitate to contact Monique Snyders- email [ostrichsurvey@gmail.com](mailto:ostrichsurvey@gmail.com)

## Appendix C

Questionnaire for Farmers (English Version)

# Farmed Ostrich Welfare Perceptions

Farmed animal welfare is becoming increasingly important and we would like your opinion for a study in the ostrich industry.

This study is part of ongoing research between the University of Stellenbosch and the Western Cape Department of Agriculture in South Africa, aimed at evaluating the well-being of farmed ostriches.

Your participation in this study is entirely voluntary and you are free to decline to participate. Participation and therefore responses to this questionnaire will be kept anonymous and entirely confidential. You are free to withdraw from the study at any point without any consequences. By completing this questionnaire you voluntarily agree to participate in this study.

**Please return all Questionnaires to [ostrichsurvey@gmail.com](mailto:ostrichsurvey@gmail.com)**





**SECTION A (Mark with an X)**

<b>1</b>	<b>Age</b>	<20	20-35	36-50	51-65	>65	
<b>2</b>	<b>Gender</b>	Male	Female	Prefer not to say	Other		
<b>3</b>	<b>Highest level of education</b>	Unschool ed	Primary school	Secondary/High school	Tertiary (College/University)		
<b>4</b>	<b>Occupation: please specify</b>						
<b>5</b>	<b>Income level</b>	<R50 000 per year	R50 000- R200 000 per year	R200 000- R400 000 per year	R400 000- R600 000 per year	>R600 000 per year	Undisclosed
<b>6</b>	<b>Country/Province of residence: please specify</b>						
<b>7</b>	<b>Dietary preference</b>	No preference	Preference for meat	Vegetarian	Vegan	Other (specify) _____	

**SECTION B (Mark with an X)**

1	<b>How would you rate your understanding of the following ostrich production and management procedures?</b>	<i>Poor/ No knowledge</i>	<i>Limited</i>	<i>Moderate</i>	<i>Knowledgeable</i>	<i>Very knowledgeable</i>
	General ostrich husbandry					
	Transportation of ostriches					
	Handling of ostriches					
	Artificial incubation of eggs					
	Human rearing of chicks					
2	<b>How important would you consider the following factors for the well-being of ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Feed availability					
	Feed quality					
	Water availability					
	Water quality					
	Chick housing					
	Shelters in outside camps					
	Stocking density					
	Body condition of ostriches					
	Internal parasites					
	External parasites					
	Limited stress					
	Absence of pain					
	Ability to exhibit natural behaviour					
	Freedom of movement					
	Environmental enrichment					

<b>3</b>	<b>How important would you consider the following management and production practises for the well-being of ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Manually assisting chicks to hatch					
	Human rearing of chicks (as opposed to natural rearing of chicks by breeder birds)					
	Frequent visual inspection of ostriches					
	Regular handling of ostriches					
	Stockmanship skill/experience					
	Type of vehicle/trailer used for transporting ostriches					
	Isolation of sick/injured birds					
	Preventative medication					
<b>4</b>	<b>How important do you think it is that people involved in ostrich production are knowledgeable with regards to the following?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Anatomy of ostriches					
	Behaviour of ostriches					
	Detecting signs of stress in ostriches					
	Detecting signs of disease/illness in ostriches					
	Handling and restraining of ostriches					
	Transporting of ostriches					
<b>5</b>	<b>How important do you consider the following?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	The welfare of farmed ostriches					
	The welfare of slaughter animals for product quality					
	Animal welfare when buying animal products					
	Implementing a formal welfare protocol for the production of ostriches (meat, leather, feathers)					

6	How likely would you be to:	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Buy a product that originates from a welfare conscious farm rather than a product from a welfare neutral farm?					
	Pay more for a product that originates from a welfare conscious farm and production line?					

**SECTION C (Mark with an X, answers are not limited to one option)**

<b>1</b>	<b>Type of farming practice</b>	<i>Hatchery</i>	<i>Chick rearing</i>	<i>Slaughter bird production</i>	<i>Breeder birds</i>	<i>Other (specify)</i> _____
<b>2</b>	<b>Years of experience in any of the following ostrich sectors:</b>	<i>&lt;5 years</i>	<i>5-10 years</i>	<i>10-20 years</i>	<i>20-30 years</i>	<i>&gt;30 years</i>
	Hatchery					
	Rearing					
	Slaughter production					
	Breeder birds					
	Other as mentioned above					
<b>3</b>	<b>Average amount of eggs/birds farmed with per year</b>	_____ eggs and / or _____ birds				
<b>4</b>	<b>What is your preferred method of incubation and hatching?</b>	<i>Natural incubation and hatching with breeder birds</i>	<i>Artificial incubation and hatching without human assistance</i>	<i>Artificial incubation with human assisted hatching only when necessary (chicks are assisted only when they can't hatch on their own)</i>	<i>Artificial incubation with regular human assisted hatching (eggs are cracked/assisted to hatch)</i>	<i>Other (specify)</i> _____ _____ _____ _____ _____
<b>5</b>	<b>How would you rate the impact of the following on the well-being of hatched chicks?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral/ No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	Natural incubation and hatching with breeder birds					
	Artificial incubation and hatching without human assistance					
	Artificial incubation with human assisted hatching only when necessary (chicks are assisted when they can't hatch on their own)					
	Artificial incubation with regular human assisted hatching (eggs are cracked/assisted to hatch)					

6	<b>What is your preferred method of rearing chicks?</b>	<i>Natural rearing with breeder birds without human assistance</i>	<i>Natural rearing with breeder birds with human assistance</i>	<i>Artificial rearing in extensive systems (pastures)</i>	<i>Artificial rearing in semi-extensive systems</i>	<i>Artificial rearing in intensive systems (dry runs/feedlots)</i>
7	<b>How would you rate the impact of the following rearing methods on the well-being of hatched chicks?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral/ No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	Natural rearing with breeder birds without human assistance					
	Natural rearing with breeder birds with human assistance					
	Artificial rearing in extensive systems (pastures)					
	Artificial rearing in semi-extensive systems					
	Artificial rearing in intensive systems (dry runs/feedlots)					
8	<b>What do you prefer regarding toenail clipping of chicks?</b>	<i>No toenail clipping</i>	<i>Toenail clipping without cauterization</i>	<i>Toenail clipping with cauterization</i>	<i>Declawing (permanent removal of the nail)</i>	<i>Neutral/ undecided</i>
9	<b>How would you rate the impact of the following practices on the well-being of ostrich chicks?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral / No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	No toenail clipping					
	Toenail clipping with cauterization					
	Toenail clipping without cauterization					
	Declawing (permanent removal of the nail)					
10	<b>How often does visual inspection of chicks/birds take place with regards to body condition/signs of injuries /distress/illness? (As practised on your farm)</b>	<i>Twice daily</i>	<i>Daily</i>	<i>Every other day</i>	<i>Weekly</i>	<i>Less than once a week</i>
11	<b>How important would you rate the rapid treatment of sick/injured birds?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
12	<b>What is your preferred mode of action for terminally ill/injured chicks/birds?</b>	<i>Contact veterinarian</i>	<i>Euthanasia-painless killing (specify method)</i>	<i>Cull- selective slaughter (specify method)</i>	<i>Other (specify)</i>	

			_____	_____	_____	
			_____	_____	_____	
			_____	_____	_____	
13	<b>What is your preferred method of feather harvesting?</b>	<i>Feather plucking</i>	<i>Feather clipping</i>	<i>Clipping of white feathers, plucking of other feathers</i>	<i>No feather harvesting</i>	<i>Other (specify)</i> _____ _____ _____
14	<b>How would you rate the impact of the following methods of feather harvesting on the well-being of ostriches?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral / No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	Feather plucking					
	Feather clipping					
	Clipping of white feathers, plucking of other feathers					
	No feather harvesting					
15	<b>What is your preferred method of restraining ostriches?</b>	<i>No devices used / man held</i>	<i>Hooks</i>	<i>Crush</i>	<i>Hoods</i>	<i>Other (specify)</i> _____ _____ _____
16	<b>How would you rate the impact of the following restraining methods on the well-being of ostriches?</b>	<i>Strong negative impact</i>	<i>Slight negative impact</i>	<i>Neutral/ No impact</i>	<i>Slight positive impact</i>	<i>Strong positive impact</i>
	No devices used/man held					
	Hooks					
	Crush					
	Hoods					

17	<b>When transporting chicks how important do you consider the following for the well-being of the chicks?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Type of vehicle being used					
	The use of crates					
	Stocking density in crates					

	Use of mats in crates					
	Time of day					
	Ventilation					
	Protection against the elements					
	Driver skill/experience					
<b>18</b>	<b>When transporting juvenile/slaughter birds how important do you consider the following for the well-being of the birds?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Type of vehicle to be used					
	Presence of a cover on top					
	Type of flooring					
	Stocking density					
	Time of day					
	Ventilation					
	Presence of workers with the birds					
	Driver skill/experience					
<b>19</b>	<b>How likely are birds to be injured during the following?</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Handling					
	Moving between camps					
	Transportation					

<b>20</b>	<b>How likely are birds to show the following behaviour when birds have been moved to different camps?</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Running up and down					
	Spinning/dancing/twirling					
	Vocalization					
	Kicking/hissing at each other					
	Trampling each other					



	Stop feeding					
	Stop drinking					
2 1	<b>How likely are birds to show the following behaviour when they have been moved to holding/loading camps before transport?</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Fearfulness					
	Running up and down					
	Spinning/dancing/twirling					
	Vocalization					
	Kicking/hissing at each other					
	Trampling each other					
	Climbing on top of each other					
2 2	<b>How important do you consider the following factors when ostriches are reared?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
	Extensive human presence/bonding from a young age					
	Familiarity of birds with specific handlers					
	Regular handling and interaction with birds					
2 3	<b>How likely do you think improving the well-being of farmed ostriches will increase product quality of the following?</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>
	Meat					
	Leather					
	Feathers					
2 4	<b>How important would you rate the implementation/use of a formal welfare protocol on the farm, to ensure the well-being of ostriches?</b>	<i>Not important</i>	<i>Less important</i>	<i>Neutral</i>	<i>Important</i>	<i>Very important</i>
2 5	<b>How likely are you to follow such a protocol if one was implemented on your farm?</b>	<i>Not likely</i>	<i>Less likely</i>	<i>Neutral</i>	<i>Likely</i>	<i>Very likely</i>

2 6	Any additional comments?	
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Thank you for your participation in this study

For any queries or feedback please don't hesitate to contact Monique Snyders- email [ostrichsurvey@gmail.com](mailto:ostrichsurvey@gmail.com)

## Appendix D

Questionnaire for Consumers (Afrikaans Version)

# Welsynspersepsies in die Volstruisbedryf

Die welsyn van produksiediere word toenemend belangrik geag en ons wil graag u opinie hê vir 'n studie in die volstruisbedryf.

Hierdie studie is deel van huidige navorsing tussen die Universiteit van Stellenbosch en die Departement van Landbou, Wes-Kaap in Suid Afrika, wat gemik is op die evaluasie van volstruise se welsyn.

Hierdie navorsing is goedgekeur deur die Navorsings Etiese Komitee (REC- Humanities) van die Universiteit van Stellenbosch (Verwysingsnommer: 7699).

U deelname in hierdie studie is heeltemal vrywillig en u is vry om te weier om deel te neem. Deelname en antwoorde word heeltemal anoniem en vertroulik gehou. U is vry om op enige punt van die studie te onttrek sonder enige nagevolge. Deur die vraelys in te vul stem u vrywillig in om aan die studie deel te neem.

**Stuur asseblief alle vraelyste terug na [volstruisvraelys@gmail.com](mailto:volstruisvraelys@gmail.com)**

**AFDELING A (Merk met 'n X)**

<b>1</b>	<b>Ouderdom</b>	<20	20-35	36-50	51-65	>65	
<b>2</b>	<b>Geslag</b>	Manlik	Vroulik	Verkies om nie te sê nie	Ander		
<b>3</b>	<b>Hoogste vlak van onderrig</b>	Ongeskoold	Primêre skool/Laerskool	Sekondêre / Hoërskool	Tersiêre opleiding (Kollege / Universiteit)		
<b>4</b>	<b>Beroep: spesifiseer asseblief</b>						
<b>5</b>	<b>Inkomste vlak</b>	<R50 000 per jaar	R50 000- R200 000 per jaar	R200 000- R400 000 per jaar	R400 000- R600 000 per jaar	>R600 000 per jaar	Onvermeld / privaat
<b>6</b>	<b>Land/provinsie woonagtig: spesifiseer asseblief</b>						
<b>7</b>	<b>Dieët voorkeur</b>	Geen voorkeur	Voorkeur vir vleis	Vegetaries	Vegan	Ander (spesifiseer) _____	

**AFDELING B (Merk met 'n X)**

1	Hoe sal u, u kennis van die volgende volstruisproduksie- en bestuursaspekte beskryf?	<i>Swak/geen kennis</i>	<i>Beperkte kennis</i>	<i>Matige kennis</i>	<i>Kundig</i>	<i>Baie kundig</i>
	Algemene volstruisboerdery					
	Vervoer van volstruise					
	Hantering van volstruise					
	Kunsmatige broei van eiers					
	Kunsmatige grootmaak van kuikens					
2	Hoe belangrik ag u die volgende faktore vir die welstand van volstruise?	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Voer beskikbaarheid					
	Voer kwaliteit					
	Water beskikbaarheid					
	Water kwaliteit					
	Kuiken behuising					
	Buitenhuse skuilings					
	Veedigheid					
	Liggaamstoestand van volstruise					
	Interne parasiete					
	Eksterne parasiete					
	Beperkte stres					
	Afwesigheid van pyn					
	Vryheid om natuurlike gedrag te toon					
	Vryheid van beweging					
	Omgewingsverryking					

<b>3</b>	<b>Hoe belangrik ag u die volgende produksie en bestuursaspekte vir die welstand van volstruise?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Uitbroei van kuikens met menslike hulpverlening/bystand					
	Kunsmatige grootmaak van kuikens (in teenstelling met natuurlike grootmaak deur broeivoëls)					
	Gereelde visuele inspeksie van volstruise					
	Gereelde hantering van volstruise					
	Vaardigheid, kundigheid en ondervinding van hanteerders					
	Tipe vervoermiddel gebruik vir vervoer van volstruise					
	Isolasie van siek/beseerde voëls					
	Toedien van voorkomende medikasie					
<b>4</b>	<b>Hoe belangrik ag u dit dat mense betrokke in volstruisproduksie kundig/vaardig en vertrouwd is met die volgende?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Volstruis anatomie					
	Volstruis gedrag					
	Identifisering van simptome van stres					
	Identifisering van simptome van siektes/beserings					
	Hantering van volstruise					
	Vervoer van volstruise					
<b>5</b>	<b>Hoe belangrik ag u die volgende?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Die welsyn van volstruise					
	Die welsyn van slagdiere vir produkkwaliteit					
	Dierewelsyn ten opsigte van u besluit om diereprodukte te koop					
	Die implementering van 'n formele welsynsprotokol vir volstruise, vir die produksie van vleis, vere en leer					

<b>6</b>	<b>Hoe waarskynlik sal u wees om:</b>	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
	'n Produk aan te koop wat van 'n welsynsbewuste plaas eerder as 'n welsyn neutrale plaas afkomstig is?					
	Meer te betaal vir 'n produk wat afkomstig is van 'n welsynsbewuste plaas en produksielyn?					
<b>7</b>	<b>Enige verdere kommentaar?</b>					

Dankie vir u deelname in hierdie studie.

Vir enige navrae of terugvoer moet asseblief nie huiwer om vir Monique Snyders by [volstruisvraelys@gmail.com](mailto:volstruisvraelys@gmail.com) te kontak nie.

## Appendix E

Questionnaire for Stakeholders (Afrikaans Version)

# Welsynspersepsies in die Volstruisbedryf

Die welsyn van produksiediere word toenemend belangrik geag en ons wil graag u opinie hê vir 'n studie in die volstruisbedryf.

Hierdie studie is deel van huidige navorsing tussen die Universiteit van Stellenbosch en die Departement van Landbou, Wes-Kaap in Suid Afrika, wat gemik is op die evaluasie van volstruise se welsyn.

Hierdie navorsing is goedgekeur deur die Navorsings Etiese Komitee (REC- Humanities) van die Universiteit van Stellenbosch (Verwysingsnommer: 7699).

U deelname in hierdie studie is heeltemal vrywillig en u is vry om te weier om deel te neem. Deelname en antwoorde word heeltemal anoniem en vertroulik gehou. U is vry om op enige punt van die studie te onttrek sonder enige nagevolg. Deur die vraelys in te vul stem u vrywillig in om aan die studie deel te neem.

**Stuur asseblief alle vraelyste terug na [volstruisvraelys@gmail.com](mailto:volstruisvraelys@gmail.com)**





**AFDELING A (Merk met 'n X)**

<b>1</b>	<b>Ouderdom</b>	<20	20-35	36-50	51-65	>65	
<b>2</b>	<b>Geslag</b>	Manlik	Vroulik	Verkies om nie te sê nie	Ander		
<b>3</b>	<b>Hoogste vlak van onderrig</b>	Ongeskoold	Primêre skool/Laerskool	Sekondêre / Hoërskool	Tersiêre opleiding (Kollege / Universiteit)		
<b>4</b>	<b>Beroep: spesifiseer asseblief</b>						
<b>5</b>	<b>Inkomste vlak</b>	<R50 000 per jaar	R50 000- R200 000 per jaar	R200 000- R400 000 per jaar	R400 000- R600 000 per jaar	>R600 000 per jaar	Onvermeld / privaat
<b>6</b>	<b>Land/provinsie woonagtig: spesifiseer asseblief</b>						
<b>7</b>	<b>Dieët voorkeur</b>	Geen voorkeur	Voorkeur vir vleis	Vegetaries	Vegan	Ander (spesifiseer) _____	

**AFDELING B (Merk met 'n X)**

1	Hoe sal u, u kennis van die volgende volstruisproduksie- en bestuursaspekte beskryf?	<i>Swak/geen kennis</i>	<i>Beperkte kennis</i>	<i>Matige kennis</i>	<i>Kundig</i>	<i>Baie kundig</i>
	Algemene volstruisboerdery					
	Vervoer van volstruise					
	Hantering van volstruise					
	Kunsmatige broei van eiers					
	Kunsmatige grootmaak van kuikens					
2	Hoe belangrik ag u die volgende faktore vir die welstand van volstruise?	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Voer beskikbaarheid					
	Voer kwaliteit					
	Water beskikbaarheid					
	Water kwaliteit					
	Kuiken behuising					
	Buitenhuse skuilings					
	Veedigheid					
	Liggaamstoestand van volstruise					
	Interne parasiete					
	Eksterne parasiete					
	Beperkte stres					
	Afwesigheid van pyn					
	Vryheid om natuurlike gedrag te toon					
	Vryheid van beweging					
	Omgewingsverryking					

<b>3</b>	<b>Hoe belangrik ag u die volgende produksie en bestuursaspekte vir die welstand van volstruise?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Uitbroei van kuikens met menslike hulpverlening/bystand					
	Kunsmatige grootmaak van kuikens (in teenstelling met natuurlike grootmaak deur broeivoëls)					
	Gereelde visuele inspeksie van volstruise					
	Gereelde hantering van volstruise					
	Vaardigheid, kundigheid en ondervinding van hanteerders					
	Tipe vervoermiddel gebruik vir vervoer van volstruise					
	Isolasie van siek/beseerde voëls					
	Toedien van voorkomende medikasie					
<b>4</b>	<b>Hoe belangrik ag u dit dat mense betrokke in volstruisproduksie kundig/vaardig en vertrouwd is met die volgende?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Volstruis anatomie					
	Volstruis gedrag					
	Identifisering van simptome van stres					
	Identifisering van simptome van siektes/beserings					
	Hantering van volstruise					
	Vervoer van volstruise					
<b>5</b>	<b>Hoe belangrik ag u die volgende?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Die welsyn van volstruise					
	Die welsyn van slagdiere vir produkkwaliteit					
	Dierewelsyn ten opsigte van u besluit om diereprodukte te koop					
	Die implementering van 'n formele welsynsprotokol vir volstruise, vir die produksie van vleis, vere en leer					

6	Hoe waarskynlik sal u wees om:	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
	'n Produk aan te koop wat van 'n welsynsbewuste plaas eerder as 'n welsyn neutrale plaas afkomstig is?					
	Meer te betaal vir 'n produk wat afkomstig is van 'n welsynsbewuste plaas en produksielyn?					

**AFDELING C (Merk met 'n X, antwoorde is nie beperk tot net een opsie nie)**

<b>1</b>	<b>Spesifiseer asseblief u rol in die volstruisbedryf (prosesseerder, plaaswerker, navorser, ens.)</b>					
<b>2</b>	<b>Watter metode van broei verkies u moet in die bedryf gebruik word?</b>	<i>Natuurlike broei by broeivoëls</i>	<i>Kunsmatige broei sonder menslike hulpverlening</i>	<i>Kunsmatige broei met menslike hulpverlening net indien nodig (kuikens word gehelp om uit te broei indien hulle dit nie self kan doen nie)</i>	<i>Kunsmatige broei met gereelde menslike hulpverlening (eiers word gekraak/kuikens word gehelp om uit te broei)</i>	<i>Ander (spesifiseer)</i> _____ _____ _____ _____
<b>3</b>	<b>Hoe sal u die impak van die volgende op die welstand van volstruise ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Natuurlike broei by broeivoëls					
	Kunsmatige broei sonder menslike hulpverlening					
	Kunsmatige broei met menslike hulpverlening net indien nodig (kuikens word gehelp om uit te broei indien hulle dit nie self kan doen nie)					
	Kunsmatige broei met gereelde menslike hulpverlening (eiers word gekraak/kuikens word gehelp om uit te broei)					

4	<b>Watter metode van kuikengrootmaak verkies u moet in die bedryf gebruik word?</b>	<i>Natuurlike grootmaak deur broeivoëls sonder menslike hulpverlening</i>	<i>Natuurlike grootmaak deur broeivoëls met menslike hulpverlening</i>	<i>Kunsmatige grootmaak in ekstensiewe sisteme (weiding/velde)</i>	<i>Kunsmatige grootmaak in semi-ekstensiewe sisteme</i>	<i>Kunsmatige grootmaak in intensiewe sisteme (kuikenhuise / voerkrale)</i>
5	<b>Hoe sal u die impak van die volgende op die welstand van volstruise ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Natuurlike grootmaak deur broeivoëls sonder menslike hulpverlening					
	Natuurlike grootmaak deur broeivoëls met menslike hulpverlening					
	Kunsmatige grootmaak in ekstensiewe sisteme (weiding/velde)					
	Kunsmatige grootmaak in semi-ekstensiewe sisteme					
	Kunsmatige grootmaak in intensiewe sisteme (kuikenhuise/voerkrale)					
6	<b>Wat is u voorkeur met betrekking tot die knip van kuikens se toonnaels in die bedryf?</b>	<i>Toonnaels word nie geknip nie</i>	<i>Toonnaels word geknip sonder seël van wond met hitte</i>	<i>Toonnaels word knip en geseël met hitte</i>	<i>Permanente verwydering van die toonnael</i>	<i>Neutraal/geen voorkeur</i>
7	<b>Hoe sal u die impak van die volgende praktyke op die welstand van kuikens ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Toonnaels word nie geknip nie					
	Toonnaels word geknip sonder seël van wond met hitte					
	Toonnaels word geknip en geseël met hitte					
	Permanente verwydering van die toonnael					
8	<b>Hoe gereeld sal u verkies dat visuele inspeksie van voëls in die bedryf plaasvind, met</b>	<i>Twee maal per dag</i>	<i>Daaglik</i>	<i>Elke tweede dag</i>	<i>Weeklik</i>	<i>Minder gereeld as een keer per week</i>

	<b>betrekking tot liggaamskondisie/tekens van siektes/beserings/stres?</b>					
<b>9</b>	<b>Hoe belangrik ag u die onmiddellike behandeling van siek/beseerde voëls?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
<b>10</b>	<b>Wat is u voorkeur met betrekking tot terminaal siek/beseerde kuikens/voëls in die bedryf?</b>	<i>Kontak u veearts</i>	<i>Genadedood- (spesifiseer metode)</i> _____ _____	<i>Slag (spesifiseer metode)</i> _____ _____	<i>Ander (spesifiseer)</i> _____ _____ _____	
<b>11</b>	<b>Wat is u voorkeur metode vir vere oes in die bedryf?</b>	<i>Vere word gepluk</i>	<i>Vere word geknip</i>	<i>Wit vere word geknip, ander vere word gepluk</i>	<i>Geen vere word geoes nie</i>	<i>Ander (spesifiseer)</i> _____ _____
<b>12</b>	<b>Hoe sal u die impak van die volgende vere oes metodes op die welstand van volstruise ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Vere word gepluk					
	Vere word geknip					
	Wit vere word geknip en ander vere word gepluk					
	Geen vere word geoes nie					
<b>13</b>	<b>Wat is u voorkeur volstruis vang/hanteringsmetode in die bedryf?</b>	<i>Geen toestelle gebruik nie/vang met die hand</i>	<i>Gebruik van 'n haak/vangstok</i>	<i>Gebruik van 'n driehoekige blinde drukgang/hanteringsboks</i>	<i>Gebruik van kappies/kous oor die kop</i>	<i>Ander (spesifiseer)</i> _____ _____
<b>14</b>	<b>Hoe sal u die impak van die volgende vang/hanteringsmetodes op die welstand van volstruise ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Geen toestelle gebruik nie/vang met die hand					
	Gebruik van 'n haak/vangstok					
	Gebruik van 'n driehoekige blinde drukgang/hanteringsboks					

	Gebruik van kappies/kous oor die kop					
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<b>1 5</b>	<b>Hoe belangrik ag u die volgende vir die welstand van kuikens tydens vervoer?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Tipe voertuig gebruik					
	Die gebruik van kratte					
	Aantal kuikens in die kratte					
	Gebruik van matte in die kratte					
	Tyd van die dag tydens vervoer					
	Ventilasie					
	Beskerming teen die elemente					
	Vaardigheid/kundigheid en ervaring van die drywer					
<b>1 6</b>	<b>Hoe belangrik ag u die volgende vir die welstand van jong/slagvoëls tydens vervoer?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Tipe vervoermiddel gebruik					
	Bedekking aan die bo-kant					
	Tipe vloer					
	Digtheid					
	Tyd van die dag tydens vervoer					
	Ventilasie					
	Teenwoordigheid van werkers by die voëls					
	Vaardigheid/kundigheid en ervaring van die drywer					
<b>1 7</b>	<b>Hoe belangrik ag u die volgende faktore wanneer volstruiskuikens grootgemaak word?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Gereelde menslike teenwoordigheid/vorm van 'n band met kuiken vanaf 'n jong ouderdom					
	Bekendheid van voëls met spesifieke hanteerders					
	Gereelde hantering en interaksie met voëls					
<b>1 8</b>	<b>Hoe waarskynlik dink u sal 'n verbetering in die welstand van volstruise die produk kwaliteit van die volgende verhoog?</b>	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>



	Vleis					
	Leer					
	Vere					
19	Hoe belangrik ag u die implementering van 'n formele welsynsprotokol op plase in die bedryf om die welstand van volstruise te verseker?	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
20	Hoe waarskynlik dink u sal boere so protokol volg indien dit op plase in die industrie inwerkstelling sou tree?	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
21	Enige verdere kommentaar?					

Dankie vir u deelname in hierdie studie.

Vir enige navrae of terugvoer moet asseblief nie huiwer om vir Monique Snyders by [volstruisvraelys@gmail.com](mailto:volstruisvraelys@gmail.com) te kontak nie.

## Appendix F

Questionnaire for Farmers (Afrikaans Version)

# Welsynspersepsies in die Volstruisbedryf

Die welsyn van produksiediere word toenemend belangrik geag en ons wil graag u opinie hê vir 'n studie in die volstruisbedryf.

Hierdie studie is deel van huidige navorsing tussen die Universiteit van Stellenbosch en die Departement van Landbou, Wes-Kaap in Suid Afrika, wat gemik is op die evaluasie van volstruise se welsyn.

Hierdie navorsing is goedgekeur deur die Navorsings Etiese Komitee (REC- Humanities) van die Universiteit van Stellenbosch (Verwysingsnommer: 7699).

U deelname in hierdie studie is heeltemal vrywillig en u is vry om te weier om deel te neem. Deelname en antwoorde word heeltemal anoniem en vertroulik gehou. U is vry om op enige punt van die studie te onttrek sonder enige nagevolge. Deur die vraelys in te vul stem u vrywillig in om aan die studie deel te neem.

**Stuur asseblief alle vraelyste terug na [volstruisvraelys@gmail.com](mailto:volstruisvraelys@gmail.com)**

**AFDELING A (Merk met 'n X)**

<b>1</b>	<b>Ouderdom</b>	<20	20-35	36-50	51-65	>65	
<b>2</b>	<b>Geslag</b>	Manlik	Vroulik	Verkies om nie te sê nie	Ander		
<b>3</b>	<b>Hoogste vlak van onderrig</b>	Ongeskool	Primêre skool/Laerskool	Sekondêre / Hoërskool	Tersiêre opleiding (Kollege / Universiteit)		
<b>4</b>	<b>Beroep: spesifiseer asseblief</b>						
<b>5</b>	<b>Inkomste vlak</b>	<R50 000 per jaar	R50 000- R200 000 per jaar	R200 000- R400 000 per jaar	R400 000- R600 000 per jaar	>R600 000 per jaar	Onvermeld / privaat
<b>6</b>	<b>Land/provinsie woonagtig: spesifiseer asseblief</b>						
<b>7</b>	<b>Dieët voorkeur</b>	Geen voorkeur	Voorkeur vir vleis	Vegetaries	Vegan	Ander (spesifiseer) _____	

**AFDELING B (Merk met 'n X)**

1	Hoe sal u, u kennis van die volgende volstruisproduksie- en bestuursaspekte beskryf?	<i>Swak/geen kennis</i>	<i>Beperkte kennis</i>	<i>Matige kennis</i>	<i>Kundig</i>	<i>Baie kundig</i>
	Algemene volstruisboerdery					
	Vervoer van volstruise					
	Hantering van volstruise					
	Kunsmatige broei van eiers					
	Kunsmatige grootmaak van kuikens					
2	Hoe belangrik ag u die volgende faktore vir die welstand van volstruise?	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Voer beskikbaarheid					
	Voer kwaliteit					
	Water beskikbaarheid					
	Water kwaliteit					
	Kuiken behuising					
	Buithuise skuilings					
	Veedigheid					
	Liggaamstoestand van volstruise					
	Interne parasiete					
	Eksterne parasiete					
	Beperkte stres					
	Afwesigheid van pyn					
	Vryheid om natuurlike gedrag te toon					
	Vryheid van beweging					
	Omgewingsverryking					

<b>3</b>	<b>Hoe belangrik ag u die volgende produksie en bestuursaspekte vir die welstand van volstruise?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Uitbroei van kuikens met menslike hulpverlening/bystand					
	Kunsmatige grootmaak van kuikens (in teenstelling met natuurlike grootmaak deur broeivoëls)					
	Gereelde visuele inspeksie van volstruise					
	Gereelde hantering van volstruise					
	Vaardigheid, kundigheid en ondervinding van hanteerders					
	Tipe vervoermiddel gebruik vir vervoer van volstruise					
	Isolasie van siek/beseerde voëls					
	Toedien van voorkomende medikasie					
<b>4</b>	<b>Hoe belangrik ag u dit dat mense betrokke in volstruisproduksie kundig/vaardig en vertrouwd is met die volgende?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Volstruis anatomie					
	Volstruis gedrag					
	Identifisering van simptome van stres					
	Identifisering van simptome van siektes/beserings					
	Hantering van volstruise					
	Vervoer van volstruise					
<b>5</b>	<b>Hoe belangrik ag u die volgende?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Die welsyn van volstruise					
	Die welsyn van slagdiere vir produkkwaliteit					
	Dierewelsyn ten opsigte van u besluit om diereprodukte te koop					
	Die implementering van 'n formele welsynsprotokol vir volstruise, vir die produksie van vleis, vere en leer					

6	Hoe waarskynlik sal u wees om:	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
	'n Produk aan te koop wat van 'n welsynsbewuste plaas eerder as 'n welsyn neutrale plaas afkomstig is?					
	Meer te betaal vir 'n produk wat afkomstig is van 'n welsynsbewuste plaas en produksielyn?					

**AFELING C (Merk met 'n X, antwoorde is nie beperk tot net een opsie nie)**

<b>1</b>	<b>Tipe boerdery</b>	<i>Broeiery</i>	<i>Kuikengrootmaak</i>	<i>Slagvoël produksie</i>	<i>Broeivoëls</i>	<i>Ander (spesifiseer)</i> _____ _____
<b>2</b>	<b>Jare ervaring in enige van die volgende volstruisbedryf afdeling</b>	<i>&lt;5 jaar</i>	<i>5-10 jaar</i>	<i>10-20 jaar</i>	<i>20-30 jaar</i>	<i>&gt;30 jaar</i>
	Broeiery					
	Kuikengrootmaak					
	Slagvoël produksie					
	Broeivoëls					
	Ander (soos bo gespesifiseer)					
<b>3</b>	<b>Gemiddelde aantal eiers/voëls mee geboer per jaar</b>	_____ eiers en/of _____ voëls				

4	<b>Watter metode van broei verkies u?</b>	<i>Natuurlike broei by broeivoëls</i>	<i>Kunsmatige broei sonder menslike hulpverlening</i>	<i>Kunsmatige broei met menslike hulpverlening net indien nodig (kuikens word gehelp om uit te broei indien hulle dit nie self kan doen nie)</i>	<i>Kunsmatige broei met gereelde menslike hulpverlening (eiers word gekraak/kuikens word gehelp om uit te broei)</i>	<i>Ander (spesifiseer)</i> _____ _____ _____ _____
5	<b>Hoe sal u die impak van die volgende op die welstand van volstruise ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Natuurlike broei by broeivoëls					
	Kunsmatige broei sonder menslike hulpverlening					
	Kunsmatige broei met menslike hulpverlening net indien nodig (Kuikens word gehelp om uit te broei indien hulle dit nie self kan doen nie)					
	Kunsmatige broei met gereelde menslike hulpverlening (eiers word gekraak/kuikens word gehelp om uit te broei)					
6	<b>Watter metode van kuikengrootmaak verkies u?</b>	<i>Natuurlike grootmaak deur broeivoëls sonder menslike hulpverlening</i>	<i>Natuurlike grootmaak deur broeivoëls met menslike hulpverlening</i>	<i>Kunsmatige grootmaak in ekstensiewe sisteme (weiding/velde)</i>	<i>Kunsmatige grootmaak in semi-ekstensiewe sisteme</i>	<i>Kunsmatige grootmaak in intensiewe sisteme (kuikenhuise / voerkrale)</i>
7	<b>Hoe sal u die impak van die volgende op die welstand van volstruise ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Natuurlike grootmaak deur broeivoëls sonder menslike hulpverlening					
	Natuurlike grootmaak deur broeivoëls met menslike hulpverlening					
	Kunsmatige grootmaak in ekstensiewe sisteme					
	Kunsmatige grootmaak in semi-ekstensiewe sisteme					



	Kunsmatige grootmaak in intensiewe sisteme.					
8	<b>Wat is u voorkeur met betrekking tot die knip van kuikens se toonnaels?</b>	<i>Toonnaels word nie geknip nie</i>	<i>Toonnaels word geknip sonder seël van wond met hitte</i>	<i>Toonnaels word knip en geseël met hitte</i>	<i>Permanente verwydering van die toonnael</i>	<i>Neutraal/geen voorkeur</i>
9	<b>Hoe sal u die impak van die volgende praktyke op die welstand van kuikens ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Toonnaels word nie geknip nie					
	Toonnaels word geknip sonder seël van wond met hitte					
	Toonnaels word geknip en geseël met hitte					
	Permanente verwydering van die toonnael					
10	<b>Hoe gereeld vind visuele inspeksie van kuikens/voëls plaas ten opsigte van liggaamskondisie/tekens van beserings/siekte/stres? (Soos op u plaas gedoen)</b>	<i>Twee maal per dag</i>	<i>Daaglik</i>	<i>Elke tweede dag</i>	<i>Weeklik</i>	<i>Minder gereeld as een keer per week</i>
11	<b>Hoe belangrik ag u die onmiddellike behandeling van siek/beseerde voëls?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
12	<b>Wat is u voorkeur met betrekking tot terminaal siek/beseerde kuikens/voëls?</b>	<i>Kontak u veearts</i>	<i>Genadedood- (spesifiseer metode)</i> _____ _____	<i>Slag (spesifiseer metode)</i> _____ _____	<i>Ander (spesifiseer)</i> _____ _____ _____	
13	<b>Wat is u voorkeur metode vir vere oes op die plaas?</b>	<i>Vere word gepluk</i>	<i>Vere word geknip</i>	<i>Wit vere word geknip, ander vere word gepluk</i>	<i>Geen vere word geoes nie</i>	<i>Ander (spesifiseer)</i> _____ _____ _____
14	<b>Hoe sal u die impak van die volgende metodes van vere oes op die welstand van volstruise ag/beoordeel?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>

	Vere word gepluk					
	Vere word geknip					
	Wit vere word geknip en ander vere word gepluk					
	Geen vere word geoes nie					
<b>15</b>	<b>Wat is u voorkeur volstruis vang/hanteringsmetode?</b>	<i>Geen toestelle gebruik nie/vang met die hand</i>	<i>Gebruik van 'n haak/vangstok</i>	<i>Gebruik van 'n driehoekige blinde drukgang/hanteringsboks</i>	<i>Gebruik van kappies /kous oor die kop</i>	<i>Ander (spesifiseer)</i> _____ _____
<b>16</b>	<b>Hoe sal u die impak van die volgende vang/hanteringsmetode op die welstand van volstruis ag?</b>	<i>Sterk negatiewe impak</i>	<i>Effense negatiewe impak</i>	<i>Neutraal/geen impak</i>	<i>Effense positiewe impak</i>	<i>Sterk positiewe impak</i>
	Geen toestelle gebruik nie/vang met die hand					
	Gebruik van 'n haak/vangstok					
	Gebruik van 'n driehoekige blinde drukgang/hanteringsboks					
	Gebruik van kappies/kous oor die kop					
<b>17</b>	<b>Hoe belangrik ag u die volgende vir die welstand van kuikens tydens vervoer?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Tipe voertuig gebruik					
	Die gebruik van kratte					
	Aantal kuikens in die kratte					
	Gebruik van matte in die kratte					
	Tyd van die dag tydens vervoer					
	Ventilasie					
	Beskerming teen die elemente					
	Vaardigheid/kundigheid en ervaring van die drywer					
<b>18</b>	<b>Hoe belangrik ag u die volgende vir die welstand van jong/slagvoëls tydens vervoer?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Tipe vervoermiddel gebruik					
	Bedekking aan die bo-kant					
	Tipe vloer					
	Digtheid					
	Tyd van die dag tydens vervoer					

Ventilasie					
Teenwoordigheid van werkers by die voëls					
Vaardigheid/kundigheid en ervaring van die drywer					

<b>1 9</b>	<b>Hoe waarskynlik is dit dat voëls beseer word tydens die volgende?</b>	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
	Hantering					
	Skuif tussen kampe					
	Vervoer					
<b>2 0</b>	<b>Hoe waarskynlik toon voëls die volgende gedrag nadat hulle van kamp verskuif is?</b>	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
	Hardloop op en af					
	Draai in die rondte/dans					
	Maak geraas/geluide					
	Skop na en blaas vir mekaar					
	Vertrap mekaar					
	Gebrek aan aptyt (hou op eet)					
	Hou op water drink					
<b>2 1</b>	<b>Hoe waarskynlik toon voëls die volgende gedrag nadat hulle na hou/laai kampe verskuif is voor vervoer?</b>	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
	Lyk vreesbevange					
	Hardloop op en af					
	Draai in die rondte/dans					
	Maak geraas/geluide					
	Skop na en blaas vir mekaar					
	Vertrap mekaar					
	Klim bo-op mekaar					
<b>2 2</b>	<b>Hoe belangrik ag u die volgende faktore wanneer volstruiskuike grootgemaak word?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
	Gereelde menslike teenwoordigheid/vorm van 'n band met kuiken vanaf 'n jong ouderdom					
	Bekendheid van voëls met spesifieke hanteerders					

	Gereelde hantering en interaksie met voëls					
2 3	<b>Hoe waarskynlik dink u sal 'n verbetering in die welstand van volstruise produkkwaliteit van die volgende verhoog?</b>	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
	Vleis					
	Leer					
	Vere					
2 4	<b>Hoe belangrik ag u die implementering van 'n formele welsynsprotokol op die plaas om die welstand van volstruise te verseker?</b>	<i>Nie belangrik nie</i>	<i>Minder belangrik</i>	<i>Neutraal</i>	<i>Belangrik</i>	<i>Baie belangrik</i>
2 5	<b>Hoe waarskynlik sal u so 'n protokol volg indien dit op u plaas geimplimenteer sou word?</b>	<i>Nie waarskynlik nie</i>	<i>Minder waarskynlik</i>	<i>Neutraal</i>	<i>Waarskynlik</i>	<i>Baie waarskynlik</i>
2 6	<b>Enige verdere kommentaar?</b>					

Dankie vir u deelname in hierdie studie.

Vir enige navrae of terugvoer moet asseblief nie huiwer om vir Monique Snyders by [volstruisvraelys@gmail.com](mailto:volstruisvraelys@gmail.com) te kontak nie.

## **Appendix G**

### **Development of an on-farm welfare evaluation protocol for farmed ostriches**

After a thorough literature review and consultation with industry specialists (scientists, veterinarians) the physiological, health and behavioural requirements of ostrich chicks and juveniles was established based on the Welfare Quality® principles that revolves around the four welfare principles (good feeding, good housing, good health and appropriate behaviour) as previously described by Keeling and Veisser (2005) for other livestock species (i.e. pigs and poultry). Based on these principles a list of welfare criteria and scores was developed (see Table 1 below). The principles and welfare criteria listed were tailored especially to ostriches, and formed the basis of the on-farm welfare evaluation protocol that aimed to gather information about the current welfare status of the ostrich industry and husbandry practices currently used by commercial farmers.

Table 1 Welfare criteria and measures for the on-farm welfare assessment of ostrich chicks and juveniles.

Welfare principle	Welfare criteria	Measures
Good feeding	Absence of prolonged hunger Absence of prolonged thirst	<ul style="list-style-type: none"> <li>• Access to feed</li> <li>• Body condition score</li> <li>• Access to water</li> </ul>
Good housing/facilities	Comfort when resting Thermal comfort Ease of movement Freedom of movement Appropriate facilities	<ul style="list-style-type: none"> <li>• Plumage cleanliness</li> <li>• Panting</li> <li>• Huddling</li> <li>• Activity level</li> <li>• Thermoregulation support</li> <li>• Stocking density</li> <li>• Mobility</li> <li>• Outdoor access</li> <li>• Housing facilities</li> <li>• Handling facilities</li> <li>• Floor quality/cleanliness in chick houses</li> <li>• Air quality/ventilation in chick houses</li> <li>• Enrichment measures</li> </ul>
Good health	Absence of injuries Absence of disease Absence of pain induced by management	<ul style="list-style-type: none"> <li>• Leg deformities</li> <li>• Injuries</li> <li>• Bruises</li> <li>• On-farm mortalities</li> <li>• On-farm culls</li> <li>• Diarrhoea</li> <li>• Skin infections</li> <li>• Respiratory problems</li> <li>• Prolapse</li> <li>• Parasites</li> <li>• Symptoms of ill health</li> <li>• Toenail clipping</li> <li>• Feather collection</li> <li>• Use of beak rings</li> <li>• Method of identification</li> </ul>
Appropriate behaviour	Expression of social behaviours Expression of other behaviours	<ul style="list-style-type: none"> <li>• Sexual behaviour</li> <li>• Dust bathing</li> <li>• Grooming</li> <li>• Exploratory behaviour</li> <li>• Abnormal behaviour</li> <li>• Stress behaviour</li> <li>• Aggressive behaviour</li> </ul>

	Reaction to human-interaction	<ul style="list-style-type: none"> <li>• Avoidance distance test</li> <li>• Fear test</li> <li>• Handling practices</li> </ul>
	Positive emotional state	<ul style="list-style-type: none"> <li>• Novel object test</li> <li>• Qualitative Behavioural Assessment</li> </ul>

#### Good feeding:

This welfare principle consists of two criteria namely absence of prolonged hunger and absence of prolonged thirst. Absence of prolonged hunger was described by two measures: access to feed and body condition. Access to feed was described as sufficient access to good quality, clean feed, that adequately provides chicks and juveniles with sufficient nutrition according to their age groups, to prevent nutritional imbalances (as recommended in the Code of conduct for the commercial production of ostriches; SAOBC, 2013). This was measured by noting whether birds had access to feed all day or were restricted (the reason therefore also noted), whether feed and feed troughs were clean without the presence of faeces, dirt or mould, what type of feeders were used and the placement thereof as well as the number of feeders per bird. The physical form of the feed was also noted along with the consistency of birds' faeces.

Body condition (scored from 0-2) is a reflection of body weight and nutrition and is scored by looking at the shape of the back of an ostrich, just behind the hips. A backbone protruding the surrounding flesh is indicative of low body weight while a backbone indented by surrounding flesh is indicative of an overweight bird. The shape of the abdomen also represents body condition as a well-rounded abdomen indicates good body weight and nutrition (Deeming 1996). Birds who were visually and physically inspected for body condition, should also appear bright and alert, with well-muscled bodies and thighs, full feather coverage and a good appetite.

Absence of prolonged thirst was described using a single welfare measure: access to water, described as sufficient access to good quality, clean drinking water (as described in the code of conduct for the commercial production of ostriches; SAOBC, 2013). It was noted whether or not birds had access to water all day or whether water was withheld and for what reason, whether water was clean of faeces, dirt or mould, what type of water troughs were used and the placement thereof as well as the number of water troughs per bird.

#### Good housing:

The welfare principle good housing/facilities consists of five criteria namely comfort when resting, thermal comfort, ease of movement, freedom of movement and appropriate facilities. According to the Code of conduct for the commercial production of ostriches (SAOBC, 2013), ostriches should be reared in facilities that allow sufficient comfort, safety and movement. Comfort when resting was described using a single welfare measure: plumage cleanliness. Plumage cleanliness was measured by visually and physically assessing birds for the presence of crusted dirt, faeces or litter as birds use their feather coverage for protection against sun damage, skin infections, moisture and dirt.

Thermal comfort was measured by four measures: panting, huddling, activity level and access to shelter/shade. Panting, defined as respiration in short gasps results in increased respiratory rates to allow the rapid exchange of air in an attempt to prevent overheating during extreme temperatures. Persistent panting indicates that environmental temperatures are not at a comfortable level. Ostrich chicks are capable of thermoregulation shortly after hatching and although ostriches might generally be tolerant of extreme temperatures over-heating and dehydration should be avoided (SAOBC, 2013). The process of thermoregulation is however an energetically expensive process that might interfere with physiological processes like growth and may hamper immunity. The percentage of birds in the flock that were actively



panting was estimated on each farm visit. Time and ambient temperature during observation was also noted.

When ambient temperatures are low, ostriches tend to tightly sit together in groups. This is called huddling. Although this is a natural response to low temperatures, consistent huddling indicates that environmental temperatures are not at a comfortable level for chicks and in some cases smaller chicks might show visible shivering due to the cold. The percentage of birds in the flock visibly huddling was estimated on each farm visit and the time and ambient temperature during observations were also noted.

Activity level was also used as a measure of thermal comfort, when chicks are cold they tend to be less active, mainly sitting or huddling. When birds maintain a comfortable body temperature they are actively moving around. Activity level was classified as (0) birds showed little to no activity (mainly sitting), (1) birds were active and (2) birds were extremely active (running around). The percentage of birds in the flock in each category was estimated on each farm.

The Code of conduct for the commercial production of ostriches (SAOBC, 2013) advise that chicks up to three months of age should be provided with some form of shelter as protection against adverse weather conditions or sudden weather changes. Shelter/shade can be in the form of natural vegetation as in the wild (trees or shrubs to use for cover) or man-made. Shelter/shade not only provides protection against the elements but also provide birds with environmental variation as a form of enrichment. The following was noted during on-farm visits: the total number of camps, the number of camps with some form of shade/shelter, the percentage of range/area covered by shelter/shade (where applicable) and the form of shelter/shade provided (where applicable).

Ease of movement was measured by two welfare measures: stocking density and mobility. Stocking density represents the floor space available per bird. It is essential that birds are not raised in overcrowded conditions (SAOBC, 2013). Housing/camps/paddock should thus provide birds with enough space to freely move around. Stocking density varies with the age and size of birds, and as such should take flock size, ambient temperature, ventilation and flock health into consideration (SAOBC, 2013). The floor space available per bird ( $\text{m}^2/\text{bird}$ ) was calculated by dividing the total available space by the amount of birds.

Mobility refers to the movement of birds. Immobility varies in severity from reduced ability to move/inability to bear weight to total immobility. The percentage of birds in the flock within the following categories was estimated: (0) normal mobility, (1) impaired mobility and (2) immobility. Freedom of movement is not only a measure of adequate housing facilities but also a measure of the ability of birds to express natural behaviour. Freedom of movement was measured by establishing whether or not birds have free access to both outdoor and indoor facilities. The following was noted: whether birds were kept inside/outside and for which age categories, whether birds had free access to both indoor and outdoor areas or not; whether birds had restricted or free access to outdoor facilities permanently or if they were restricted, how many hours were they allowed outdoor access per day.

Appropriate facilities were measured by evaluating the following: housing facilities, handling facilities, floor quality and cleanliness in chick houses, air quality/ventilation in chick houses and enrichment measures. Housing facilities were evaluated based on the type of chick rearing method (whether chicks were raised with breeder pairs, on pastures or in chick houses), whether juveniles were raised on pastures or in feedlots, what type of housing facilities were used and at what age chicks were housed (where applicable). Handling facilities

were evaluated based on whether permanent or mobile facilities were used, whether facilities offered shade or not and whether facilities were safe for birds (without any protruding wires or sharp edges that could cause injuries).

Hygiene practices in chick houses are of vital importance to chick health and well-being, floors should be cleaned and disinfected regularly and the creation of 'wet spots' in chick houses should be prevented as this could cause disease outbreaks. Chick house floors should prevent chicks from slipping or injuring themselves and allow chicks' easy movement (SAOBC, 2013). The following was noted when evaluating floor quality and cleanliness: the type of flooring and whether flooring was anti-slip or not, how often chick houses were cleaned and whether disinfectants were used. Chick house cleanliness was scored based on the cleanliness of floors and walls: (0) floors/walls were clean, (1) floors and walls were moderately soiled and (2) floors/walls were severely soiled.

Adequate air quality/ventilation in chick houses are critical for the health and well-being of ostrich chicks and should never be compromised in an effort to regulate temperature (SAOBC, 2013). Chicks require an adequate oxygen supply and ammonia build-up should be prevented as this can lead to respiratory infections. Ammonia levels might be time dependent, especially in closed chick houses where ammonia accumulates overnight when high chicks are confined, without adequate ventilation in an attempt to control ambient temperatures. The following was noted when evaluating air quality and ventilation: time of observation, whether chicks were inside the chick house when the measurement was taken, whether chicks were kept inside all day or not, the time chicks were generally let out of the chick house (where applicable) and the ventilation system used. The ammonia level was also measured using ammonia test papers or detector tubes.

Enrichment measures are used to alleviate barren environments, boredom and to mentally stimulate animals. Enrichment measures can be natural (vegetation that allows foraging behaviour), structures that make the environment less barren (shelter, shade, dust bathing areas) or additional material to manipulate (toys, ropes, hay bales). The following was noted while assessing enrichment measures: the total number of camps, the presence or absence of enrichment measures and the type of enrichment measure if present. Enrichment measures were categorised according to the type of enrichment measure present: (0) none, (1) vegetation, (2) structural enrichment and (3) material to manipulate. Other enrichment measures used were also noted.

Good health:

The welfare principle good health consists of three welfare criteria: absence of injuries, absence of disease and absence of pain induced by management. Absence of injuries was evaluated by three welfare measures: leg deformities, injuries and bruises. Leg deformities in ostriches may be caused by various nutritional deficiencies, injuries or as a result of management practices, and can affect the health, well-being and mobility of ostrich chicks significantly. Leg deformities were classified according to the following: (0) no deformities/abnormalities, (1) rolled toes, (2) slipped tendons, (3) crooked legs, (4) other. Injuries included deep skin lesions or lacerations and wounds and broken toes or wings.

Ostriches were visually and physically inspected to observe the presence of injuries. The thighs, legs, head, neck, wings, feet and areas under the wings were examined and injuries were classified according to the following description: (0) no injuries present, (1) some less severe wounds/injuries present and (3) severe wounds/injuries present. If injuries were present the location and type of injury was noted and whether the injury has been treated or not. It is imperative that wound or injuries be treated to prevent infections, pain and suffering.

Bruises, or discoloration of the skin, is caused by blows or impact to the skin and may be more prevalent in areas of high stocking density as birds tend to interact more without the necessary space to evade conflict. The presence and severity of bruises were noted by visually and physically inspecting birds, the neck, thighs, legs and areas under the wings were inspected. Bruises were classified according to the following: (0) no bruises present, (1) light to moderate bruising, covering less than 10% of the body and (2) severe bruising, covering more than 10% of the body.

The absence of disease was measured using seven welfare measures: on-farm mortalities, on-farm culls, diarrhoea, skin infections, respiratory problems, parasites and symptoms of ill health. Mortality is defined as the 'uncontrolled' death of animals (distinct from culling/euthanasia), any bird found dead in a camp/run is considered as a mortality. The animal unit manager/farmer was asked about mortality management on the farm based on data collected from farm records. To calculate the percentage of mortalities on-farm the total number of birds found dead (not actively killed) during the flock cycle was divided by the number of birds placed at the beginning of the flock cycle and multiplied by 100. The average age of mortalities and most common reason for mortalities (when available) was also noted. Culling is defined as animals that are actively and humanely killed for disease control purposes, lameness, sickness, injuries or due to suffering. The animal unit manager/farmer was asked about cull management on the farm based on data collected from farm records. To calculate the percentage of culling the total number of culled birds (this excludes mortalities) in the flock cycle was divided by the total amount of birds placed at the beginning of the flock cycle and multiplied by 100. The average age at culling and reasons for culling was also noted (when available). If no records of cull management are available this should be noted and implies that all deaths are 'uncontrolled' on the farm.

Diarrhoea can be a symptom of various diseases, gut infections or metabolism abnormalities and indicates that animals are unhealthy. This altered faecal state can present itself as watery or discoloured faeces. The percentage of floor space covered in diarrhoea-like faeces was estimated to quantify diarrhoea in the flock. Skin infections can be observed as crusty or scaly lesions on bare areas of the skin that might become bacterially infected that can lead to puss filled wounds.

Birds were visually and physically inspected for the presence of skin infections. Areas assessed were the eyes, around the beak and bare areas of the skin on the legs and areas under the wings. Skin infections were classified according to the following: (0) no infection, (1) less than three crusty lesions, no sign of bacterial infection and (2) more than three crusty lesions and/or signs of bacterial infection/puss filled wounds. The percentage of birds in the flock in each category was estimated.

Symptoms of respiratory problems can be present in the form of coughing, sneezing and laboured breathing and could indicate the presence of serious health problems in the flock. The percentage of birds showing respiratory problems was estimated and the type of respiratory symptom was noted. To assess the flock for visible signs of internal and external parasites which affects the overall health of the flock, visual and physical inspection of birds and faecal matter was done. Signs of internal parasites can be seen by observing faecal matter in camps/houses for the presence of tapeworms and estimating the percentage of faecal matter with visible signs of parasites. External parasites were measured by physically inspecting birds for the presence of lice, mites or ticks and estimating the percentage of birds showing signs of external parasites. Symptoms of ill health assessed the flock in terms of sickness behaviours that indicates the overall health of the flock. Birds were classified

according to the following: (0) healthy birds, no symptoms of ill health, (1) birds with decreased appetite, birds do not appear bright and alert, (2) inactive birds showing listless behaviour, (3) completely immobilised birds, necks twisted backwards. The percentage of the flock in each category was estimated.

The welfare criteria absence of pain induced by management was assessed based on three common management practices in the ostrich industry: toenail clipping, feather collection and the use of beak rings. Toenail clipping is used to prevent birds from injuring one another or damaging the skins of other birds on commercial farming enterprises. The code of conduct for the commercial production of ostriches (SAOBC, 2013) provides the industry with a recommended monitoring protocol, which includes a certified training course for operators of toenail clipping equipment to ensure that toenail clipping is done by trained individuals. Proper equipment should be used and all clipped nails should be kept in a 10% formalin container for macroscopic evaluation of a predetermined amount of clipped toenails by independent experts. Toenail clipping, when done incorrectly, may lead to abnormal growth of toenails. All toenails should be clipped within 72hrs after hatching under hygienic conditions. To assess this management practice the following was noted: whether this management practice was followed on a routine or ad hoc basis, the use of pain relief, and which practice was followed. Toenail clipping was classified according to the following: (0) no toenail clipping, (1) toenail clipping with cauterization, (2) toenail clipping without cauterization or (3) permanent declawing.

Feather collection methods and the type and/or amount of feathers collected differ from farm to farm. According to guidelines in the code of conduct for the commercial production of ostriches (SAOBC, 2013) feather collection must be done by trained handlers. The correct timing and feather collection procedures should be followed and the health and nutritional

status of birds and the environmental conditions should be taken into account before collection. Feather clipping should be done by clipping ripe feathers approximately 2.5cm from the feather base above the marrow of the feather stem. It is proposed that the ripe wing feathers of juveniles be clipped at six months of age, while leaving the wing floss feathers for protection. At seven and a half to nine months the dried shafts of the clipped wing feathers should be removed, the tail feathers can be clipped and the ripe body feathers can be harvested. Blood feathers may under no circumstances be removed. Plucking of feathers are not allowed on live birds and no feathers of slaughter birds may be removed before slaughter, neither on-farm nor at the abattoir. All feathers may thus only be removed post-mortem. To assess feather collection, the age of first collection and interval of collection was noted and feather collection was classified according to the following: (0) no feather collection, (1) feather collection by means of clipping and quilling only, (2) feather collection by means of clipping (and quilling) white wing feathers and removal of other feathers or (3) feather collection by complete removal of feathers.

Beak rings are used in the ostrich industry to prevent birds from pecking one another's feathers. To assess the use of beak rings the following was noted: the reason for use (where applicable), whether it was used preventatively or curatively and the age when beak rings were used. The practice was classified according to the following: (0) no use of beak rings, (1) preventative use of beak rings or (3) curative use of beak rings.

Appropriate behaviour:

This welfare principle consists of four welfare criteria: expression of social behaviour, expression of other behaviour, reaction to human-interaction and positive emotional state. Expression of social behaviour was evaluated based on three welfare measures: sexual behaviour, dust bathing and grooming. Birds only exhibit sexual behaviour when they are not



stressed, hence signs of sexual behaviour can be seen as a positive state of well-being. The presence or absence of sexual behaviours such as clucking/fluttering, kantling and copulation was noted.

Dust bathing is an important social behaviour healthy bird's exhibit and they should have enough space to dust bathe in social groups. The absence or presence of dust bathing was noted. Healthy birds naturally keep their feathers 'preened' and often exhibit grooming socially. Hence, the absence or presence of grooming behaviour was noted.

The expression of other behaviours were assessed by five welfare measures: exploratory behaviour, stereotypical behaviour, stress behaviour, aggressive behaviour and plumage damage. Exploratory behaviour form a part of the normal behaviour of a healthy ostrich. This behaviour includes exploratory or inquisitive pecking at non-food objects, the ground, or other birds once before moving on. Pecking is not repetitive and can include foraging. The absence or presence of these behaviours were noted.

Stereotypical behaviours can be a sign of boredom or frustration and include repetitive actions such as pecking at other birds without a definite purpose. The presence or absence of such behaviour was observed. Stress behaviours are induced by high levels of stress. Repetitive behaviours such as pacing, running and spinning or severe shivering (especially when handled) may be indicative of stressed birds. The absence or presence of stress behaviours was noted. Finally, the display of aggressive behaviour might increase due to high stocking densities, which can potentially negatively affect the welfare of the recipients of such behaviour. Hence, the presence or absence of aggressive behaviour was also recorded.