

Households' Willingness to Pay for Donkey Milk: Evidence from Mahikeng Local Municipality

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DECLARATION

I hereby declare that the study “Households’ Willingness to Pay for Donkey Milk: Evidence from Mahikeng Local Municipality” is my original work and has not been submitted for degree purposes to any other university. All the sources utilised have been acknowledged by means of complete references.

Name: Keitshweditse Boago

Signature:.....

Date:____/____/20____

DEDICATION

This dissertation is dedicated to my mother, the late Naledi Keitshweditse who passed away in July 2018. I had to find collateral beauty resilience and strength to complete this dissertation while dealing with this loss. It gave me solace that your passing freed you from immense pain and may your beautiful soul rest in eternal peace. I will always miss you.

ACKNOWLEDGEMENT

First of all, I would like to thank God through whom this work was successfully accomplished. I want to also express my sincere gratitude to my supervisors Dr M.L. Mabuza and Ms C.Z. Tsvakirai for their invaluable support, guidance, patience with my faults, and allocating extra hours towards my project. Thank you so much.

A special word of appreciation is due to my late grandparents who raised me to become the man that I am today. I wish you were alive to see the fruits of your love and dedication. May your souls rest in peace.

I am also truly grateful to JB MARKS Education Trust Fund, whose financial support brought this idea to fruition.

I am also indebted to all the respondents that took their time to complete a detailed questionnaire for my benefit.

ABSTRACT

Donkey milk has a host of qualities which make it a superior alternative to cow milk. Donkey milk contains low fat and a very high level of Lysozyme content. Lysozyme act as a defence against infections such as mastitis and also eliminate the possibility of new infections. The alternative milk from donkeys does not only have good nutritional value, but also has medicinal attributes such as treating metabolic, digestive and liver problems.

The main aim of this study was to assess consumers' willingness to pay for donkey milk with a view to initiate proper intermediations, as well as informing donkey milk projects and policies. To achieve this, and with reference to the North West Province, the specific objectives were to: Identify dominant indicators underlying consumers' perceptions on donkey milk consumption; Determine socio-economic factors affecting consumers' perceptions on donkey milk consumption; Assess consumers' willingness to pay for donkey milk; and Determine socio-economic factors influencing consumers' willingness to pay for donkey milk. A stratified sampling technique was used to obtain a representative sample. Using probability proportional to size, a total number of 348 households were drawn from 31 wards and a systematic method was then used to determine the number of households to interview from each ward.

Principal Component Analysis (PCA) was applied to identify dominant indicators underlying consumers' perception. The first principal component (PC) was then used as a dependent variable in the Logit model used to identify socio-economic factors affecting consumers' perceptions on donkey milk. The Logit results revealed that age of household head, proportion of adult members with at least secondary education, number of children under 18 years, prior knowledge on donkey milk and income from grants significantly influenced households' perceptions on donkey milk consumption.

It was also found that households in Mahikeng Local Municipality, on average, were willing to pay R4 more per litre of donkey milk over the price of cow milk (R13). This finding is consistent with expectations given that donkey milk has some similarities with human milk and offers more nutritional and cosmetic values than cow milk. It could be inferred, therefore, that there is a potential market for donkey milk that can be developed in Mafikeng. However, further developments will depend on whether a conducive policy framework to attract meaningful private sector participation exists.

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LIST OF ABBREVIATIONS

CVM	Contingent Valuation Method
DAFF	Department of Agriculture Forestry and Fisheries
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
PCA	Principal Component Analysis
PC	Principal Component
WHO	World Health Organisation
WTP	Willingness To Pay

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Global consumption trends indicate that there has been a significant shift from the consumption of starch dominated diets into diversified meals comprising increasing quantities of meat and dairy products. This trend has been driven by the general increase in per capita income (FAO and WHO, 2013). In the developing world, the fundamental forces behind these trends are expected to continue as the demand for livestock products keep escalating (FAO and WHO, 2013).

In 2015, the agricultural sector contributed about 2% to South Africa's GDP (DAFF, 2016). Despite the low contribution to GDP, the agricultural sector remains essential in terms of employment creation and foreign exchange earnings. Household expenditure on milk and milk products for South African households accounts for 8% to 11% of the food consumption budget (Stats SA, 2017). Expenditure in this food category comes fourth after cereals, meat, fruits and vegetables for poor households; and meat, cereals, fruits and vegetables for non-poor households, respectively.

Bovine (cattle, bison and water buffalo) milk is the most universally consumed and dominates production of milk globally (Gerosa and Skoet, 2012). Milk from cattle and other related species such as bison have been reported to produce (85%) of milk consumed worldwide. However, in other parts of the world, different animal species make significant contributions to the supply of milk. Species such as goats and sheep have been reported to provide 2.3% and 1.4% of global milk respectively, while camel milk is estimated to account for the remaining 0.2% (Gerosa and Skoet, 2012). Horses and donkeys have been reported as other alternative sources of milk, but their contribution to global milk is estimated to be below 0.1% (Faye and Konuspayeva, 2012).

Milk is a rich source of nutrients such as calcium, magnesium, selenium and vitamin B12 (FAO and WHO, 2013), thus it plays a role in ensuring good human nutrition. Due to its nutrient

abundance, milk plays a critical role in the development and strengthening of infant's immune system. This is particularly true for cow milk which has been documented as the best alternative feed for humans (Polidori and Vincenzetti, 2013). Cow milk has been accepted by society as a suitable substitute during infant weaning and also in cases where breastfeeding and infant formula-feed are not possible. However, given the hostile responses to cow milk in babies resulting from cow milk protein allergies, milk from other animals has been considered in recent years. One example of an alternative is donkey milk. The interest in this substitute product is the striking similarities with human milk. It is due to the properties of donkey milk that it has been suggested as a substitute to goat, cow and artificial milk in the nourishment of allergic infants (Pilla *et al*, 2010).

Donkey milk has a host of other qualities which make it a superior alternative to cow milk. It contains low fat and very high level of Lysozyme content 3750 mg/l in comparison to the 0.09 mg/l contained in cow milk and 40–200 mg/l in human milk (Chiavari *et al.*, 2005; and Vincenzetti *et al.*, 2008). Such high levels of Lysozyme exhibit antibacterial properties which act as a defense against infections such as mastitis and also eliminate the possibility of new infections (Salimei *et al.*, 2004; Vincenzetti, 2008; Conte *et al.*, 2006). The alternative milk from donkeys does not only have good nutritional value, but also has medicinal attributes as confirmed by studies conducted in a number of European countries (Marchand *et al.*, 2009; and Uniacke-Lowe, 2011). These studies found that donkey milk is ideal for treating metabolic, digestive and liver problems, prevention of atherosclerosis, arthritis and cancer.

1.2 Problem Statement and Justification of the study

Most consumed milk is sourced from cows due the economies of scale that commercial dairy cattle enterprises offer. Whilst this provides great advantages for large scale agribusiness, dairy cattle enterprises have disadvantages for smallholders due to high production and maintenance costs (Mariani, 2008). As a result, cow milk is priced beyond the reach of low income consumers in developing countries where smallholders are significantly active in the milk value chain. Consequently, a greater proportion of consumers in developing countries cannot access better quality diets with a high milk composition (FAO and WHO, 2013).

Donkey rearing for milk production presents a more economic substitute given the animal's low maintenance costs and its capability to withstand harsh environmental conditions. According to Aganga (2000), donkeys consume a wide variety of low cost feed and graze effectively when there is insufficient rainfall and still remain in a relatively good body condition. These strengths are especially advantageous for South African's North West Province, particularly Mahikeng, which has a semi-arid climate and is typically unfavourable for a number of agricultural enterprises (Mahikeng Local Municipality, 2016). As most grazing lands in the Province are not irrigated, the seasonal rainfall average limits the size and productivity of cattle enterprises. Notwithstanding the above prospects, the important question that remains is whether donkey milk has a considerable demand. The willingness to pay aspect, which is a crucial determinant for any industry's viability, has not been explored in South Africa, a gap that this study sought to address using evidence from Mahikeng Local Municipality.

Moreover, donkeys are tough animals which are resilient to diseases, and can survive in hot and dry climates (Mariani, 2008). Donkeys also play a crucial role in subsistence plans of many people in semi-arid areas, helping families with energy intensive jobs because of their strength and resistance to harsh weather conditions (Blench, 2000).

Unlike ruminant milk, there have been a limited number of studies on donkey milk despite the fact that it has proven to be an alternative feed for babies allergic to cow milk (Mariani, 2008). Donkey milk has high levels of Lysozyme content which exhibits antibacterial properties in comparison with cow milk and human milk (Chiavari *et al.*, 2005; Salimei *et al.*, 2004; Vincenzetti, 2008; Conte *et al.*, 2006). This study sought to determine whether consumers were willing to pay for donkey milk and what socio-economic factors could influence donkey milk consumption. The findings were intended to provide stakeholders in the dairy supply chain and policy makers with information required to develop and commercialize the donkey milk industry, including value adding prospects. The study was guided by the following research questions:

1.3 Research questions

- (i) What are the dominant indicators of consumers' perceptions on donkey milk consumption?
- (ii) What socio-economic factors affect consumers' perceptions on donkey milk consumption?
- (iii) Are consumers willing to pay for donkey milk?
- (iv) What socio-economic factors influence consumers' willingness to pay for donkey milk?

1.4 Research objectives

The main aim of the study was to assess the willingness to pay for donkey milk with a view to initiate proper intermediations, as well as informing donkey milk projects and related policies. To achieve this, and with reference to the North West Province, the specific objectives were to:

- (i) Identify dominant indicators underlying consumers' perceptions on donkey milk consumption;
- (ii) Determine socio-economic factors affecting consumers' perceptions on donkey milk consumption;
- (iii) Assess consumers' willingness to pay for donkey milk; and
- (iv) Determine social-economic factors influencing consumers' willingness to pay for donkey milk.

1.5 Hypothesis of the study

It was hypothesized that:

- (i) None of the identified indicators significantly define consumers' perceptions on donkey milk consumption;
- (ii) None of the socio-economic factors significantly influence consumers' willingness to pay for donkey milk
- (iii) Consumers are not willing to pay for donkey milk; and
- (iv) None of the socio-economic factors significantly influence consumers' willingness to pay for donkey milk.

1.6 Organisation of the dissertation

The rest of the dissertation is organised as follows: The following chapter, Chapter 2, reviews literature related to the subject. Chapter 3 presents the methodology which comprises data collection procedure and empirical models. Chapter 4 discusses the results where comparison is also made with findings from past similar studies. The dissertation ends with conclusions and policy recommendations in Chapter 5.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

A review of the literature related to the study will be presented in this chapter. It starts with an overview of the dairy donkey production followed by the value of donkey milk. The third section reviews the concept of consumer's WTP for a product. The fourth section describes the factors that determine the consumers' WTP. A theoretical framework of analytical methods used to measure WTP is presented in section five. The chapter concludes with a conceptual framework for factors influencing individual perceptions on products.

2.2. Overview of the dairy donkey production

The donkey (*Equus asinus*) is a member of the horse family and was domesticated around 4000 BC on the coastlines of the Mediterranean Sea. Its predecessor was the *Equus africanus*, also known as the small gray donkey originating from northern Africa. The donkey is used mostly for transport, and it has worked for centuries with human beings and remains an imperative power animal in the lower economy constituencies (Mariani, 2008). Donkey milk has in recent years been broadly studied because of its similarity in composition to that of human milk, nutritional value as well beneficial properties of its milk in skin care (Salimei, 2011).

Although there are limited statistics available, donkey's global contribution to milk production is estimated to be just under 0.1%. In some areas of the world such as southern Russia, France, Hungary, Mongolia and Belgium, the donkey is an imperative producer of meat and milk (Uniacke-Lowe, 2011).

In Africa, countries such as Mali and Niger have made meaningful profits from selling donkey products such as milk, skin and meat to the Chinese market (Blench, 2000). Although donkey milk has an essential figurative value due to its cosmetic and therapeutic properties, in Africa the practice of milking donkeys is uncommon and of diminutive economic significance. In some parts of West Africa, donkey milk is used in magical medicines whereas the western Maasai from Kenya are believed to milk and consume donkey milk after mixing it with blood as part of

their culture (Blench, 2000). In Sub-Saharan Africa, countries like Botswana and South Africa, particularly in Mahikeng, regularly use donkeys for pulling carts and ploughs (Blench, 2000).

2.3. The value of donkey milk

Milk contains necessary nutrients required by new-borns of different mammals. The most commonly consumed type of milk is bovine milk (Faye and Konuspayeva, 2012). In other regions of the world, milk from different animal species such as donkeys make up a substantial portion in milk supply due to its cosmetic and therapeutic properties. According to Claeys *et al* (2013), donkey milk has diverse skin benefits due to the composition of certain proteins, minerals and vitamins found in the milk. Specifically, the amount of vitamin C found in donkey milk is estimated to be four times more than cow's milk.

Other chemicals present in donkey milk offer antiviral and anti-stress benefits. These include three proteins namely; lactoglobulin, lactalbumin and lysozyme. A combination of these components helps defend infants against infections and diseases. Moreover, the high level of lysozyme give donkey milk the taste and appearance believed to be attractive to children (Chiavari *et.al.* 2005)

Apart from the cosmetic benefits and improvement of taste, the level of lysozyme has also been found to aid preservation of raw milk (Zhang *et.al.* 2008). Because of all these characteristics, donkey milk has been deemed to be an ideal replacement to cow, goat and artificial milk in infants who are allergic to cow milk (Vita *et.al.* 2007). Table 2.1 shows an evaluation of chemical composition between physical properties of donkey and human milk:

As shown in Table 2.1, the pH and amount of fat in donkey milk is almost similar to that of human milk. On the other hand, the levels of proteins and ash are much higher in donkey milk as compared to human milk. The 7% lactose level of donkey milk is comparable to that of human milk and higher than that contained in cow milk. The high lactose level plays a key role in the absorption of calcium in the intestines that is crucial for hardness and strength of infant's bones (Mariani, 2008).

Table 2.1. Chemical composition comparison of and physical properties of donkey with human milk.

MILK PROTEIN	DONKEY MILK	HUMAN MILK
PH	7.0-7.2	7.0-7.5
Protein (g/100g)	1.5-1.8	0.9-1.7
Fats (g/100 g)	0.3-1.8	3.5-4.0
Lactose (g/100 g)	5.8-7.4	6.3-7.0
Ash (g/100 g)	0.3-0.5	0.2-0.3
Solids (g/100 g)	8.8-11.7	11.7-12.9
Caseins (g/100 g)	0.64-1.03	0.32-0.42
Proteins (whey) (g/100 g)	0.49-0.80	0.68-0.83

Source: Vincenzetti *et al.* (2008)

Results from a study by Monti *et al.* (2008) demonstrated that donkey milk has a significant impact on the weight of children. Additionally, an investigation on the immunological benefits of donkey milk has revealed that human beings that consume donkey milk inhibit an increased nitric oxide production, a chemical which is required for preventing atherosclerosis (Tafaro *et al.* 2007).

2.4. Consumer WTP for a product and factors that determine WTP

Willingness to pay (WTP) is defined as the maximum quantity an individual is willing to sacrifice in order to obtain a good. It measures human preferences and may fluctuate across products and households (Kontoleon *et al.* 2002; Van Loo *et al.* 2011). For example, a study by Brooks and Lusk (2010) used WTP to answer a sequence of separate questions concerning which milk option they would buy when shopping. The choice options were based on price per gallon, fat content and use of cloning.

There are various ways to classify consumer divisions based on consumer WTP for food products (Hu *et al.*, 2009). A study by Aizaki *et al.* (2011) on consumers' attitudes towards consumption of cloned beef identified factors such as age, education, income and individual attitudes and perceptions as factors that may influence consumer's WTP.

A study by Carlberg *et al.* (2007) on WTP for brand-named beef in Canada indicated that as people grew older, their WTP for four beef brands that were being investigated dropped. Elderly respondents are less likely to diverge from their daily diet, and the majority of the older respondents are pensioners and earn less for additional expense. A similar relationship was observed by Jerop's (2012) on consumer WTP for goat milk whereby it was found that young individuals were willing to pay a premium for goat milk than older consumers. However, findings by El Hatmiet *al.* (2014) revealed that older respondents expressed greater WTP for processed camel milk than young ones.

A study by Voona and Agrawal (2011) disclosed that respondents who attained a higher level of education were willing to procure organic fruits. This implies that education favours positive attitude towards change. On the contrary, Senturk (2009) studied WTP for genetically modified foods in Turkey and found that a borderline increase in education decreased the probability of WTP for the premium price. When considering household head's gender, Carpio *et al.* (2009) observed that female consumers were willing to pay for an increased price for limited number of features in animal products compared to their male counterparts. It is believed that women are responsible for nourishing the family while men are responsible for providing money for the family.

Based on different countries, a health safety consideration is found as the highest percentage purchase motivation in European countries (Botonaki, 2006). Additionally, Radam *et al.*'s (2010) study on consumer attitudes regarding organic foods showed that consuming organic food is related to a growing concern for health. Similarly, Roitner-Schobesberger *et al.* (2008) found that the main motivation to buying organic food in Thailand was health consciousness.

Household size may be associated with total food spending because larger households require more food to feed their members. Smaller households have less expenses, on average, than larger households. This is because food requirements in the household increase with the number of persons and, thus, larger families may have less disposable income to use for supplementary

premium, especially if the total number household members who are unemployed is higher (Jerop, 2012).

Consumers' perceptions and attitudes may influence the decision making process and buying behavior of individuals. Perceptions signify the establishment of an individual state of mental awareness that is affected by economic, social and cultural influences (Radam *et al*, 2010). According to a study by Voona and Agrawal (2011), subjective norms will positively influence the willingness to purchase of a product.

2.5. Analytical methods used in understanding WTP

A substantial number of experimental studies have been conducted to determine WTP for an assortment of products. Methods used to elicit WTP have developed substantially subsequent to a rich diversity of new auction and contingent valuation methods that are now being accessible to researchers (Carlberg *et al.*, 2007). Some of the suitable models include among others; the Vickrey auction (Vickrey, 1961), Hedonic Price Model (Nesheim, 2006), Contingent Valuation Method (Lopez-Feldman, 2012) and Conjoint analysis (Glueck and Savage, 2012).

2.5.1 Conjoint analysis

Consumers always expect the utmost features at the lowest price. From the viewpoint of the producer, however, this may not be true given production costs. Therefore, there are trade-offs between price and features that producers are not aware of before product launch. Conjoint analysis allows for an accurate assessment of choices among hypothetical features that vary concurrently (Glueck and Savage, 2012). Conjoint analysis is regularly established on rankings of product profiles. Each profile is demarcated as a set of characteristics, plus price (Jerop, 2012).

2.5.2 Hedonic Price functions

Hedonic price functions are usually used in evaluating of the correlation among the price of a good and its features. They designate the correlation between the economically applicable features of a product or service and its price (Nesheim, 2006). Akankwasa (2007) used the Hedonic price functions to study consumer acceptability and WTP for banana desert and concluded that some of the socio-economic characteristics such as education, household size,

income, and banana desert characteristics like taste and skin colour significantly influenced the WTP for the bananas. However, Carlberg and Froehlich (2011) observed that Hedonic models are occasionally condemned for reasons such as the “addition” problem, which is a situation whereby when summed up, the value of all features is not equivalent to the price of a product.

2.5.3 Vickrey Auctions

A Vickrey auction is a method whereby the purchasing price is determined by the second highest bid, the auction is performed in closed and sealed form. A person partaking in the auction process hands in a bid in closed form comprising the price he or she would be willing to pay. The highest bidder wins the auction (Wertenbroch and Skiera, 2002; Charles, 2016). Nevertheless, the participant is only required to pay the second highest bid’s price. With this method, the contestants are given an enticement to disclose their exact valuation, because they have to buy the good provided their bid wins the auction (Vickrey, 1961).

Under the Vickrey auction, the bias from the real valuation is often reduced and the distribution of bids is lessened down swiftly. In this way, the participants learn the best bidding method easily. Noussair *et al.* (2004) determined that Vickrey auctions are one of the best procedures to elicit WTP for private goods.

2.5.4 Contingent Valuation Method

Valuation methods can be separated into direct and indirect methods. The indirect method’s estimations are established on the behaviour of individuals observed in the market of a good linked to the one of interest. On the other hand, direct methods try to produce data directly from the individual price of the non-marketed good or service (Lopez-Feldman, 2012).

Contingent valuation method (CVM) entails asking a section of the people about their WTP for the provision of a good or service. Even though the use of CVM has not been universally recognized as a dependable tool for assessing WTP, there is a substantial volume of research which shows that a well applied contingent valuation study will produce information that is reasonable and reliable (Gunatilake *et al.*, 2007). For this study, Contingent valuation method was used as it can easily estimate how much a consumer is willing to pay for donkey milk as compared to other methods.

2.6 Analytical framework

In the analytical framework, methods of measuring WTP are examined, whether they produce price evidence based on the individual level. Based on the highest level, approaches may be segregated in accordance to whether they exploit measuring systems or whether they are established on the real price response data (Breidert *et al.*, 2006; Charles, 2016).

Market observations under response data may be used by performing trials from either fields or laboratory research. Since auctions are an imperative form of laboratory trials, they are encompassed as extra methods of framework classification. Results acquired through price-responses are frequently denoted as revealed preference information and considering survey-based methods for estimation of WTP, both direct and indirect assessments for gathering data are found under response data. Preference data resulting from studies or surveys are often known as specified preferences (Louviere *et al.*, 2000; Uniacke-Lowe, 2011).

Under the method of direct surveys, participants are requested to reveal the amount they would be willing to pay for donkey milk. On the other hand, in indirect surveys a classification or ranking technique for diverse products is used so as to evaluate a preference arrangement from which WTP may be derived. Conjoint analysis is an example of indirect surveying methods (Breidert *et al.*, 2006). Choosing a possible method for measuring WTP is often limited, for example, by either time or monetary limitations. Hence, this framework offers a valuable recommendation for selecting a suitable method for measuring WTP for donkey milk.

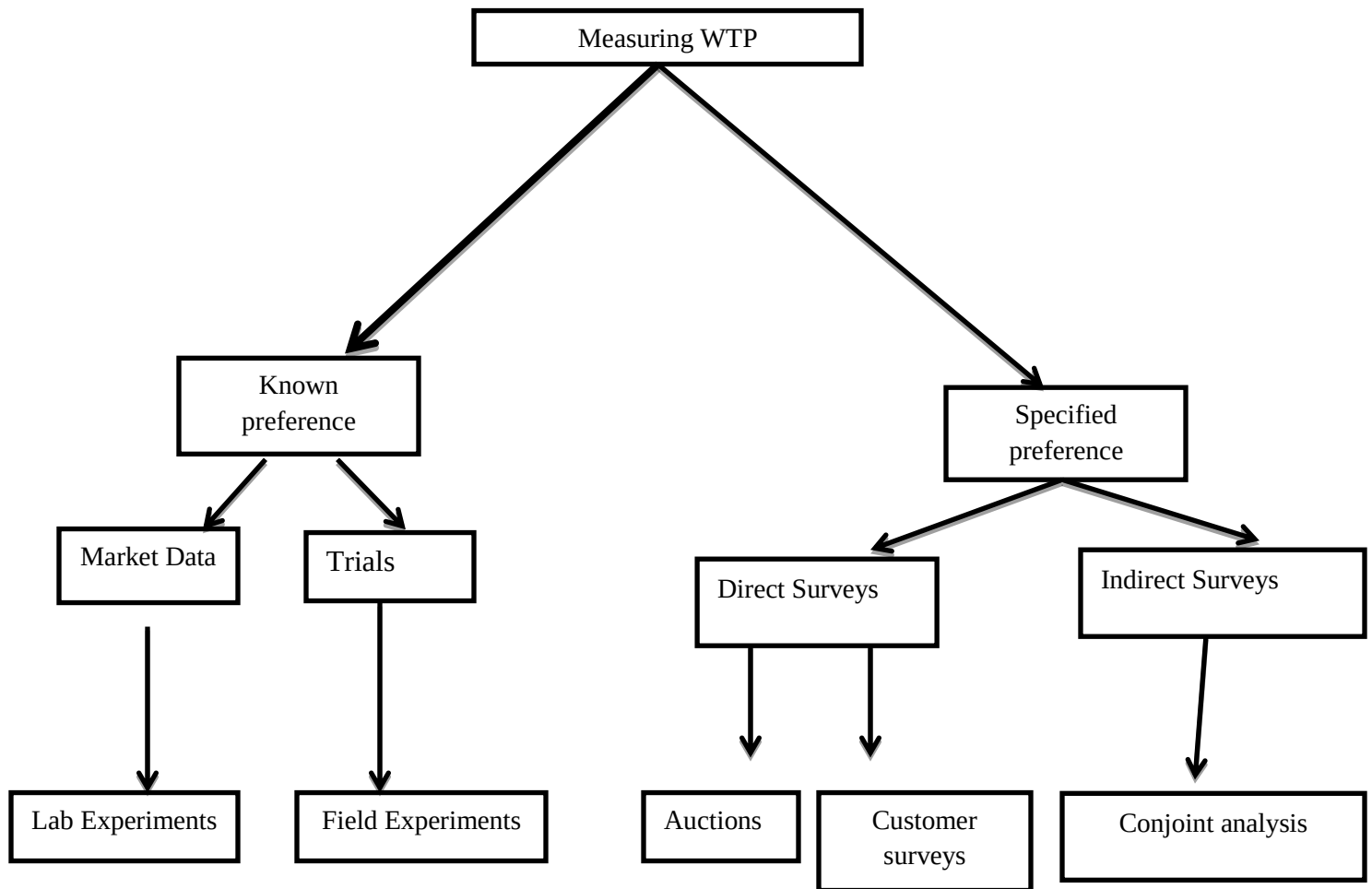


Figure 1: Classification framework for methods used to measure willingness-to-pay.(Source: Breidert et al., 2006)

2.6.1 Market Data

Analyzing market data is frequently used in estimating price-response functions and is established on the hypothesis that historical demands may be used to calculate upcoming market behaviour. However, limitations of using market data are that differences in price in the information are generally very limited, making it hard to estimate WTP for new products in cases where there is no data are available yet (Sattler and Nitschke, 2003; Tonsor and Shupp, 2011).

2.6.2 Experiments/ trials

During laboratory trials or experiments, purchasing behaviour is characteristically replicated by providing the respondents with a certain amount of money and requesting them to spend it on selected goods. The goods as well as the prices differ systematically. In contrast, Field experiments are frequently held in the form of test markets whereby the prices are systematically diverse and the responses from the consumers are analyzed. A vital subject in the analysis of a test market is to choose a small market locations that are illustrative of the target market investigated (Nagle and Holden, 2002; Tonsor and Shupp, 2011)

2.6.3 Auctions

Auctions have been intensively involved to elicit WTP in laboratory settings. If the exact monetary estimation of a product as imagined by the customers were known, a need for auction would not be required. The auction may take place in closed or sealed form, whereby the purchasing price is dependent on the second highest bid. A partaker in the auction submits a bid comprising of how much he or she would be willing to pay in sealed form. A person partaking in the auction process hands in a bid in closed form comprising the price he or she would be willing to pay (Wertenbroch and Skiera, 2002).

2.7 Summary

In conclusion, most studies have investigated the concept of willingness to pay for cow milk and there is a dearth of studies on donkey milk despite the fact that it has proven to be an alternative feed for babies allergic to cow milk. Considering this gap, it would be interesting to see if households would have positive perceptions on donkey milk consumption and subsequently be willing to pay accordingly for the milk.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines the methodology of the study. It consists of a brief depiction of the study area, method of data collection as well as sampling and analytical procedures used to address the study's specific objectives. The empirical methods are also described including how each objective was addressed.

3.2 Description of the study area

The study was conducted in Mahikeng Local Municipality, in the North West Province. The North West Province is situated on South Africa's border with Botswana and the total area of Mahikeng Local Municipality is 3703 km². The study area is divided into 31 wards consisting of 102 Villages and the coordinates are 25°51'S and 25°38 ' E. (Fig 3.1)

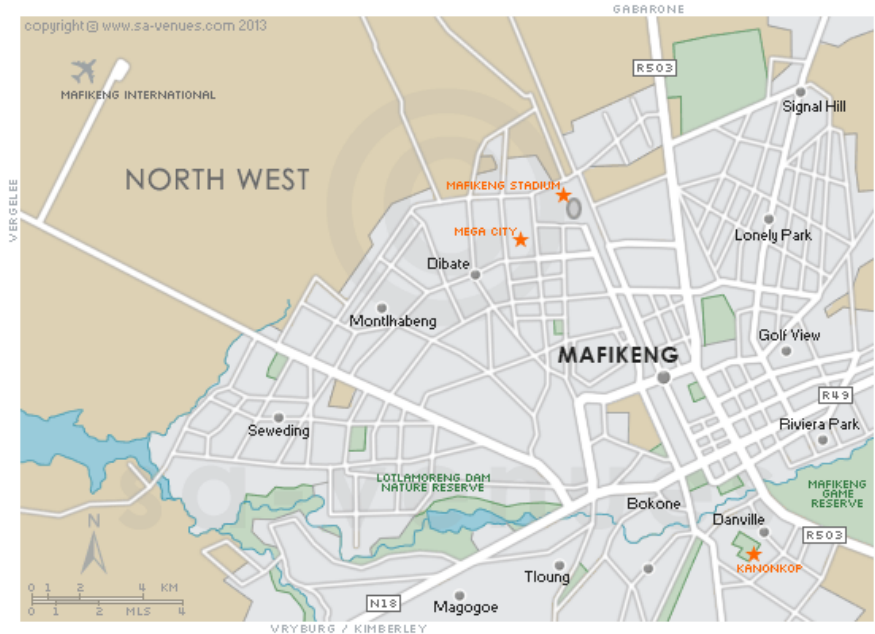


Figure 3.1: The map of Mahikeng Local Municipality, North West province

Source: SA Statistics, 2011

The main economic activity in Mahikeng Local Municipality is Agriculture, especially farming activities such as cattle ranching, game farming and crop production. Common crops include

maize and vegetables. The climate in the study area is typically semi-arid savannah with 500-600 mm mean annual rainfalls. The temperatures in summer range between 22 and 34°C and between 2 to 20°C in winter (Thomas *et al.*, 2007; Materechera, 2009, 2011).

3.3 Sampling procedure

The target population of this study was the potential consumers of donkey milk. The sampling unit which was used in the study is Mahikeng Local Municipality as the study sought to investigate household consumption choice at household level. According to Statistics SA (2011), the total number of households in Mahikeng Local Municipality is 86853. To determine a sample size from this population, Krejcie and Morgan (1970) formula was used to draw a representative sample of 348, expressed as:

$$s = X^2 \frac{NP(1-P)}{d^2(N-1)} + X^2 P(1 - P) \quad 3.1$$

Where

s = required sample size;

X^2 = the table chi-square value for 1 degree of 95% confidence level;

N = size of the population;

P = population proportion to size supposed to have a probability of 0.5;

d = degree of accuracy, in this case 50% response distribution.

The population from which a sample of this study was drawn did not constitute a homogeneous group, and for that reason a stratified sampling technique was used to obtain a representative sample. In this technique, the population was stratified according to wards. Using probability proportional to size, a total number of 348 households were drawn from the 31 wards and because there was no list of the households, a systematic method was used to determine the number of households chosen from each ward. This method involved selecting a sample according to a random starting point and a fixed periodic interval, whereby every third household on the list, starting the count at the starting point (ward 1), was chosen as a participant until a

total of 348 was reached. Finally, the number of households per ward was arrived at after considering the population size from each ward as well as the total sample size of 348.

Table 3.1: Distribution of sampled potential consumers in Mahikeng Local Municipality

Wards	Population of households per ward	Sample size Per Ward
Ward 1	2525	11
Ward 2	2339	10
Ward 3	2693	12
Ward 4	2594	11
Ward 5	895	4
Ward 6	3261	14
Ward 7	4943	22
Ward 8	3783	17
Ward 9	2920	13
Ward 10	2803	12
Ward 11	1526	7
Ward 12	3170	14
Ward 13	5448	24
Ward 14	3617	16
Ward 15	2754	12
Ward 16	3648	16
Ward 17	2183	10
Ward 18	2627	12
Ward 19	1447	6
Ward 20	2112	9
Ward 21	2215	10
Ward 22	3282	15
Ward 23	2150	10
Ward 24	2409	11
Ward 25	2082	9
Ward 26	2066	9
Ward 27	2636	12
Ward 28	2905	13
Ward 29	3187	14
Ward 30	3549	16
Ward 31	3085	14
TOTAL	86853	348

Source: Stat SA (2011)

3.4 Data collection

This study utilised primary data. A structured questionnaire comprising of both open and closed ended questions was administered for primary data collection from the respondents. The structured questionnaire that was based on the study objectives consisted of four main sections:

- i. Section A: Household demographic characteristics;
- ii. Section B: Household socio-economic characteristics;
- iii. Section C: Perceptions on donkey milk consumption;
- iv. Section D: Willingness to pay for donkey milk.

Pre-testing was done to increase consistency of the questionnaire and translation from English to the local language, Setswana. Eventually, data collected was captured and analysed using STATA 14. The next section discusses the empirical methods that were used to address the study's specific objectives.

3.5 Empirical methods

3.4.1 Consumers' perceptions on donkey milk

In order to draw the necessary evidence from potential consumers and study their perceptions, the questions used as variables to identify dominant indicators underlying consumers' perceptions on donkey milk consumption were phrased as indicated in Table 3.2. Besides being structured in different directions, some of the questions sought to draw responses on similar indicators. This is one strategy suggested by behavioural and socio-economic researchers (e.g. Mayer and Davis, 1999) to check for consistency in responses to perception- related questions. However, during data analysis the questions and responses were transformed such that they assumed the same direction to maintain consistency in the perception being measured.

Table 3.2: Variables used to measure households' perceptions on donkey milk

Statement	2	1	0	-1	-2
Nutritional content					
1. Donkey milk contains more nutrients than cow milk					
2. Consuming donkey milk can strengthen the human immune system					
3. There are no nutritional differences between cow and donkey milk					
4. Donkey milk is poisonous and can cause health problems					
Ecological welfare					
5. Donkey milk is produced in a way that does not affect the balance of nature					
6. Milk from donkeys is extracted in a way that animals do not experience pain					
7. Donkey milk is produced in a way that animals' rights are respected					
Enterprise considerations					
8. Compared to cows, donkeys can thrive under difficult environmental conditions					
9. Given the changing climate conditions in Mahikeng and elsewhere, which continues to affect agriculture, I believe that donkeys can play a role as a source of food and nutrition security in the future					
10. I am aware that donkey milk has a range of by-products, including cosmetics					
Sensory appeal					
11. Donkey milk looks better than cow milk					
12. Donkey milk tastes better than cow milk					
13. Compared to cow milk, donkey milk has a pleasant texture					
14. By simply looking at the animal (donkey), I cannot even think of consuming any of its products.					
Accessibility					
15. Donkey milk is expensive than cow milk					
16. Only high income earners can afford to buy donkey milk					
17. I am not aware of an outlet that sells donkey milk around my area					
18. The retail outlets I normally visit do not sell donkey milk					
19. Donkey milk is only available in limited outlets					
Social considerations					
20. Donkey milk is food for people who are classified as "poor" in society					
21. Donkey milk is recommended for "unhealthy" consumers					
22. Donkeys are known for providing hard labour and are not associated with food and nutrition					
Behavioural intentions					
23. If asked to make a choice between a litre of cow milk and a litre of donkey milk offered at the same price, I would choose donkey milk					
24. If asked to make a choice between a litre of cow milk and a litre of donkey milk where donkey milk is offered at a discount, I would choose cow milk					
25. If asked to make a choice between a litre of cow milk and a litre of donkey milk where cow milk is offered at a discount, I would choose cow milk					
26. The fact that donkey milk is not sold by reputable supermarket chain stores means it is sub-standard and not good for human health.					
27. I would not recommend donkey milk to anyone					

Note: 2 = Strongly agree; 1 = agree; 0 = not sure (neutral); -1 = disagree; and -2 = strongly disagree

Given the number of variables that were used to study consumers' perceptions on donkey milk consumption, Principal Component Analysis (PCA) was used to source composite measures of perceptions from the responses. The fundamental idea of PCA is to lessen the width of a set of data comprising of a large number of variables that are interrelated, but retaining the distinction existing in the data and this is accomplished by changing to new variables, known as the principal components (PCs), which are not correlated, and to ensure that few PCs retain most of the distinctions existing among all the original variables (Frank, 2009). The principal components were estimated as a linear function as follows;

$$PC_i = a_{i1}X_1 + a_{i2}X_2 + \dots + a_{in}X_n \quad 3.2$$

where

i = number of principal components ranging from 1... n ;

$a_{i1} \dots a_{in}$ = the component loadings; and

$X_1 \dots X_n$ = perception variables.

3.4.2 Factors that influence consumers' perceptions on donkey milk

Objective two sought to identify the socio-economic factors that influence consumers' perceptions on donkey milk. These factors have distinctive characteristics that can be separated into categories such as social, personal, cultural and psychological factors. The PC scores for each respondent were used as proxy variables for perceptions on donkey milk.

Age

Age as a continuous variable, represented the number of years of the household head and is often used to distinguish consumer needs and the way of satisfying them. As age increases, the level as well as size and the structure of consumption also change, even the buyer's role in the buying process changes (Dorota, 2013). Furthermore, a study by Kiezel (2010) suggested that older people are more cautious about the nutritional aspect of the food that they eat. As result, a

household with more elderly people is more likely to be open to donkey milk consumption, given its health attributes.

Gender

Women and men execute dissimilar roles in each household and their demand for some products as well as their behavior in the process of consumption is diverse. Unlike men, women seek more information during the buying decision process and consider a lot of options making the process more complex (Żelazna, Kowalczyk and Mikuta 2002). Gender as dummy variable, was measured as 0 = Male; 1 = otherwise and based on the evidence from a study above, households headed by females are more likely to have a positive influence on donkey milk consumption.

Prior knowledge

Consumer awareness creates an environment for consumers to cultivate product familiarity, which forms a foundation for estimating diverse options available for satisfying the scarcity (Jerop, 2012). This factor was a dummy variable captured as 1 for those with prior knowledge on donkey milk and 0, otherwise (Yes =1 No=0). Prior knowledge may affect perception on donkey milk positively in that when consumers have information on the benefits of donkey milk, they may be willing to pay for it. In contrast, prior knowledge may have a negative impact on how consumers perceive donkey milk because of pre conceived attitudes attributed to cultural attachments or beliefs on donkey milk.

Level of education

The predominantly important factor influential to the purchasing behaviour is the level of education. This variable is defined as a proportion of adult household members with no formal education; with primary education; with matric; and with tertiary education. Education regulates the amount of acquired incomes as well as affects the pecking order and the magnitude of the needs, which grows and develops with knowledge and increasing awareness of consumers (Żelazna, Kowalczyk and Mikuta 2002). The education level of consumers has an effect on their personality, needs and attitudes, therefore, the assumption is that if a household head is more educated, he/she is more aware and has knowledge by seeking more information and considering more options when buying. As a result an educated household head may be open to buying donkey milk given its health benefits.

Sources of income

Besides the price, the prospect of fulfilling the needs of a consumer is restricted by income level. The amount of acquired income from different sources has an effect on the attitudes as well as lifestyle of a consumer (Woś, Rachocka and Kasperek-Hoppe 2011). Following Alemu (2012), the variable was captured using dummies for respective sources of income, including income from pension, income from salary and wages, income from non-farm activities and income from grants. A consumer with lesser incomes will have an increased demand for elementary goods, whereas as the income increases so does the demand for expensive goods (Krugman *et. al*, 2012). Compared to consumers with no other sources of income, those with diverse sources of income are therefore more likely to buy donkey milk.

Household size

Household size is a variable associated with total food spending as a large household requires more food to feed it. For this variable, adult equivalent, which measures household composition by assigning weights to different age and gender categories, was used. Adult equivalents were estimated as follows;

Table 3.3 Calculating Adult Equivalents

AGE GROUP (years)	MALE	FEMALE
<10	0.6	0.6
10- 13	0.9	0.8
14- 16	1.0	0.75
17- 50	1.0	0.75
>50	1.0	0.75

Source: Storck *et al* (1991)

Smaller households have less expenses, on average, than larger households. This is due to the fact that food requirements in the household increase with the number of members and, thus, larger household may have less disposable income to use for supplementary premium, especially if the dependency ratio is relative to the household size (Jerop, 2012). Studies reflect varied views on the influence of household size on perceptions. For example, Feng *et al.* (2009) found that household size was negatively correlated with perception on organic products. In contrast, a study by Akankwasa (2007) on consumer acceptability for introduced dessert bananas reported a

positive association between household size and perception. The deviation could be linked to the uneven household members' participation in income producing activities. Hence, the effects of this variable on perception can either be positive or negative.

The results of the Principal components are continuous. Therefore, Ordinary Least Squares (OLS) model was used to analyse the socio-economic factors that affect consumer perceptions. However, the estimated model was not significant and diagnostic results suggested the need for an alternative model. A Logit model was then used where negative PC scores were assigned the value=0 while positive PC scores were assigned the value=1. A logit highlights the probability of a specific outcome happening, given an individual's arrangement of responses to a group of independent variables (Hutcheson, G., and Sofroniou, N. 1999). The model was estimated as:

$$P(Y = 1) = \frac{\pi}{1 + \pi} \quad 3.3$$

Consequently, the logit regression can then be predicted as:

$$y_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p \quad 3.4$$

where:

Y is the dependent variable (negative PC scores=0, positive PC score=1)

X's are the independent variables (Explanatory variables)

Table 3.4: Summary of variables included in the Logit model

Variable	Type	Unit of measurement
Dependent variable		
PC scores for each respondent	Dichotomous	negative PC scores=0, positive PC scores=1
Explanatory variables		
Age	Continuous	Years
Gender	Dummy	0 = Male; 1 = otherwise
Prior knowledge of nutritional attributes of donkey milk	Dummy	Yes =1; 0= otherwise
Level of education	Continuous	Proportion of adult household members with secondary education and above.
Sources of income	Dummy	Income from pension=1; 0=otherwise Income from salary and wages=1; 0=otherwise Income from non-farm=1; 0=otherwise Income from grants=1; 0=otherwise
Children under 18	Continuous	The number of children under the age of 18 in the household.
Household size	Continuous	Adult equivalent (See Table 3.4 for details)

3.4.3 Consumers' willingness to pay for donkey milk

The third objective sought to determine potential consumers' willingness to pay for donkey milk. To achieve this, the double bounded contingent valuation method was used. This method entails asking the respondents about their willingness to pay (WTP) for provided goods and services. A respondent is asked the amount he/she is willing to pay for a commodity and if he/she answers 'yes' to the first question then he/she is asked about his WTP for a premium amount. On the other hand, a lower amount is offered if their answer to the first question is 'no' to the first question then (Alejandro, 2012). Respondents were asked to outline their WTP using the current prices of cow milk as the initial bid. For example; the valuation questions read to the participants was as follows:

Compared to cow milk, donkey milk has many benefits. Donkey milk has proven to be just the best alternative feed to babies with allergies to cow milk because of its low fat content. The milk also has high levels of Lysozyme content which exhibits antibacterial action against a number of bacteria and offer protection against infections in human beings. Given these attributes, if a litre of cow milk is valued at around R13, would you be willing to pay more for buy donkey milk? Yes[☐] No [☐] Same Price [☐]
If yes, how much more are you willing to pay for donkey milk?
If No, how much less are you willing to pay for donkey milk?

The respondents' true WTP is determined by the arrangement of questions, putting it among one of the following intervals: $(-\infty, BL)$, (BL, BI) , (BI, BH) , or $(BH, +\infty)$ suggesting that, accepting the first bid the consumer WTP was greater than the bid. If the consumer turns down the first bid, then his WTP is less than the initial bid (Alberini and Cooper, 2000). The second bid, in concurrence with the answer to the first choice decision, makes it easier to place an upper as well as a lower bound on the respondent's true WTP. In particular, once the second decision takes the exact direction as the first one (yes, yes, no, no), it increases the lower bound or drops the upper bound, separately (Loureiro *et al.*, 2002). As a result, the following outcomes of the bidding process are noticeable:

$$(I_i^1, I_i^2) = \begin{cases} (1,1), & \text{when } Y_i^D \geq A_i \text{ and } Y_i^D \geq A_i^U \\ (1,0), & \text{when } Y_i^D \geq A_i \text{ and } Y_i^D < A_i^U \\ (0,1), & \text{when } Y_i^D < A_i \text{ and } Y_i^D \geq A_i^L \\ (0,0), & \text{when } Y_i^D < A_i \text{ and } Y_i^D < A_i^L \end{cases} \quad 3.4$$

The double-bounded dichotomous presents four possible outcomes YY, YN, NY and NN, whereby YY suggests that the answers were “yes”, then WTP is greater than the upper bid, for YN, “yes” is the first answer followed by “no” and in this case, WTP is between the initial bid and the upper bid. In a case of NY, it means a “no” answer followed by “yes” and WTP is amid the lower bid and the initial bid. Finally, NN means that both answers are “no” and this case WTP range between zero as well as the lower bid (Vanit and Schmidt, 2002).

3.4.4 Factors that influence consumers' willingness to pay for donkey milk

Objective four sought to identify the key factors that determine the consumers' WTP for donkey milk, and to achieve this, the double bound probit model was used. The assumption is that variance is equivalent to one because in the old-style case there is no sufficient information obtainable to guess that parameter. However, in this case that hypothesis is not required as there is an extra variable ti (Alejandro, 2012). Therefore, counting ti as an extra explanatory, we get estimates of β/σ and $-1/\sigma$. In other words, the outcomes that we obtain from the probit command are:

$$\hat{\alpha} = \frac{\hat{\beta}}{\hat{\sigma}} (\text{The vector of coefficients related to each explanatory variable}) \text{ and}$$

$\hat{\delta} = -\frac{1}{\sigma}$ (The factor for the variable that measures the quantity of the bid).

Given this, WTP can be estimated in various ways subject to the values that we allocate to vector $\tilde{z}$. Certain options seek to estimate every individual's WTP, as well as the WTP for individuals with certain features and the WTP using the explanatory variable's average. Overall, what we get is:

$$E(WTP|\tilde{z},\beta) = \tilde{z}' \left[-\frac{\hat{\alpha}}{\hat{\delta}}\right] 3.5$$

Where;

$\tilde{z}'$: Represents a vector with the values of explanatory variables (i.e., Gender, Age, Level of education of the household head, Children ≤ 18 , household size, sources of income, prior knowledge of nutritional attributes of donkey milk and Perceptions and Attitude).

In the regression model, age was a continuous variable representing the number of years of the household head. Carlberg *et al.* (2007)'s study carried out in Canada on WTP for beef indicated that as people grew older their WTP for four beef brands that were being investigated dropped. Older respondents are less likely to diverge from their daily diet. In addition, majority of the older individuals are on pension and earn less for additional expense. A similar relationship was observed by Loureiro and Hine (2002) on consumer WTP for organic products whereby it was discovered that young individuals were willing to pay a premium for organic products than older consumers. However, findings by Vanit and Schmidt (2002) reveal that older respondents expressed greater WTP for environmentally friendly vegetables than young ones. As a result, the effect of age on WTP was expected to be either positive or negative.

Highest level of education was captured as a continuous variable defined as a proportion of adult household members with secondary education and above. A study by Du Toit and Crafford (2003) showed that participants with a higher level of education were willing to procure organic food, implying that education favours positive attitude towards change. On the contrary, Senturk (2009) studied WTP for genetically modified foods in Turkey and found that a borderline increase in education decreased the probability of WTP the premium price. Therefore, it was

hypothesized that highest level of education can either have a positive or negative impact on WTP.

Gender of household head examines the individual's role in providing household's needs and attainment of food. It was captured as a dummy variable where 0 = Male; 1 = otherwise. Carpio and Isengildina- Massa (2009) observed that female consumers were willing to pay an increased price for confined features in animal products compared to male consumers. It is believed that women are responsible for nourishing the family while men are responsible for providing money for the family. Gender as an explanatory variable was therefore expected to have a positive effect on WTP.

Income of the household head as a dummy variable explains different sources of income in a household. Income may be from salaries, agricultural activities or non-labour activities. The importance of a steady income on WTP has been confirmed by Jolly and Dhesi (1989) and Jolly (1991). Both studies confirmed that people buying organic poultry products were respondents with formal employment and steady off-farm generated income. Therefore, it was hypothesized that off-farm generated income has a positive correlation with WTP.

Parents have the duty of providing nutritive and safe food for the children. They are concerned about the health of their children and may be less concerned about the somewhat higher price of healthy food. Therefore, families with children below 18 which is a continuous variable were expected to have a positive effect on WTP (Jerop, 2012).

Perceptions as well as attitudes of consumers may have an effect on the decision making process and buying behaviour of individuals. This is a dummy variable and was computed using PCs obtained in the analysis for objective two, whereby 1= positive perception towards donkey milk consumption and 0, otherwise. Perceptions indicate the establishment of an individual's mental awareness that is affected by economic, social and cultural influences (Radam *et al*, 2010). According to a study by Voona *et al* (2011), individual norms and beliefs will positively affect the willingness to buy a product. Hence, the expected effects of this variable on WTP can either be positive or negative.

Table 3.5 Expected relationship between explanatory variables and WTP

Variable Expectation	Description	A priori Expectation
DEPENDENT VARIABLE		
WTP	Yy= yes to both answers Yn= yes to first answer followed by no Nn= no to both answers Ny= no answer followed by yes	
INDEPENDENT VARIABLES		
Gender	0 = Male; 1 = female	+
Age	Age (in years)	+/-
Highest Level of Education of household head	Proportion of adult household members with secondary above	+/-
Sources of income	Income from pension=1; 0=otherwise Income from salary and wages=1; 0=otherwise Income from non-farm=1; 0=otherwise Income from grants=1; 0=otherwise	+
Perceptions	PC scores	+/-
Number of children under 18	The total number of children under 18 years	+

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter is divided into five sections. The first section presents the results of descriptive analysis of the survey respondents' demographic and socio-economic characteristics while respondents' perceptions on donkey milk consumption are presented in the second section. The third section presents the empirical results of the estimation showing the socio-economic factors that affect consumers' perceptions on donkey milk consumption, while the fourth section presents results of the calculation for consumer's willingness to pay for donkey milk. The chapter is concluded by a fifth section with a discussion on socio-economic factors influencing consumers' willingness to pay for donkey milk.

4.2 Demographic characteristics of respondents

4.2.1 Gender of household heads

The results in Figure 4.1 indicate that the study area was characterized by a high proportion of male headed households (63.7%), with the remainder being female headed.

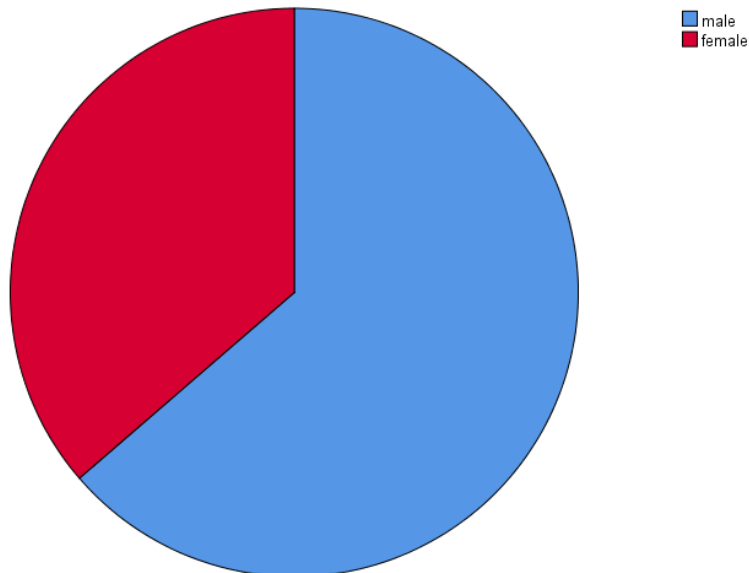


Figure 4.1: Gender of household heads, Source: Field Survey, 2018

4.2.2 Age distribution of household heads

The age distribution of household heads presented in Table 4.1 depicts that the majority (47%) of the sampled respondents were between the ages of 50 to 64 years, followed by 22.3% and 13.8% of respondents falling in the 40 to 59 and 65 to 74 years age categories, respectively. As the age distribution was skewed to the right, this implies that respondents in the sampled area were relatively old.

Table 4.1: Age distribution of household heads

Age distribution	Frequency	Percentage
20 – 29	3	0.8
30 – 39	43	10.8
40 – 49	89	22.3
50 – 64	188	47.0
65 – 74	55	13.8
Above 75	22	5.5
Total	400	100.0

Source: Field Survey, 2018

4.2.3 Education level of household head

One of the predominantly significant factors influencing the purchasing behaviour is the level of education because education of consumers has an effect on their personality, needs and attitudes (Żelazna, Kowalczyk and Mikuta, 2002). The results indicated that 21.5% of the respondents had no formal education. About 46.0% of the household heads had attained primary education, while 32.5% had secondary education and above. The low level of formal education of household heads may affect the perception on donkey milk consumption as well as the willingness to pay for donkey milk.

Table 4.2: Education level of household head

Education level	Frequency	Percentage
No Schooling	86	21.5
Primary	184	46.0
Secondary	70	17.5
Matriculated	43	10.8
Tertiary	17	4.3
Total	400	100.0

4.2.4 Household heads' employment status

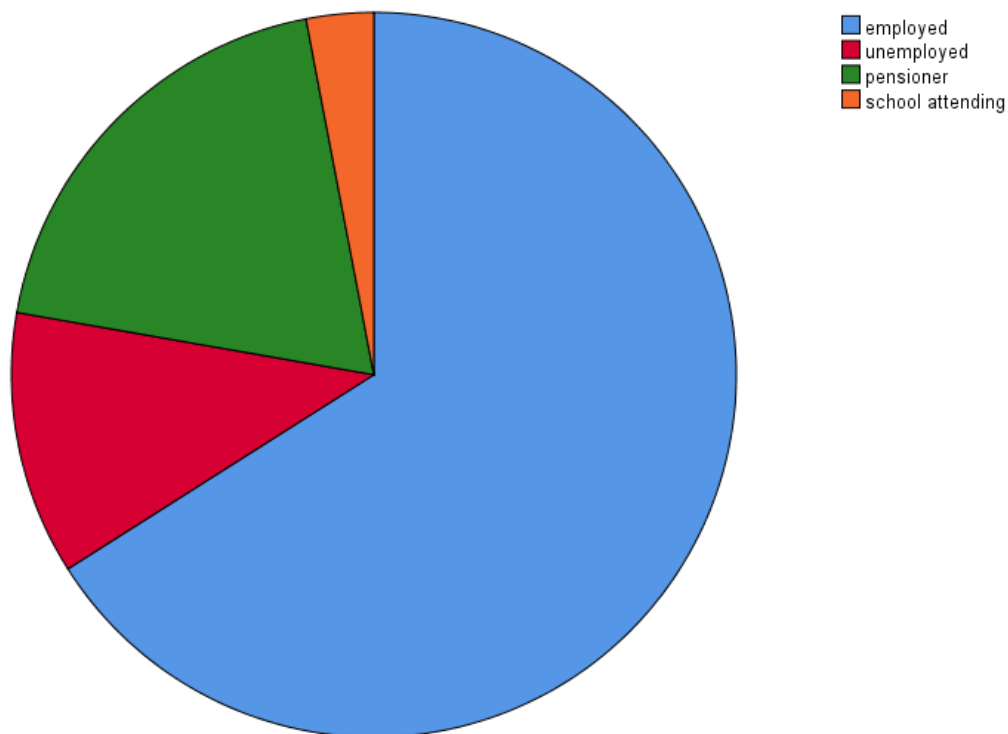


Figure 4.2: Household heads' employment status

Source: Field Survey, 2018

As shown in Figure 4.2, about 66% of the household heads were employed while 18.5% were on retirement. The results also reveal that 11.8% of the respondents were unemployed whereas a minority (3%) of household heads was still attending school. Household heads who were still attending school did so in order to acquire formal education.

4.2.5 Sources of income for surveyed households

Table 4.3 presents the various sources from which households generate income. The results show that the surveyed households received income from a number of diversified sources. The majority of the respondents (62.5%) were employed and received wages and salaries followed by income from child social grant and disability grant (17.5%).

Table 4.3: Household Sources of Income

Source of income	Frequency	Percentage
Non- farm	20	5
Pension	30	7.5
Grants	70	17.5
Wages & salary	250	62.5
On farm	30	7.5
Total	400	100

Source: Field Survey, 2018

4.2.6 Knowledge on donkey milk

About 95.8% of the households did not know of the health attributes associated with donkey milk compared to only 4.3% who said they knew of the benefits of donkey milk. The high number of people with no knowledge on donkey milk level may affect the perception on donkey milk consumption as well as the willingness to pay for donkey milk.

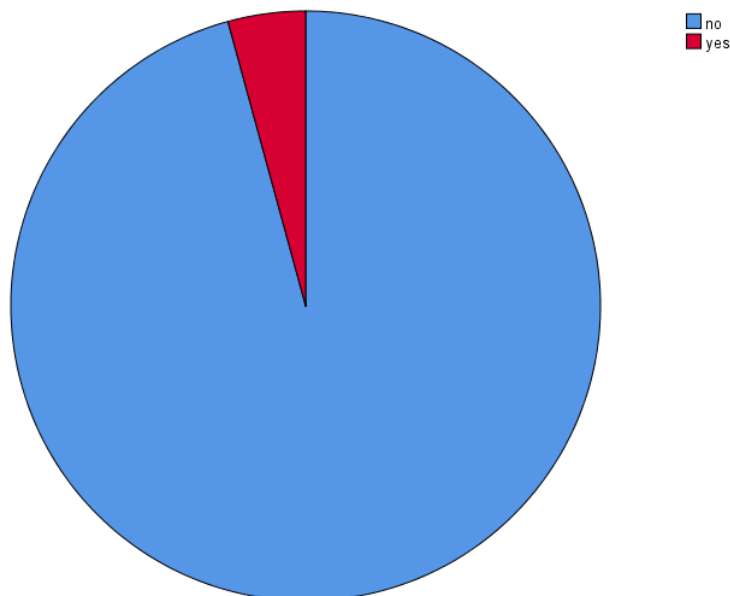


Figure 4.3: Knowledge on donkey milk, Source: Field Survey, 2018

4.3 Distribution of mean and standard deviation of continuous variables

The descriptive statistics of continuous variables are presented in Table 4.4. The results indicate that the average age of household heads had a mean of 54.46 and standard deviation of 11.619. This result suggests that on average, the household heads were matured adults. Additionally, Table 4.3 shows that the proportion of adult household members with secondary education and above had a mean of 0.32 and standard deviation of 0.469. A measure of household composition which assigns weights to different age and gender categories (adult equivalent) had an average of 3.34 and standard deviation of 0.824 whereas families with children under the age of 18 had a mean of 0.83 and $SD= 0.891$.

Table 4.4 Distribution of mean and standard deviation of continuous variables

Variable	Description	Mean	Standard Deviation
Age	Age in (years) of the household head	54.46	11.619
Children under 18 years	Number of children under 18 years	0.83	0.891
Secondary education and above	Proportion of adult household members with secondary education and above	0.32	0.469
Adult equivalent	measure of household composition which assigns weights to different age and gender categories	3.34	0.82357
FAC1(perception)	PC scores for each respondent	0.000	1.0000

Source: Field Survey, 2018

4.3.1 Descriptive statistics of categorical variables used in the regression model

The results of descriptive statistics of categorical variables included in the logit regression are reported in Table 4.5 below.

Table 4.5: Descriptive statistics of categorical variables used in the regression model

Variable	Percentage of total sample (n=400)
Gender	63.7(male)
	36.3 (female)
Income from non-farm activities (% of yes)	8.3
Income from wages and salaries (% of yes)	94.8
Income from pensions (% of yes)	15
Income from grants (% of yes)	17.5
Prior knowledge on donkey milk (% of yes)	4.3

Source: Field Survey, 2018

The analysis of categorical variables revealed that among respondents that had a positive perception on donkey milk, 8.3% got extra income from non-farm activities. Additionally, 17.5% of the respondents received income from grants and 4.3% had prior knowledge on donkey milk.

4.3.2 Summary Statistics of Variables used to measure households' perceptions on donkey milk

Respondents were asked to score each perception question on a five-point Likert-Scale from 2(strongly agree) to -2(strongly disagree) to solicit their perceptions on donkey milk and PCA was applied using a covariance matrix (Krzanowski 1987) to identify dominant ones. Table 4.6 presents the summary statistics of variables that were found to be the dominant factors affecting household's perceptions on donkey milk consumption.

Table 4.6 Summary Statistics of Variables used to measure households' perceptions on donkey milk

Statement	Mean	Standard Deviation
Nutritional content		
Donkey milk contains more nutrients than cow milk	-0.08	0.441
Consuming donkey milk can strengthen the human immune system	-0.12	0.498
Ecological welfare		
Donkey milk is produced in a way that does not affect the balance of nature	0.25	0.460
Milk from donkeys is extracted in a way that animals do not experience pain	0.30	0.516
Donkey milk is produced in a way that animals' rights are respected	0.17	0.387
Enterprise considerations		
Given the changing climate conditions in Mahikeng and elsewhere, which continues to affect agriculture, I believe that donkeys can play a role as a source of food and nutrition security in the future	-0.71	0.851
Sensory appeal		
Donkey milk tastes better than cow milk	-0.01	0.244
Compared to cow milk, donkey milk has a pleasant texture	0.01	0.200
Accessibility		
Donkey milk is expensive than cow milk	0.01	0.193
Only high income earners can afford to buy donkey milk	0.01	0.150

Overall, the survey respondents had mixed perceptions of donkey milk with the mean perceptions in some categories being positive or negative. The perception of the 'nutrient content' of donkey milk had negative mean values, suggesting that households' do not believe that donkey milk contains more nutrients than cow milk and that consuming donkey milk can strengthen the human immune system. Other notable negative mean values were recorded under 'enterprise considerations' and this suggests that households' generally do not think that given the changing climate conditions in Mahikeng and elsewhere, which continue to affect agriculture, donkeys can play a role as a source of food and nutrition security in the future and are not aware that donkey milk has a range of by-products, including cosmetics. This may be because of the preconceived attitudes on donkeys as animals. Donkeys are known to provide labour and most people do not see them as sources of food and nutrition.

The majority of the respondents were indifferent in the way they perceived the attributes of donkey milk. Perceptions in the 'sensory appeal', 'ecological welfare' and 'accessibility' attributes had mean values that are close to 0 (not sure) and that shows that most households are indifferent and are not sure with regards to the statements under each of these variables. This may be because the demand (consumption) aspect for donkey milk, which is a crucial

determinant for any industry's viability, has not been explored in South Africa, a gap that this study seeks to address.

4.4 Empirical findings

4.4.1 Consumers' perceptions on donkey milk

In attempting to address objective one, which sought to identify dominant indicators underlying consumers' perceptions on donkey milk consumption, the study considered 10 perception statements sourced from the literature. The variables were measured using a 5- point Likert-scale and as a result PCA was applied using a covariance matrix (Krzanowski 1987). The Kaiser-Meyer-Olkin's measure of sampling adequacy (KMO) and Barlett's test of sphericity chi-square were 0.648 and 2131.182, respectively, suggesting that PCA was an appropriate tool to provide significant reductions in dimensionality in the number of variables. Kaiser criterion of retaining PCs with eigenvalues 1 or greater was applied and as a result, three PCs that accounted for 69% of the variance of the original variables were perceived to be dominant in explaining consumers' perceptions on donkey milk. The PCs that had a PC loadings of more than ± 0.30 were considered to have a significant association between the extracted components and the original PCs as recommended by Koutsoyiannis (1992) for observations greater than 50. These loadings are highlighted in bold print in Table 4.7 below.

Table 4.7 Principal component analysis of households' perceptions on donkey milk, 2017(n=400)

VARIABLES	VARIABLE LABEL	PRINCIPAL COMPONENTS		
		1(Sensory Appeal and Accessibility)	2(Animal Welfare and Enterprise considerations)	3(Nutritional content)
Donkey milk contains more nutrients than cow milk.	D1	0.2560	-0.0493	0.6671
Consuming donkey milk can strengthen the human immune system.	D2	0.2928	-0.1091	0.6208
Donkey milk is produced in a way that does not affect the balance of nature.	D3	0.0426	0.5445	0.0545
Milk from donkeys is extracted in a way that does not cause pain to animals.	D4	0.0897	0.5023	-0.0072
Donkey milk is produced in a way that animals' rights are respected.	D5	0.0292	0.5425	0.1115
Given the changing climate conditions in Mahikeng ,donkeys can play a role as a source of food and nutrition security in the future	D6	0.1739	0.3369	-0.0837
Donkey milk tastes better than cow milk	D7	0.3889	-0.0342	-0.1308
Compared to cow milk, donkey milk has a pleasant texture	D8	0.3987	-0.1645	-0.1772
Donkey milk is more expensive than cow milk	D9	0.5099	-0.0164	-0.2317
Only high income earners can afford to buy donkey milk	D10	0.4874	-0.0230	-0.2119
Eigenvalues		3.077	2.365	1.517
Total variance explained		30.77	23.66	15.18

Note:

Bartlett's test of sphericity chi-value = 2131.182*; Kaiser-Meyer-Olkin measure of sampling adequacy = 0.648.

*, denotes significance at the 1% level of probability.

The first significant principal component (PC1), which accounted for 31% of the total variation of the original variables, was referred to as ‘Sensory Appeal and Accessibility’. This principal component is important as it reveals the dominant indicators (sensory appeal and accessibility) that underline households’ perception on donkey milk. The dominant indicators for this component were D7, D8, D9 and D10. These results suggest that households’ perceptions are influenced mostly by how donkey milk tastes and how it appeals to the eye. The household’s perceptions are also influenced by how easily accessible and affordable donkey milk is.

The second significant principal component was found to represent ‘animal welfare and enterprise consideration’. Animal welfare implies that households’ perception towards consuming donkey milk is based on whether the animal’s rights are observed when extracting milk and whether donkey milk is produced in a way that does not affect the balance of nature. On the other hand, enterprise consideration explains that households’ perception towards donkey milk is based on the donkey rearing enterprise ability to thrive under harsh conditions. This principal component explained 23% of the total variation of the original variables and the dominant indicators for PC2 were D3, D4 and D5, and D6.

The third significant PC represents the respondents’ ‘nutritional content’ concerns and it explains 15% of the variation of original variables. The dominant indicators for PC3 were D1 and D2. These results suggest that households’ perception on donkey milk is also influenced by the concerns of the nutritional attributes of donkey milk in terms of strengthening the human immune system. In Kenya, for instance, Jerop (2012) also found that most people had a positive attitude and were as a result willing to pay for goat milk due to its nutritional content. Therefore, ‘nutritional content’ is a significant factor perceived by households towards donkey milk consumption

4.4.2 Factors that influence consumers’ perceptions on donkey milk

After PCA was applied using a covariance matrix (Krzanowski 1987) to identify dominant variables, the first principal component (PC1), which accounted for most (31%) of the total variation of the original variables, was used as a dependent variable in the model. The Logit regression results are shown in Table 4.8 and the discussion focuses on the factors that were

found to have a significant influence on households' perception on donkey milk. The overall estimated model was statistically significant as the estimated Wald χ^2 value was significant at the 1% level of probability. Correct classification test predicted about 70% of the households' decisions, suggesting that the model fitted the data quite well. Before estimating the Logit model, the variables were tested for possible multicollinearity using pairwise correlations and variance inflation factor (VIF). With the results showing that the variables were independent of one another, the model was then estimated with robust standard errors to address possibilities of heteroscedasticity.

The results depicted that the age of household head, proportion of adult members with secondary education, number of children under 18 years, prior knowledge and income from grants significantly influenced household's perception on donkey milk consumption. The estimated coefficient for age of the household head had a positive impact on perception on donkey milk consumption and was significant at the 5% level of probability. The result suggests that older people had a positive perception on consumption of donkey milk given the nutritional attributes associated with the milk. This finding was in line with expectations and the findings of previous studies. Yegbemey et al., (2014) attributed this finding to health concerns that older consumers tend to have which often lead them to be more open to trying products that provided higher health benefits.

Another estimated coefficient that was found to be statistically significant ($p < 0.01$) was the proportion of adult household members with secondary education and above. The variable was negatively related to perception on donkey milk consumption implying that an increase in the proportion of household members with secondary education was associated with an increase in the likelihood of having a negative perception to donkey milk consumption. This could be because educated household heads could be exposed to other nutritious foods apart from donkey milk. These results are in line to previous findings (e.g Shi et al., 2014) which revealed an inverse correlation between education and perceptions on unconventional products.

Table 4.8 Logit marginal effects estimation of socio- economic factors affecting perception on donkey milk consumption (n=400)

Variables	Coefficient	Robust Std. error	dy/dx	Std. error	Z	P> z	VIF
<i>Household demographics & socio economic characteristics</i>							
Dummy for gender of household head (male = 1) ^a	-0.2886570	0.2374186	-0.634162	0.5215	-1.22	0.224	1.02
Age of household head	0.202696*	0.0123302	0.0044531*	0.00269	1.65	0.098	1.48
Proportion of adult household members with secondary education and above	-0.63555620**	0.2762567	-0.1333947**	0.05485	-2.43	0.015	1.18
Number of children under 18 years	0.3487627**	0.131332	0.0766211**	0.02892	2.65	0.008	1.16
Dummy for income from non-farm activities (Yes=1) ^a	-0.7497007*	0.5355793	-0.1441425*	0.08652	-1.67	0.096	1.09
Dummy for income from wages and salaries(Yes=1) ^a	0.5266227	0.5318277	0.1050852	0.09469	1.11	0.267	1.18
Dummy for Income from pensions(Yes=1) ^a	0.603648	0.3638631	0.0133583	0.08113	0.16	0.869	1.25
Dummy for income from grants(Yes=1) ^a	-0.4625318*	0.2593943	-0.0982894*	0.05288	-1.86	0.063	1.09
Household size(adult equivalents)	-0.0052528	0.1414801	-0.001154	0.03109	-0.04	0.970	1.03
Dummy for Prior knowledge on donkey milk(Yes=1) ^a	1.488915***	0.5665313	-0.3557773***	0.12548	2.84	0.005	1.07
Constant	-1.862799	1.152919					
<i>Measures of fit</i>							
Log pseudolikelihood	-234.60835						
Wald chi ² (24)	37.89						
Pseudo R ²	0.0859***						
Number of observations	400						
Correct classification	70%						
Mean VIF							1.15

Note: *, ** and *** means significant at 10%, 5% and 1% levels, respectively

^ady/dx is for discrete change of dummy variable from 0 to 1

Source: field survey, 2018

The estimated coefficient for households with children under the age of 18 was found to have a positive and significant effect on perception on donkey milk consumption (p<0.01). This result suggests that parents are more concerned with providing nutritive and safe food for the children. The greater awareness of diseases which could affect children in their early child development,

especially by mothers with day jobs that do not allow them to always breast feed their babies, would have positive perception to a healthy alternative (Pilla *et al.*,2010).

The results highlighted the significant effect of income from off-farm activities on perception on donkey milk consumption. However, the estimated coefficient for this variable was negative and this could be because of the preconceived attitudes towards donkeys. Donkeys are known for providing hard labour and are not associated with food and nutrition as a result. A consumer with lesser incomes will have an increased demand for elementary goods, whereas as the income increases so does the demand for expensive and luxurious goods.

Access to income from social grants was another estimated coefficient that was found to have a negative and significant impact on perception on donkey milk consumption ($p<0.05$), indicating that people with access to social grants are less likely to consume donkey milk. This may be because grants do not significantly change the financial classification of the recipients. They remain poor people who would have a negative perception on goods which they have not tried before which are likely to have higher price (Stats SA, 2017).

The results further revealed that prior knowledge on donkey milk had a positive effect and significantly influenced household's perception on donkey milk consumption ($p<0.05$). This result implies that respondents who have knowledge on the nutritional as well as cosmetic benefits of donkey milk were more open to the consumption of donkey milk. Rousseau and Vranken (2011) made similar findings showing that after being provided with information on health benefits of goods with similarly high health benefits, consumers had a positive perception towards the products in question.

4.4.3 Analysis of households' willingness to pay for donkey milk

In attempting to address objective three, which sought to assess consumers' willingness to pay for donkey milk, the double bounded contingent valuation method was used, whereby respondents are asked the amount they are willing to pay for a product. If they answer 'yes' to the first question then they are asked about their WTP for a premium amount. On the other hand, a lower amount is offered if their answer to the first question is 'no' (Alejandro, 2012).

In this study, the respondents were asked if they were willing to pay R13 for donkey milk and following the responses from 400 respondents, three categories of R13, R16 and R20 were arrived at. Table 4.9 below presents the distribution of the amount of the initial bid. The results revealed a high of 177 respondents (44.25%) under the first category which represented R13, followed by 130(32.50%) and 93(23.25%) representing R16 and R20, respectively.

Table 4.9: Distribution of the amount of the initial bid (n=400)

Bid 1	Frequency	Percentage	Cumulative frequency
R13	177	44.25	44.25
R16	130	32.50	76.75
R20	93	23.25	100.00
Total	400	100	

Respondents were asked the maximum and minimum amounts of money they would consider paying for donkey milk relative to their initial bid. Following responses from the first question, four outcomes YY, YN, NY and NN were achieved, whereby YY suggested that the answers were "yes", then WTP is greater than the upper bid, for YN, "yes" is the first answer followed by "no" and in this case, WTP is between the initial bid and the upper bid. In a case of NY, it means a "no" answer followed by "yes" and WTP is amid the lower bid and the initial bid. Finally, NN means that both answers are "no" and this case WTP range between zero as well as the lower bid (Vanit and Schmidt, 2002).

Subsequent to the above mentioned combinations, the following results in Table 4.10 were obtained. The table presents consumers' responses to the first question; whether they were willing to pay R13 for donkey milk. The results show that 88% of the respondents agreed to the first question whereas only 12% refused to pay R13 or more for donkey milk.

Table 4.10: Consumer's response to first question (n=400)

Answer 1	Frequency	Percentage	Cumulative frequency
No	48	12	12
Yes	352	88	100
Total	400	100	

When using a double contingent valuation data, it is important to verify whether the data make economic logic in the sense that as the bid amount is increased; the proportion of respondents that give a positive answer must go down (Alejandro, 2012). In this study the percentage of people who responded “yes” decreased from 88.7% to 78.49% as the price moved from R13 to R20. However, it is interesting to note that when the bid was increased from R13 to R16, the number of respondents initially slightly increased. Table 4.11 below presents the potential donkey milk consumer's responses to different premium and discount levels.

Table 4.11: Consumer's response to different premium and discount levels (n=400)

Answer 1	R13	Bid 1 R16	R20	Total
No	11.30	6.15	21.51	12
Yes	88.70	93.85	78.49	88
Total	100	100	100	100

Source: Analysis of Field Survey Data, 2018

Finally, the willingness to pay for donkey milk was obtained by comparing the current market price of cow milk in the study area. The findings in Table 4.12 below indicated that households in Mahikeng Local Municipality, on average, were willing to pay R17 per litre for donkey milk. This implies that consumers were willing to pay R4 more per litre of donkey milk over the price of cow milk (R13). This finding is consistent and in line with expectation because donkey milk has similarities with human milk and offers more nutritional and cosmetic values than cow milk as cited in earlier chapters of this study. This indicates that donkey milk production could be a profitable enterprise and hence provide feasible means to improve the livelihood and nutrition of resource constrained-farmers.

Table 4.12: Estimating consumer's Willingness to Pay (n=400)

	Coefficient	Stand. Error	z	P> Z	[95% conf. interval]
WTP	17.61195	1.31887	13.35	0.000	15.027

Source: Analysis of Field Survey Data, 2018

4.4.4 Factors that influence consumers' willingness to pay for donkey milk

Objective four sought to determine socio-economic factors influencing consumers' willingness to pay for donkey milk and to achieve this, the double bound probit model was used. The regression results are shown in Table 4.13 below and the results depicted that perception, age of household head, proportion of adult members with secondary education, number of children under 18 years, prior knowledge and income from grants, on farm activities, pensions and grants significantly influenced household's willingness to pay for donkey milk.

Table 4.13; Double bound Probit results of factors affecting household's Willingness to pay for Donkey milk. (n=400)

Variables	Coefficient	Standard error	z	p-value	[95% conf. interval]
FAC1(perception)	0.9969672	0.3232937	3.08	0.002*	0.3633232
Dummy for Gender of household head	-0.3196469	0.4470775	-0.71	0.475	-1.195903
Age of household head	-0.0602491	0.022015	-2.71	0.007*	-0.1037632
Proportion of adult household members with secondary education and above	0.296872	0.4946871	0.60	0.548	-0.672697
Number of children under 18 years	-0.3766364	0.2499215	-1.51	0.132	-0.8664735
Dummy for Income from on-farm activities	1.874651	0.6837981	2.74	0.006*	0.5344316
Dummy for Income from wages and salaries	0.9618252	1.060886	0.91	0.365	-1.117474
Dummy for Income from pensions	2.028583	0.687866	2.95	0.003*	0.6801539
Dummy for Income grants	-0.9662551	0.4729017	-2.04	0.041*	-1.893125
Constant	20.89296	1.854318	11.27	0.000	17.25865

Source: Analysis of Field Survey Data, 2018

Perceptions of consumers may have an effect on the decision making process and buying behaviour of individuals and this is evident from the results as the estimated coefficient for perception (PCA results) of household head had a positive impact on willingness to pay for donkey milk and was significant ($p < 0.05$). Despite the mixed perceptions, households were willing to pay for donkey milk. This shows that people are willing or not hesitant to make investment in good health. This finding is consistent with Voona *et al*'s (2011) study, which confirmed that individual norms and beliefs will positively affect the willingness to buy a product.

Another estimated coefficient that was found to be statistically significant ($p < 0.01$) was the age of the household head although it was negatively related to willingness to pay for milk. Similar to previous studies, age has been found to have mixed results with regard to WTP. For example, Diederich and Goeschl (2014) found that the age was negatively correlated with WTP. On the other hand, Loomis (2011) concluded that older consumers were more concerned with their health and were more willing to pay for healthy products. Another explanation could be that older people are often stuck in their ways and are unwilling to consume a product which they have deemed unpalatable for most of their lives.

Sources of income from wages and salaries as well as on-farm activities were found to be positive and statistically significant ($p < 0.05$) and ($p < 0.1$) respectively. This is because as the income increases so does the demand for expensive and luxurious goods. This finding reaffirms studies by Radam *et al*, (2010) on willingness to pay for organic products where it was found that respondents with income from salaries and other activities were willing to pay more for organic products.

On the other hand, although income from grants was another estimated coefficient that was found to be statistically significant ($p < 0.05$). The correlation between the variable and willingness to pay for donkey milk was negative. This could be because most of the grants recipients are poor and as a result would opt against buying goods they have not tried before which are likely to be costly.

4.5 Summary of the chapter

This chapter presented the study findings and discussion associated with dominant indicators underlying perception on donkey milk consumption, socio-economic factors that affect consumers' perception on donkey milk consumption as well as assessment of willingness to pay for donkey milk and finally, socio-economic factors that influence consumers' willingness to pay for donkey milk. In the following chapter, conclusions, recommendations and areas for further research are presented.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Recap of research objectives and methodology

Cow milk is most readily available because of the economies of scale that commercial dairy cattle enterprises offer. Whilst this provides great advantages for large scale agribusiness, dairy cattle enterprises have disadvantages for smallholders due to high production and maintenance costs (Mariani, 2008). As a result, cow milk is priced beyond the reach of poor small-scale farmers in developing countries where smallholders are significantly active in the milk value chain. Consequently, a greater proportion of consumers in developing countries cannot access better quality diets with a high milk composition (FAO and WHO, 2013).

On the other hand, donkey rearing for milk production presents a more economic substitute given the animal's low maintenance costs and its capability to withstand harsh environmental conditions. According to Aganga (2000), donkeys can survive on a wide variety of low cost feed and graze effectively even when there is insufficient rainfall and still remain in a relatively good physical condition. These strengths are especially advantageous for South African's North West Province, particularly Mahikeng, which has a semi-arid climate and is typically unfavorable for a number of agricultural enterprises (Mahikeng Local Municipality, 2016). This study therefore, sought to determine whether donkey milk has a considerable consumer demand and what socio-economic factors could influence donkey milk consumption. The findings were intended to provide stakeholders in the dairy supply chain and policy makers with information required to develop and commercialize the donkey milk industry, including value adding prospects. It also provided an opportunity to help initiate proper intermediations, as well as informing donkey milk projects and policies.

The specific objectives of the study were to: Identify dominant indicators underlying consumers' perceptions on donkey milk consumption; determine socio-economic factors affecting consumers' perceptions on donkey milk consumption; assess consumers' willingness to pay for donkey milk and determine socio-economic factors influencing consumers' willingness to pay for donkey milk.

Dominant indicators underlying consumers' perceptions on donkey milk consumption were studied using Principal Component Analysis (PCA). Given the numerous variables applied to study objective 1, PCA was used for the purpose of dimensional reduction by extracting few principal components (PCs) and summarizing the data with little loss of information. The PCs extracted had Eigenvalues of greater or equal to one and were later used in the regression model to identify dominant indicators underlying consumers' perceptions on donkey milk consumption. The results of the Principal components are continuous. Therefore, Ordinary Least Squares (OLS) model was used to analyse the socio economic factors that affect consumer perceptions. However, the estimated model was not significant and diagnostic results suggested the need for an alternative model. A Logit model was then used where the dependent variable was computed as follows: Negative PC scores were assigned the value=0 while the positive PC scores were assigned the value=1. A double bounded contingent method was used to assess consumers' willingness to pay for donkey milk and then a probit double bound was used to determine social-economic factors influencing consumers' willingness to pay for donkey milk.

5.2 Conclusions

5.2.1 Consumers' perceptions on donkey milk

PCA was applied using a covariance matrix to identify dominant variables. The first significant principal component represented "sensory appeal and accessibility". These results suggest that households' perceptions are influenced mostly by how donkey milk tastes and how it appeals to the eye. The household's perceptions are also influenced by how easily accessible and affordable donkey milk is.

The second significant principal component was found to represent 'Animal welfare and Enterprise consideration'. Animal welfare explains that households' perception towards consuming donkey milk is based on whether the animal's rights are observed when extracting milk and whether donkey milk is produced in a way that does not affect the balance of nature. On the other hand, enterprise consideration explains that households' perception towards donkey milk is based on the donkey rearing enterprise ability to thrive under harsh conditions.

The third significant PC represented the respondents' 'nutritional content' concerns. The results suggest that households' perception on donkey milk is also influenced by concerns on nutritional attributes of donkey milk in terms of strengthening the human immune system.

5.2.2 Factors that influence consumers' perceptions on donkey milk

After PCA was applied using a covariance matrix (Krzanowski 1987) to identify dominant variables, The first principal component (PC1), which accounted for most (31%) of the total variation of the original variables, was used as a dependent variable in the logit model to address objective two. The results revealed that the age of household head, proportion of adult members with secondary education, number of children under 18 years, prior knowledge and income from grants significantly influenced household's perception on donkey milk consumption.

The estimated coefficient for age of the household head had a positive impact on perception on donkey milk consumption and was significant at 5% level of probability. The result suggests that older people had a positive perception on consumption of donkey milk given the nutritional attributes associated with the milk.

The proportion of adult household members with secondary education and above was also significant although it was negatively related to perception on donkey milk consumption. An increase in the proportion of household members with secondary education was associated with an increase in the likelihood of having a negative perception to donkey milk consumption. This could be because educated household heads are more likely to find formal jobs and their choices for other nutritious foods is elastic and may therefore not consider consuming donkey milk.

The estimated coefficient for households with children under the age of 18 was found to have a positive and significant effect on perception on donkey milk consumption ($p < 0.01$). This result suggests that parents are more concerned with providing nutritive and safe food for the children.

The results also highlighted the significance of income from off-farm activities and grants towards perception on donkey milk consumption, although the latter had a negative correlation with perception on donkey milk consumption. This may be because grants do not significantly

change the financial classification of the recipients. They remain poor people who would have a negative perception on goods which they have not tried before which are likely be costly.

The results finally revealed that prior knowledge on donkey milk had a positive effect and significantly influenced household's perception on donkey milk consumption ($p<0.05$). This result implies that respondents who have knowledge on the nutritional as well as cosmetic benefits of donkey milk were more open to the consumption of donkey milk.

5.2.3 Analysis of households' willingness to pay for donkey milk

In attempting to address objective three, which sought to assess consumers' willingness to pay for donkey milk, the double bounded contingent valuation method was used. Initially, the respondents were asked if they were willing to pay R13 for donkey milk and following the responses from 400 respondents, three categories of R13, R16 and R20 were arrived at.

Willingness to pay for donkey milk was obtained by indicating the current price of cow milk in the study area as the base price. The findings indicated that households in Mahikeng Local Municipality, on average, were willing to pay R4 more per litre of donkey milk over the price of cow milk (R13). This indicates that consumers were willing to pay R17 per litre for donkey milk. This finding is consistent and in line with expectations because donkey milk shares some similarities with human milk and offers more nutritional and cosmetic values than cow milk.

5.2.4 Factors that influence consumers' willingness to pay for donkey milk

Objective four sought to determine socio-economic factors influencing consumers' willingness to pay for donkey milk and to achieve this, the double bound probit model was used. The results depicted that perceptions, age of household head, proportion of adult members with at least secondary education, number of children under 18 years, prior knowledge on donkey milk and income from grants, on farm activities and pension significantly influenced household's willingness to pay for donkey milk.

Perceptions of consumers may have an effect on the decision making process and buying behaviour of individuals and this was evident from the results as the estimated coefficient for perception (PCA results) of household head had a significant ($p<0.05$) positive impact on

willingness to pay for donkey milk. Despite the mixed perception reflected in the descriptive statistics, on average, households were willing to pay for donkey milk.

The age of the household head was negatively related to willingness to pay for milk. Like in previous studies, age has been found to have mixed results with regard to WTP. An explanation to this could be that older people are often stuck in their ways and are not willing to consume a product which they have deemed unpalatable for most of their lives.

Sources of income from wages and salaries as well as on-farm activities were found to be positive and statistically significant ($p < 0.05$) and ($p < 0.1$), respectively. This implies that as the income increases so does the demand for expensive and luxurious goods.

Although income from grants is another estimated coefficient found to be statistically significant ($p < 0.05$), the correlation between the variable and willingness to pay for donkey milk was negative. This could be because most of the grants recipients are poor and as a result would opt against buying goods they have not tried before and which are likely to be costly.

5.3 Policy recommendations

In line with the findings of the study, the following recommendations are made:

The empirical findings indicated “Sensory Appeal and Accessibility” as the dominant indicators underlying consumers’ perceptions on donkey milk consumption. This provides useful information to agribusiness as it highlights the significance of product or brand positioning as the key requirements for the donkey milk industry. Programmes and supporting services such as farmer training and extension should, therefore, be provided so as to ensure the success of the donkey production enterprises.

The government could partner with NGOs to provide resource-constrained farmers with donkeys to increase the production of donkey milk, build a conducive policy environment that would enable the willing market participants to succeed in this new market especially given that consumers are willing to pay more for donkey milk, than cow milk. These initiatives would

improve the food and nutrition security and incomes of the small-scale farmers with limited resources.

Other role players in the milk value chain need to invest in the establishment of the donkey milk industry because it is profitable, given the results on willingness to pay. Stakeholders need to be informed of the important attributes of donkey milk through media so as to raise awareness and, consequently, provide potential consumers with accurate information so that they can make informed decisions.

5.4 Limitations of the study

The study was based on an unaccustomed idea, donkey milk. As a result, interviewers had to first give a background of the idea by highlighting its benefits before responses from households could be drawn. Hence, the interviews took too long, making most respondents reluctant to take part in the study. Moreover, most time was consumed by translating the questionnaire contents to the local language of Setswana.

Secondly, the study was only limited to the consumers' side and did not study viability from the producers' side.

5.5 Suggested areas for further research

The focus of the study was to assess how much consumers were willing to pay for donkey milk. More efforts have to be made to establish the viability of a commercialised donkey milk industry. Future research may also consider analysing the willingness to pay for other agricultural products such as goat milk so as to draw a well-informed comparisons.

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APPENDICES

APPENDIX A

Household's Willingness to Pay for Donkey Milk; Evidence from Mahikeng Local Municipality Questionnaire.

Consent to take part in research

- I..... voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that participation involves(The study involves information on demography, perception on donkey milk as well willingness to pay for donkey milk)
- I understand that I will not benefit directly from participating in this research
- I understand that all information I provide for this study will be treated confidentially.
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.

Signature of research participant

Date.....

I believe the participant is giving informed consent to participate in this study

Signature of researcher.....

Date.....

SECTION A: CONSUMER'S DEMOGRAPHIC CHARACTERISTICS

Number of household members: _____

	Household members (start with the household head)	Relation with household head	Gender	Age	Highest level of education	Employment status	Does member contribute household income? Yes =1 No = 0
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							

NB: Use the codes below

Relation with household head 1 = spouse 2 = daughter/son 3 = daughter/son in law 4 = grandchild 5 = hired worker 6 = other	Gender 1 = male 2 = female	Highest level of education 1 = no schooling 2 = primary education 3 = secondary education 4 = matriculated 5 = tertiary education	Employment status 1= employed 2= unemployed 3=pensioner 4=school attending
--	----------------------------------	--	--

SECTION B: HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS

Please provide information on the major sources of household income on a monthly basis.

Source of household income	Not applicable	R0-R399	R400-1399	R1400-2399	R2400-3399	R3400-4399	R4400 and above
Crop production							
Beef cattle							
Dairy							
Goat production							
Sheep production							
Piggery							
Indigenous							
Commercial							
Formal/salary							
Temporary labour							
Temporary labour							
Self-employment							
Pension							
Child social grant							
Disability grant							
Other (specify)							

What type of livestock do you own and how many? *(Please indicate number owned in appropriate box. Complete table below)*

Type of livestock	Number currently owned
Cattle-oxen/bull	
Cattle-cows	
Cattle-heifers	
Cattle-immature	
Calves male	
Sheep	
Goat	
Donkeys	
Poultry	
pigs	

Besides livestock, do you produce crops? Yes [] No []

If yes, state the type(s) and size of production in Ha

Type of crop	Total area (Ha)
Total	

What is the total area of the arable land?

Other assets

Domestic assets	Number owned	Less than 3 years	3 to 7 years	Above 7 years
Coal stove				
Kitchen cupboard				
Radio				
Television				
DVD player				
Satellite receiver				
Chair				
Cell phone				
Gas stove				
Sewing machine				
Borehole				
Transport		Less than 3 years	3 to 7 years	Above 7 years
Car/truck				
Motorcycle				
Bicycle				
Cart				
Agricultural assets		Less than 3 years	3 to 7 years	Above 7 years
Tractor				
Tractor plough				
Tractor trailer				
Hand hoes				

Household Food expenditure

How much do you spend on food consumed by the household per month? Tick appropriate option

R0 – R 500 []

R501 – R 1 000 []

R 1 001- R1 500 []

R 1 501- R 2 000 []

R 2 000 and more []

Please rank your expenditure on the following food items, where 1 indicates highest expenditure and 5 the least expenditure

Cereals, bread []

Meat, chicken, fish []

Fruits and vegetables []

Milk and other dairy products []

Alcohol and cigarettes []

SECTION C: CONSUMER'S PERCEPTION ON DONKEY MILK CONSUMPTION

To what extent do you perceive the following statements before purchasing and consuming donkey milk? *For each statement, please choose one response from the list*(Where: 2 = Strongly agree; 1 = agree; 0 = not sure (neutral); -1 = disagree; and -2 = strongly disagree

Statement	2	1	0	-1	-2
Nutritional content					
I try to buy a variety of nutritious foods these days					
Donkey milk contains more nutrients than cow milk					
Consuming donkey milk can strengthen the human immune system					
There are no nutritional differences between cow and donkey milk					
Donkey milk is poisonous and can cause health problems					
Ecological welfare					
Donkey milk is produced in a way that does not affect the balance of nature					
Milk from donkeys is extracted in a way that animals do not experience pain					
Donkey milk is produced in a way that animals' rights are respected					
Enterprise considerations					
Compared to cows, donkeys can thrive under difficult environmental conditions					
Given the changing climate conditions in Mahikeng and elsewhere, which continues to affect agriculture, I believe that donkeys can play a role as a source of food and nutrition security in the future					
I am aware that donkey milk has a range of by-products, including cosmetics					
Sensory appeal					
Donkey milk looks better than cow milk					
Donkey milk tastes better than cow milk					
Compared to cow milk, donkey milk has a pleasant texture					
By simply looking at the animal (donkey), I cannot even think of consuming any of its products.					
Accessibility					
Donkey milk is expensive than cow milk					
Only high income earners can afford to buy donkey milk					
I am not aware of an outlet that sells donkey milk around my area					
The retail outlets I normally visit do not sell donkey milk					
Donkey milk is only available in limited outlets					
Social considerations					
Donkey milk is food for people who are classified as "poor" in society					
Donkey milk is recommended for "unhealthy" consumers					
Donkeys are known for providing hard labour and are not associated with food and nutrition					
Behavioural intentions					
If asked to make a choice between a litre of cow milk and a litre of donkey milk offered at the same price, I would choose donkey milk					
If asked to make a choice between a litre of cow milk and a litre of donkey milk where donkey milk is offered at a discount, I would choose cow milk					
If asked to make a choice between a litre of cow milk and a litre of donkey milk where cow milk is offered at a discount, I would choose cow milk					
The fact that donkey milk is not sold by reputable supermarket chain stores means it is sub-standard and not good for human health.					
I would not recommend donkey milk to anyone					

SECTION D: CONSUMER'S EXPERIENCE WITH DONKEY MILK.

1.1 Are you or any member of the family in any special diet currently? 1=Yes 0=No

1.2 Are you responsible for deciding what type of meal to consume? 1=Yes 0=No

1.3 Do you have knowledge of the health attributes of donkey milk? 1= yes 0=No

1.4 If yes to 1.3, from which source? [] 1. radio 2. Neighbour 3. Newspaper 4. Television 5.

Others (specify).....

1.5 If yes to 1.3, Indicate what you know of the health attributes.....

1.6 Have you or any member of the household tasted donkey milk before? 1= yes 0=No

1.7 Do you or any of the household members currently consume donkey milk? 1= yes 0=No

1.8 What are your reasons for consuming milk? Habit [] health reasons [] special occasion []

1.9 If no to 1.7, please state reasons.....

1.10 Do you take time to search for information when purchasing? Never[] rarely []
sometimes []

1.11 Do you base your Buying decisions on own preferences or opinions? Never[] rarely []
sometimes []

SECTION E: CONSUMER'S WILLINGNESS TO PAY FOR DONKEY MILK.

- 1.1 Compared to cow milk, donkey milk has many benefits. Donkey milk has proven to be just the best alternative feed to babies with allergies to cow milk because of its low fat content. The milk also has high levels of Lysozyme content which exhibits antibacterial action against a number of bacteria and offer protection against infections in human beings. Given these attributes, if a litre of cow milk is valued at around R13, would you be willing to pay more for donkey milk? Yes [] No [] Same amount []
- 1.12 If yes, how much are you willing to pay for donkey milk?
- 1.13 If no, how much less are you willing to pay for donkey milk?

**THANK YOU
FOR PARTICIPATING IN THIS STUDY**

APPENDIX B

LOGISTIC REGRESSION AND MARGINAL EFFECTS ON PERCEPTIONS ON DONKEY MILK CONSUMPTION

Logistic regression		Number of obs	=	399
		Wald chi2(10)	=	37.89
		Prob > chi2	=	0.0000
Log pseudolikelihood = -234.60835		Pseudo R2	=	0.0859

PERC	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
Gender	-.288657	.2374186	-1.22	0.224	-.753989	.176675
age_num	.0202696	.0123302	1.64	0.100	-.0038972	.0444364
Sec_above	-.6355562	.2762567	-2.30	0.021	-1.177009	-.0941031
no_ofchil~18	.3487627	.131332	2.66	0.008	.0913568	.6061687
non_farm	-.7497007	.5355793	-1.40	0.162	-1.799417	.3000154
wage_salary	.5266227	.5318277	0.99	0.322	-.5157404	1.568986
pension_in~e	.0603648	.3638631	0.17	0.868	-.6527937	.7735233
grants	-.4625318	.2593943	-1.78	0.075	-.9709353	.0458717
Adult_Equiv	-.0052528	.1414801	-0.04	0.970	-.2825486	.2720431
doyouhavek~e	1.488915	.5665313	2.63	0.009	.3785339	2.599296
_cons	-1.862799	1.152919	-1.62	0.106	-4.12248	.3968805

```
. estat classification
```

Logistic model for PERC

Classified	True		Total
	D	~D	
+	38	23	61
-	99	239	338
Total	137	262	399

Classified + if predicted Pr(D) >= .5

True D defined as PERC != 0

Sensitivity	Pr(+ D)	27.74%
Specificity	Pr(- ~D)	91.22%
Positive predictive value	Pr(D +)	62.30%
Negative predictive value	Pr(~D -)	70.71%

False + rate for true ~D	Pr(+ ~D)	8.78%
False - rate for true D	Pr(- D)	72.26%
False + rate for classified +	Pr(~D +)	37.70%
False - rate for classified -	Pr(D -)	29.29%

Correctly classified 69.42%

```
. mfx
```

Marginal effects after logit

y = Pr(PERC) (predict)
= .32591418

variable	dy/dx	Std. Err.	z	P> z	[95% C.I.]	X
Gender	-.0634162	.05215	-1.22	0.224	-.165621 .038789	1.36341
age_num	.0044531	.00269	1.65	0.098	-.000826 .009732	54.411
Sec_ab~e*	-.1333947	.05485	-2.43	0.015	-.240901 -.025888	.325815
no_of~18	.0766211	.02892	2.65	0.008	.019939 .133304	.829574
non_farm*	-.1441425	.08652	-1.67	0.096	-.313719 .025434	.082707
wage_s~y*	.1050852	.09469	1.11	0.267	-.080498 .290668	.947368
pensio~e*	.0133583	.08113	0.16	0.869	-.145662 .172379	.14787
grants*	-.0982894	.05288	-1.86	0.063	-.201924 .005346	.318296
Adult_~v	-.001154	.03109	-0.04	0.970	-.06208 .059772	3.34105
doyouh~e*	.3557773	.12548	2.84	0.005	.109846 .601709	.042607

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
. collin PERC Gender age_num Sec_above no_ofchildrenlessthan18 non_farm wage_sa
> lary pension_income grants Adult_Equiv doyouhaveknowledgeofdonkeymilkbe
(obs=399)
```

Collinearity Diagnostics

Variable	VIF	SQRT VIF	Tolerance	R- Squared		
PERC	1.12	1.06	0.8946	0.1054		
Gender	1.02	1.01	0.9795	0.0205		
age_num	1.48	1.21	0.6779	0.3221		
Sec_above	1.18	1.09	0.8464	0.1536		
no_ofchildrenlessthan18			1.16	1.08	0.8645	0.1355
non_farm	1.09	1.04	0.9163	0.0837		
wage_salary	1.18	1.08	0.8504	0.1496		
pension_income		1.25	1.12	0.8000	0.2000	
grants	1.09	1.05	0.9150	0.0850		
Adult_Equiv	1.03	1.02	0.9680	0.0320		
doyouhaveknowledgeofdonkeymilkbe			1.07	1.04	0.9321	0.0679
Mean VIF	1.15					

```
. correlate PERC Gender age_num Sec_above no_ofchildrenlessthan18 non_farm wage
> _salary pension_income grants Adult_Equiv doyouhaveknowledgeofdonkeymilkbe
(obs=399)
```

	PERC	Gender	age_num	Sec_ab~e	no_of~18	non_farm	wage_s~y
PERC	1.0000						
Gender	-0.0635	1.0000					
age_num	0.1908	-0.0120	1.0000				
Sec_above	-0.1874	-0.0027	-0.3312	1.0000			
no_ofchil~18	0.1502	0.0334	0.1183	-0.1252	1.0000		
non_farm	-0.1022	-0.0188	-0.1505	0.0631	-0.1162	1.0000	
wage_salary	-0.0187	-0.0786	-0.1622	0.1399	-0.2846	-0.0922	1.0000
pension_in~e	0.0556	0.0522	0.4180	-0.0636	0.0163	-0.0738	-0.0915
grants	-0.1428	0.0095	-0.1817	0.1793	-0.0082	0.0878	0.1370
Adult_Equiv	0.0256	-0.0697	0.0951	-0.0774	0.0567	-0.0484	-0.0128
doyouhavek~e	0.1349	-0.0304	0.0611	-0.0143	-0.0850	0.1169	0.0497
	pensio~e	grants	Adult_~v	doyouh~e			
pension_in~e	1.0000						
grants	-0.0118	1.0000					
Adult_Equiv	-0.0224	0.0030	1.0000				
doyouhavek~e	-0.0529	-0.0642	-0.0863	1.0000			

APPENDIX C

DOUBLE BOUND PROBIT MODEL ON WILLINGNESS TO PAY

Log likelihood = -532.18874

Number of obs = 399
Wald chi2(9) = 37.86
Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Beta						
FAC1_1	.9969672	.3232937	3.08	0.002	.3633232	1.630611
Gender	-.3196469	.4470775	-0.71	0.475	-1.195903	.5566089
age_num	-.0602491	.0222015	-2.71	0.007	-.1037632	-.016735
Sec_above	.296872	.4946871	0.60	0.548	-.672697	1.266441
no_ofchil~18	-.3766364	.2499215	-1.51	0.132	-.8664735	.1132008
on_farm	1.874651	.6837981	2.74	0.006	.5344316	3.214871
wage_salary	.9618252	1.060886	0.91	0.365	-1.117474	3.041124
pension_in~e	2.028583	.6879866	2.95	0.003	.6801539	3.377012
grants	-.9662551	.4729017	-2.04	0.041	-1.893125	-.0393849
_cons	20.89296	1.854318	11.27	0.000	17.25856	24.52736
Sigma						
_cons	3.845301	.1876469	20.49	0.000	3.477519	4.213082

First-Bid Variable: bid1
Second-Bid Variable: bid2
First-Response Dummy Variable: answer1
Second-Response Dummy Variable: answer2

```
. nlcom (WTP: (_b[_cons] + FAC1_1_m*_b[FAC1_1] + age_num_m*_b[age_num])), nohea
> der
```

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
WTP	17.61195	1.318872	13.35	0.000	15.027	20.19689

