AN ASSESSMENT OF SMALLHOLDER LIVESTOCK KEEPERS' WILLINGNESS-TO-PAY FOR CATTLE INSURANCE ATTRIBUTES IN BOTSWANA: THE CASE OF CENTRAL DISTRICT

RAMOLEFHE OREEDITSE SHIRLEY

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DECLARATION

This thesis is my original work and has not been submitted for a degree in any other university.

_____ Date: _____

Oreeditse Shirley Ramolefhe

Reg NO: A56/76816/2014

(Candidate)

This proposal has been submitted with our approval as University Supervisors:

Dr Patrick Irungu

Department of Agricultural Economics, University of Nairobi

_____ Date: _____

Prof Rose Nyikal

Department of Agricultural Economics, University of Nairobi

_____ Date: _____

DEDICATION

This thesis is dedicated to my family members Peter, Maithoko, Segomotso and Kagiso Ramolefhe. It was through your prayers, unconditional love, unending encouragement and support that I have made it this far.

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ABBREVIATIONS AND ACRONYMS

BIC	Botswana Insurance Company
BMC	Botswana Meat Commission
BIC	Botswana Insurance Company
BMC	Botswana Meat Commission
CA	Conjoint analysis
CAR	Centre for Applied Research
CBPP	Contagious Bovine Pleura Pneumonia
CVM	Contingent Valuation Method
DBDCM	Double-bounded dichotomous choice method
FGD	Focus Group Discussions
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
GoB	Government of Botswana
IIA	Independence of Irrelevant Alternatives
MNL	Multi-Nominal Logit Model
NDP	National Development Plan
NI	Normal Insurance
OPM	Ordered Probit Model

RUT	Random Utility Theory
SMEs	Small and medium enterprises
SPSS	Statistical Package for Social Sciences
TPB	Theory of planned behaviour
TRA	Theory of reasoned action
USA	United States of America
WIBI	Weather Index-Based Insurance
WTP	Willingness-to-pay

ABSTRACT

Botswana's livestock sector accounts for about 70 percent of foreign exchange earned from the agriculture sector. Livestock is a major source of income, employment and provides a store of wealth to many low and unskilled Batswana. However, the livestock sector is threatened by several risks including pests and diseases, climatic shocks and abrupt policy shifts that affect production. Some of these risks can be mitigated by adopting livestock insurance. In 2010, the Botswana Insurance Company (BIC) introduced a livestock insurance policy with the objective of encouraging farmers to take up measures that reduce the adverse effects of natural calamities. However, despite the existence of livestock insurance policy, few traditional livestock keepers have adopted it. The objective of this study, therefore, was to assess smallholder cattle keepers' willingness-to-pay (WTP) for cattle insurance attributes (as a non-market commodity) in the Central District, the largest traditional cattle-keeping district in Botswana. Five focus group discussions (FGDs) were conducted in Mahalapye, Radisele, Tamasane, Palapye and Serowe villages to determine the main attributes that the livestock keepers would want to have in a cattle insurance policy. Using the factorial design in conjoint analysis, six attributes and their levels were combined into sixteen profiles which were presented to respondents in pictorial format for preference ranking. The profiles were presented to 182 random selected smallholder cattle keepers for their expression of WTP. The WTP was derived from the marginal utilities of insurance attributes. An ordinary least squares regression was used to assess factors influencing the WTP for cattle insurance attributes among livestock keepers in the study. The results show that the livestock farmers were willing to pay $17.77, $7.07 and $1.12 for weather index-based insurance cover, covering proportion of a herd and replacing a dead cow with a live one respectively. The overall

mean WTP for a full insurance product was $11.45, which is within the price range of the current livestock policy used by commercial livestock keepers in Botswana.

The factors that positively influenced respondents' WTP for cattle insurance were distance to the nearest tarmac road, off-farm investment income, total land size owned by the respondent, and total livestock unit (TLU). The age of household head, access to credit, annual crop sales income and vaccine cost negatively influenced the WTP. In addition, having extra income, land and many cattle increased livestock keepers' WTP for cattle insurance. Being an older farmer who vaccinated his livestock and received cash from arable farming reduced the WTP for the cattle insurance policy. Given that the most preferred cattle insurance profiles were numbers 7, 12, 10 and 14 with WTP values of US$23.88, US$20.13, US$18.88 and US$18.13 per unit respectively, the BIC could consider designing cattle insurance policy products within that price range. The most ideal policy should have the attributes of profile number 7, i.e., have a 1-month compensation period, cover a portion of the cattle herd, be weather index-based at a monthly premium of US$0.7 paid as an annuity, and compensate keepers with a live animal in case of a loss.

Keywords: Willingness to-pay, Cattle insurance attributes, Preference, Smallholder livestock keepers, Conjoint analysis, Ordered probit model, Central District, Botswana

CHAPTER ONE: INTRODUCTION

1.1 Background

Although diamond and tourism sectors are the mainstay of Botswana's economy, the agricultural sector is the main source of livelihood to the majority of Batswana and accounts for approximately three percent of the Gross Domestic Product (GDP) (Masole, 2018). Within agriculture, the beef sub-sector accounts for 80 percent of agricultural GDP (Kgosikoma and Malope, 2016; Mogotsi et al., 2016). The beef industry contributes about 70 percent of foreign exchange earned from agriculture (Bahta et al., 2017) and injected 160 million US dollars to the economy in 2014 (Masole, 2018). Moreover, the beef sector has employed about 63 percent of low and unskilled people (Yaron et al., 2012). Amidst the prosperous beef sector, 80 percent of Botswana's landmass is the Kalahari Desert, with arid to semi-arid climatic conditions (Rudee, 2011).

As such, arable farming is severely constrained by moisture stress due to arid climatic conditions. The only sustainable means of exploiting the land is extensive livestock production based on nomadic transhumance and commercial ranching (Madzwamuse et al., 2007). According to Statistics Botswana (2015), there were 2.8 million cattle, 512,000 sheep and 616,000 goats in 1979. However, over the years, the cattle population declined due to several challenges including weak linkages with markets, climate change and re-occurring diseases (Bahta et al., 2015; Temoso et al., 2015). Currently, the livestock population consists of 1.7 million cattle, 1.5 million goats and 274,000 sheep respectively, indicating a 56 percent increase in goat population (Statistics Botswana, 2018). The growth in goat population is attributed to the Livestock Management and Infrastructure Development (LIMID) Programme implemented by the Government of Botswana (GoB) in 2006 (Moreki et al., 2010). This programme aimed at ameliorating food security through

improved productivity of livestock management and eradicating poverty among smallholder keepers (Yaron et al., 2012; Moreki et al., 2010).

Botswana's livestock sector is characterized by two production systems, i.e., commercial and traditional farming. Commercial farmers rear livestock mainly for sale to the Botswana Meat Commission (BMC). Accounting for about 20 percent of the livestock population, this production system involves private grazing or ranching on freehold or leasehold farms (ranches) solely producing livestock for sale (Orlowski and Sigwele, 2014; Bahta et al., 2013; van Engelen et al., 2013). This production system is characterized by use of improved cattle breeds, frequent vaccination, supplemental feeding and other improved livestock production methods including use of livestock insurance (van Engelen et al., 2013; Bahta et al., 2015).

The traditional livestock sector, on the other hand, entails extensively rearing livestock in the communal grazing areas by subsistence-oriented keepers (although some practice semi-commercial production as well) (Mahabile, 2014; Bahta et al., 2013). This system is predominantly practiced by smallholder livestock keepers (owning an average 150 cattle each), and accounts for about 80 percent of cattle in Botswana (Mogotsi et al., 2016; Statistics Botswana, 2018). Under this system, the land is communally owned where grazing land is used collectively hence restricting the scope for improved management practices (Temoso et al., 2015). Livestock keepers employ few modern inputs, and routine disease vaccination is occasionally undertaken by the government (Tselaesele et al., 2018; Bahta et al., 2013). Livestock is mainly kept for socio-cultural purposes including paying for the bride price, use in cultural ceremonies, and occasionally sold to

meet household cash needs (for example, paying children's school fees). In particular, farmers keep large herds of cattle for social prestige and as a sign of wealth (Mahabile et al., 2008).

Despite the high contribution of the traditional livestock production to beef exports and livelihoods of many rural Batswana, it faces many challenges including high prevalence of pests and diseases, lack of agricultural investment, contracting grazing land amidst high stocking rates, climatic shocks (e.g., recurring droughts), and low adoption of productivity-enhancing technologies (Tselaesele et al., 2018; Bahta et al., 2017; Temoso et al., 2015). Due to these constraints, Botswana's beef industry has experienced a reduction in the number of traditional cattle sent to BMC from 53,573 in 2013 to 34,358 in 2015 (Statistics Botswana, 2018). In addition, high stocking rates in communal areas have been associated with increased land degradation (Mahabile, 2014), while frequent outbreaks of foot and mouth disease (FMD) and contagious bovine pleura pneumonia (CBPP) have led to an overall decline in the national cattle herd population from about three million in the early 1980s to roughly 1.7 million in 2015 (Statistics Botswana, 2018). A decline in cattle population causes a threat to Botswana's lucrative beef industry, affecting both the economy and smallholder keepers who heavily rely on it as a source of income and livelihood.

In an attempt to deal with the above-mentioned challenges, in 2010, the Botswana Insurance Company (BIC) set up a livestock insurance policy aimed at easing the burden on government of compensation to livestock keepers for occasional livestock losses to adverse effects of natural calamities such as disease incursions and predation by wildlife (van Engelen et al., 2013; Kgathi et al., 2012; Kgosikoma and Batisani, 2014). The insurance policy is conditional on good management practices and hence mainly targets commercial farmers or cattle kept in ranches (van

Engelen et al., 2013). However, since its inception, only a handful of traditional livestock keepers have adopted the policy as most of them do not rear their livestock in fenced cattle areas.

Specialized and individually-tailored livestock insurance cover is available for a variety of clients, from private farm owners to commercial operations (BIC, 2013). The current livestock insurance policy has three products namely, "Herd Select", "Herd Essential" and "Stud Animal" (van Engelen et al., 2013). "Herd Select" is where the entire herd of cattle is insured whereas in "Herd Essential", the farmer selects a specific number of cattle to be insured. The "Stud animal cover" is meant for all breeding animals in cases where a farmer keeps special animals for breeding purposes (BIC, 2013). The BIC offers livestock insurance nationwide focusing on cattle, goats and sheep, with benefits of the insurance inclusive of assisting policyholders to obtain credit from financing institutions (commercial banks), and serving as a risk management option (ibid).

Despite the fact that both traditional and commercial livestock production systems experience similar constraints, the current livestock insurance policy mainly targets commercial farmers (BIC, 2013). The stringent conditions of the current insurance policy largely exclude smallholder livestock keepers even though they hold a relatively larger proportion of livestock than their commercial counterparts (Bahta et al., 2017; Statistics Botswana, 2018). This discrimination is occasioned by the fact that most smallholder cattle keepers do not rear their livestock in fenced areas, hence violating one of the terms and conditions of the insurance policy (Personal communication, Leoketsa). Because of the orientation of the traditional production system, there are few alternative options for managing risk. In addition, traditional livestock keepers are highly vulnerable to production and market risks as they have low risk bearing ability. Livestock

insurance could serve as a risk mitigating tool to insure keepers against external shocks especially those associated with disease outbreak and climate change.

1.2 Statement of Research Problem

The decline in the cattle population due to climate shocks and FMD outbreaks has placed a huge strain on Botswana's economy. In particular, the loss of cattle has mostly affected the smallholder keepers as they have few alternative sources of livelihood and are therefore highly dependent on government support. For example, in 2011, smallholder cattle keepers in the North-East District of Botswana lost about $10,570 to an outbreak of FMD (Masole, 2018). Responding to this loss, the GoB spent about $1,000,000 to compensate keepers after cattle culling to prevent the spread of the disease to other districts (Masole, 2018).

One important remedy to insulate the cattle producers against such losses is livestock insurance. Although livestock insurance has been present in Botswana since 2010, its uptake is very low (Personal communication, Leoketsa), the reason for which is not clear. Could it be that the conditions of the insurance policy exclude the smallholder cattle keepers even though they hold a large proportion of cattle kept in Botswana? Or is it that smallholders are not aware of existing policy? If they are, is it that livestock management practices exclude them from the current insurance policy? Meanwhile, due to the importance of livestock insurance in Botswana, it would be important to structure it to make it more customer-focused.

From the foregoing, there is need to understand why smallholder cattle keepers have not taken up the livestock insurance policy. Such understanding would be of great importance to the GoB

because the beef industry contributes a large share of the agricultural GDP. Additionally, a lot of tax revenue is usually lost compensating livestock keepers against disease, especially FMD and climate change. For example, in 2015, smallholder livestock keepers in the Central District lost 1,429 cattle to disease and 429 cattle to drought (Statistics Botswana, 2018). However, because they were not insured, no compensation was paid, which negatively affected their livelihoods.

Previous studies conducted in Botswana on risk management strategies focus more on informal responses as compared to formal risk responses. For example, Masole (2018) assessed the risk factors and *ex post* responses adopted by smallholder beef producers after FMD outbreaks in the North-East District of Botswana. The study found that *ex post* response strategies such as frequency of contact with extension officers, training on FMD, distance to grazing and water areas as well as proximity to other household farms were adopted by farmers. All of the adopted risk responses are informal, while adoption of livestock insurance as a formal risk management strategy was not included as a way of insulating cattle producers against their loss.

Studies on formal risk mitigating measures adopted by smallholder cattle keepers in the Central District of Botswana are virtually non-existent. For example, no study so far has focused on cattle keepers' WTP for cattle insurance attributes. Most importantly, the information on smallholder cattle keepers' awareness and perceptions on the existing livestock insurance policy in Botswana is not known. This study aimed to fill these gaps in knowledge.

1.3 Justification of the Study

The livestock sector contributes 70 percent of livelihood to rural dwellers in Botswana and (Bahta et al., 2017). However, the sector faces many challenges that have caused cattle population to decline over the years (Yaron et al., 2012). Loss of cattle has reduced the amount of foreign exchange earned by the country as well as the wealth accumulated by smallholder cattle keepers. The study focuses on cattle insurance as a strategy for mitigating and reducing loss of cattle due to production risk associated with drought and diseases.

It is envisaged that the study will be beneficial to policy makers, the BIC and smallholder cattle keepers. Providing formal risk management strategy to smallholder cattle keepers may assist them to realize the nation's first pillar of Vision 2036 of achieving sustainable economic development (Moroka, 2017). This contribution would also meet the aspirations of the Malabo Declaration on accelerated agricultural growth and transformation and improved livelihoods to reduce the vulnerability of livelihoods through building resilient systems by ensuring that at least 30 percent of farms and households in Africa are resilient to risk by 2025 (African Union, 2014). The realization of Sustainable Development Goal (SDG) number 1 and 2 of reducing poverty and ending hunger will also be achieved.

Knowledge of the preferred cattle insurance attributes will assist the BIC to formulate insurance products that are suitable and tailor-made for this group of farmers and hence encourage them to adopt the policy to safeguard their wealth against risk. The estimated WTP for cattle insurance attributes will assist the BIC to target particular market segments based on their WTP. Smallholder cattle keepers will benefit by acquiring knowledge of the importance of livestock insurance policy,

its benefit and how it can address the production challenges that they encounter. Knowledge of the importance of insurance policy can assist them adopt formal risk management strategies and persuade them to shift their production objective from subsistence to commercial orientation.

This study contributes to the existing literature in that it is the first (at least in the context of Botswana) to assess both smallholder livestock keepers' preference and WTP for cattle insurance attributes. Most empirical studies (e.g., Xiu et al., 2012; Khan et al, 2013; Asamoah, 2019; Mataqin and Usami, 2019) concentrate on the WTP for the insurance policy as a whole and ignore WTP for individual attributes of the policy like the current study. The approach adopted in this study is unique in that it contributes to science by using a CA approach to elicit WTP for livestock insurance.

1.4 Objectives of the Study

The overall objective of this study was to examine smallholder livestock keepers' WTP for cattle insurance attributes in the Central District of Botswana. The specific objectives were:

1. To assess smallholder livestock keepers' knowledge and awareness of cattle insurance policy in the Central District of Botswana.
2. To characterize smallholder livestock keepers' preference for cattle insurance attributes in the study area.
3. To estimate smallholder livestock keepers' willingness-to-pay for cattle insurance attributes in the study area.
4. To evaluate factors influencing smallholder livestock keepers' willingness-to-pay for cattle insurance attributes in the study area.

1.5 Hypotheses tested

The following hypothesis were tested in this study. That

1. There is no difference in the livestock keepers' preferences for cattle insurance attributes.

2. Smallholder livestock keepers' WTP for cattle insurance attributes is zero.

3. Smallholder livestock keepers' characteristics, institutional factors and insurance attributes, taken singly, have no effect on the WTP for cattle insurance attributes in Central District of Botswana.

1.6 Organization of this Thesis

This thesis is organized into five chapters. The first chapter presents the introduction of the study including the background, statement of the research problem, objectives and justification of the study. Chapter two reviews the exant literature on WTP for livestock insurance policy and the theoretical frameworks employed in such studies. The third chapter presents the methodology describing the study area, data collection and analytical methods used in the study to address the objectives. Chapter four presents the results and discussion while chapter five summarized and concludes the thesis ending with the key recommendations of the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Understanding the Concept of Willingness-to-Pay

Willingness-to-pay (WTP) is defined as either the maximum quantity or amount of money an individual will pay in exchange for an improved circumstance, or the maximum amount a person has to pay to avoid a decline in the circumstance (Abebe and Bogale, 2014). Ramasubramanian (2012) described WTP as the amount of money an individual is willing to pay to procure a product given his income, background characteristics and risk preferences. According to Breidert et al. (2006), the amount a person is willing to pay is subject to the perceived economic value and the expected utility of the good. WTP is important because consumers' response to price influences their consumption of goods or services provided and the revenues collected.

An implicit assumption in measuring WTP is that individuals who report positive WTP values should be both willing and able to pay the price if offered the product or service (Mabaya et al., 2010). WTP measures are considered beneficial as they provide information of the value that consumers attach to some goods or services, thus appraise the pricing of these goods or services (Hanley et al., 2003). Similarly, WTP measures can be convenient tools for making relative evaluations and rankings of the desirability of goods and services (Hole et al., 2012).

2.2 Theoretical review

2.2.1 Theories explaining WTP

The literature gives five theories that anchor the WTP concept. These are: the basic economic model, theory of public goods, theory of planned behaviour, altruistic/moral behavior, and norm-activation model (Liebe et al., 2011). According to Liebe et al. (2011), the basic economic model

focuses on two determining factors of WTP; income and use of the good in question. When individuals contemplate to pay for an upgraded environmental quality, their choices are restrained by disposable income. Ideally, income should correlate with the amount of money consumers are willing to spend to procure environmental goods or to attain improved environmental quality (Carson et al., 2001; Liebe et al., 2011). People use goods to improve their well-being creating a direct behavioral link between the good and the individual's well-being. This link is articulated by the concept of "use values" (Liebe et al., 2011). Use values are tangible features of a commodity which satisfy some human needs or wants, assuming that users are willing to pay for the good they used (Carson et al., 2001).

For the theory of public goods and collective action, dilemma concern and trust in other people's cooperation are assessed to determine WTP (Liebe et al., 2011). This theory arises from the concept of individuals perceiving and defining their WTP as a contribution to gain a public good (Olson, 1965; Sandler, 1992). A crucial point in this theory is the non-excludability attribute of public goods, i.e., once the good/service is provided, an individual cannot be excluded from using the good even if they do not contribute towards its provision (Gillinson, 2004). Dilemma concern is a perception that measures the magnitude to which people apprehend environmental protection as a social dilemma and monitor strategies of conditional cooperation (Castro Caldas et al., 2003). On the other hand, the notion "trust in other people's cooperation" refers to a person's belief that others are willing to pay or "do their share". Ostrom (2000) stated that individuals who put their trust in others to cooperate will unlikely assume that they are the only ones contributing for the good.

The theory of planned behaviour (TPB) states that attitude toward behavior, subjective norms, and perceived behavioral control shape an individual's behavioral intentions (Ajzen et al., 1996). TPB is derived from the theory of reasoned action (TRA) which states that an individual's intention is determined by two factors, one reflecting his individual interests and the other his social influence (Joel, 2018). According to Ajzen et al. (1996), for a behaviour to be executed, the immediate determinant includes "the behavior of paying money for a good", thereby proposing three determinants of behavioral intention as "perceived behavioral control", "subjective norm" and "attitude toward behavior". For public environmental goods, WTP is anticipated to increase with a supplementary satisfactory attitude towards paying for such goods, increasing social pressure toward paying and with an increasing perceived behavioral control regarding paying for such goods (Liebe et al., 2011).

The ability and behaviour of helping other people without expecting anything in return is termed as altruism (Batson et al., 2011). Schwartz (1977) explains that the altruistic behavior is causally influenced by emotional state of moral obligation to act on one's personal norms. This behaviour is designed to increase another person's welfare, especially by performing actions which do not provide a direct compensation to the person who performs them (Batson et al., 2011). At times, WTP does not fluctuate with the quantity of the good provided but by the utility derived from the act of giving (Liebe et al., 2011). Altruistic motivation leads to personal satisfaction by contributing towards a good deed yielding individual utility because feelings of moral obligation are met (Schwartz, 1977). In economic valuation, the feelings of obligation are discussed in terms of "a warm glow of giving" or "purchase of moral satisfaction" (Liebe et al, 2011). It is expected

that WTP will be positively affected by both a general warm glow and a subjective obligation to pay for the specific good which is independent of the specific good in question (ibid).

The norm-activation model reckons that a personal norm leading to moral obligations regarding a distinct activity of paying for an environmental good is only stimulated and transformed into behavior if definite conditions are fulfilled (Liebe et al., 2011). This theory was developed by Schwartz in 1977 to explain the helping behaviour and is a cognitive and sequential decision model that covers the entire process from norm-activation to action. With regard to WTP for environmental goods, most conditions include the awareness of need and the awareness of responsibility as determinants of norm-activation (Blamey, 1998a, 1998b; Guagnano, 2001; Guagnano et al., 1994) (quoted in Liebe et al. (2011)). In the framework of WTP analyses, behavioral determinants of WTP are the individual norm to pay for the good or service, the awareness of need with respect to providing the good, and the awareness of responsibility for paying (Liebe et al., 2011). The theories and determinants of WTP are summarized in Table 2.1.

Table 2. 1 Summary of theories underpinning the concept of willingness-to-pay

Theoretical Approach	Determinants of WTP
Basic Economic Model	Income, Use of public goods
Theory of Public goods	Dilemma concern, Trust in other people's cooperation
Theory of Planned Behaviour	Attitude towards paying, subjective norm, Perceived behavioral control
Altruistic/ Moral behavior	General warm glow, subjective Obligation to pay
Norm-Activation Model	Awareness of need for paying, Awareness of responsibility for paying

Source: Liebe et al. (2011)

From the theoretical review of WTP above, it is evident that the most suitable theory for the current study is TPB as it explains a consumer's behavioral intention to pay for a non-market commodity. The consumer's behavioral intention can then be used to estimate actual behavior (Davies et al., 1989). Therefore, the TPB was adopted in this study as a framework to assess the WTP for cattle insurance policy in the Central District of Botswana.

2.2.2 Approaches used in estimating WTP

To determine the worth of non-marketed goods and services, economists have developed numerous techniques broadly categorized into revealed and stated preference methods (Dofonsou et al., 2008; Briedert et al., 2006). The distinguishing feature between revealed and stated preference approaches is that whereas revealed preference techniques rely on values directly observed from people's market behavior (e.g., demand or uptake of a good or a service), stated preference methods are used to determine their behavior towards a non-marketed good or service from their responses about their behavioural intensions (Briedert et al., 2006). As such, stated preference methods are the most suitable for this study as they utilize respondents' ranking of different products to estimate their preference, for example, for hypothetical insurance policy profiles from which WTP can be derived.

2.2.2.1 Stated preference methods

The most commonly used stated preference methods for estimating WTP are contingent valuation method (CVM) and choice experiment (CE) or choice modelling (Dofonsou et al., 2008; Abebe and Bogale, 2014; Owusu-Sekyere, 2014). The CVM involves a consumer estimating the value of a good or service. The respondents are probed to directly state their maximum WTP for an

alteration in the quantity of a non-market commodity (Scarpa et al., 2003; Dofonsou et al., 2008). This method uses a hypothetical scenario rather than inferring WTP from actual choices or observed behaviour in the regular market (Rohani, 2013). Although most studies have applied the CVM because of its flexibility in valuation of non-market goods or services, it has numerous controversies over whether it adequately measures WTP (Bridges et al., 2011; Carson et al., 2001). The CV method is regarded biased because it excludes information about respondent's preferences for the good or service (Owusu-Sekyere, 2014), and is inadequate to value characteristics of a multi-attribute good (Scarpa et al., 2003). Moreover, the CV method is based on observing what people say they would do as opposed to observing their actual behaviour, hence respondents might actually articulate their state of mind about the good rather than the appraisal exercise itself ("warm glow" effect) **(**Rohani, 2013).

The CE method has the ability to scrutinize a single attribute embodied in the good (Scarpa et al., 2003). The method involves asking individuals to state their preference over hypothetical alternative characteristics of a good or service (Hill, 2013). Respondents make choices across a product comprising diverse attributes by ranking and rating the profiles (Breidert et al., 2006). One of the most commonly used CE method is the conjoint analysis (CA) (ibid).

Conjoint analysis is a stated preference method that requires the utility of a good or service to be firstly fragmented into various components or attributes (Kairu-Wanyoike et al., 2014; Louviere, 1988). It is based on Lancaster's neo-traditional consumer theory that posits that a good/service by itself does not provide utility to the consumer *per se*, rather, such utility is derived from the attributes of that good/service (Lancaster, 1966). CA helps to identify attribute combinations that

are preferred by respondents from which the relative importance of each attribute is computed (Fischer and Buchenrieder, 2009). Elicitation of stimuli for conjoint analysis uses the full-concept approach where a good or service is decomposed into its characteristics or attributes (SPSS, 2007). Each attribute has different levels which are used to generate alternative product profiles using the orthogonal fractional design (SPSS, 2007; Kairu-Wanyoike et al., 2013). The alternative product profiles are then presented to the respondents for preference ranking of the product profiles (Irungu, 2011; Hill, 2013; Tetaz, 2014). Output from CA includes relative importance values for the attributes and partworth estimates showing preferences for each attribute alternative (Tano et al., 2003; Kairu-Wanyoike et al., 2013).

The main advantage of CA over CVM is its ability to simultaneously elicit the relative importance between attribute levels (Lusk and Hudson, 2004) and WTP values of hypothesized goods and services (Vaca Moran, 2014; Tetaz, 2014). This method also measures tradeoffs between product attributes (Dofonsou and Lowenberg-DeBoer, 2008). Compared with the other rating and ranking methods, CA is less intrusive and its procedural design simulates real-life purchasing decision making more closely (Orme et al., 1997; Dofonsou and Lowenberg-DeBoer, 2008). However, one of the weaknesses of CA is its failure to distinguish differences in preferences between groups of respondents within specific agro-ecological zones (Tano et al, 2003). Respondents may consider only the few most important attributes, resulting in exaggerated differences in importance between the most and least important factors (ibid). Fischer and Buchenrieder (2009) further add that CA at times errs in compelling individuals to pay attention to every attribute, whether important or not, which results in information overload. Nevertheless, CA has been widely used in health,

marketing, psychology, transportation research and environmental economics studies (Bridges et al., 2011; Louviere, 1988) and was therefore deemed appropriate for this study.

2.3 Review of empirical literature

Teweldemedhin and Kafidi (2009) assessed the appropriateness of livestock insurance as a risk management tool for farmers in communal and commercial areas of Omaheke and Otjozondjupa regions in Namibia. They found that gender, production, off-farm income, value of sale and frequency of theft positively influenced farmers to diversify their enterprise. Age, education, frequency of sales and credit negatively influenced farmers to diversify their enterprises. The possibility of off-farm income implied that Namibian livestock industry growth was achieved with support from other income as a strategy for diversifying risk. The study recommended that insurance companies in Namibia should intensify advertising efforts to inform farmers of the importance of insurance as majority of livestock farmers seem to follow diversification activities as alternative risk management strategies (ibid).

Khan et al. (2013) investigated perceptions of Indian farmers on livestock insurance as a risk management strategy using a logit model. The study evaluated factors that influence the participation of dairy farmers in an insurance scheme and determined farmers' WTP for livestock insurance. The study found an annual mean WTP to insure an indigenous cow, crossbred cow, and buffalo of US$3.63, US$10.88, and US$9.26 respectively. In addition, the premium price varied across various dairy breeds, most probably due to dairy farmers' awareness about the high vulnerability of crossbred cows to different diseases compared to other breeds. The study

established that 29 percent of respondents were unwilling to purchase the proposed insurance policy but desired to shift from the riskier livestock production to less risky non-agricultural small and medium enterprises (SMEs). The education level of household heads, landholding and dairy farming experience increased farmers' WTP for livestock insurance.

Fischer and Buchenrieder (2009) examined rural smallholder farmers' preferences for livestock insurance attributes in Northern Vietnam using the Adaptive Conjoint Analysis (ACA). They found that 52 percent of respondents had no idea of what insurance was or how it worked but were interested in purchasing it. The most preferred insurance attribute was the type of insured animal, followed by coverage, payment and contract type. The most highly rated average utility value of an insured animal was buffalo with 51 percent; it was rated this much because the buffalo is a highly valued animal in Asian countries including Vietnam. Farmers expressed preference for a mixed insurance product that suited a variety of households; for instance, a combination of the type of insurance attribute and financial service attribute, i.e., 'insurance and credit' or 'insurance and saving' option.

Wan (2014) used a Tobit model to assess the factors influencing pig farmers' WTP for insurance premium and the desired coverage level in five townships in Hubei Province of China. The study found an average WTP of US$2.09 per breeding sow while the average desired coverage level was US$173.03 per breeding sow. Both estimated WTP and the desired coverage premium values exceeded the insurance premium of US$1.73 and the desired coverage level premium of US$145.28 per animal that farmers were paying at the time of the survey. Farmers' choice to purchase insurance was positively influenced by their own decision, trust of insurance companies

and location. However, it was negatively influenced by both WTP premium and the preferred coverage level. The factors that positively influenced WTP and the desired coverage premium were household income, being mobilized by officials to purchase sow insurance, knowledge of government subsidy premium, and knowledge of highest possible payment.

Asamoah (2019) examined livestock farmers' WTP for cattle insurance in the Northern region of Ghana using the CVM. The study revealed that the maximum and minimum amount of money that cattle farmers were willing to pay was US$5.17 and US$0.87 respectively with an average of US$1.74 per cow per year. The study recommended that insurance policy providers should design affordable premiums and demand-oriented insurance products as a way of enhancing farmers' WTP.

2.4 Summary

From the foregoing review, livestock insurance is an important risk mitigating strategy especially for smallholder farmers because they mainly rely on livestock for their livelihood. Several previous studies have focused on factors influencing the WTP for livestock insurance but fail to elicit preference ranking of insurance policy attributes which would be helpful to insurance product providers when designing insurance products targeting different clientele. Based on the literature review, there are no studies yet that elicit the preferred livestock insurance attributes from which WTP could be estimated especially among smallholder cattle farmers. In particular, there is no study focusing on farmers' WTP for cattle insurance policy attributes in Botswana, and hence this study.

CHAPTER THREE: METHODOLOGY

3.1 Theoretical Framework

This study is anchored upon the TPB which states that attitude toward behavior, subjective norms, and perceived behavioral controls and shapes an individual's behavioral intentions as shown in Figure 3.1 (Ajzen, 1991). As indicated elsewhere, the TPB is derived from the TRA which states that an individual's intention to perform a behavior is ultimately determined by two factors; one reflecting his individual interests and the other his social influence (Davis, 1989). The TPB postulates that the performance of behaviour is a joint function of an individual's intention to perform and the perceived behavioral control, which predicts the attitude towards use a given technology (Davis, 1989; Ajzen, 1991).

Behavioral intentions capture the motivating factors that influence a behavior and the effort devoted towards achieving a certain behaviour so that the stronger the will and desire to participate in a behaviour the higher the likelihood of performing it (Ajzen, 1991). During the decision making process of performing a behaviour of interest, the ease or difficulty of performing it is evaluated via the perceived behavioral control (Ajzen, 1991). From these two factors, the desirability to use a good or new technology can be assessed.

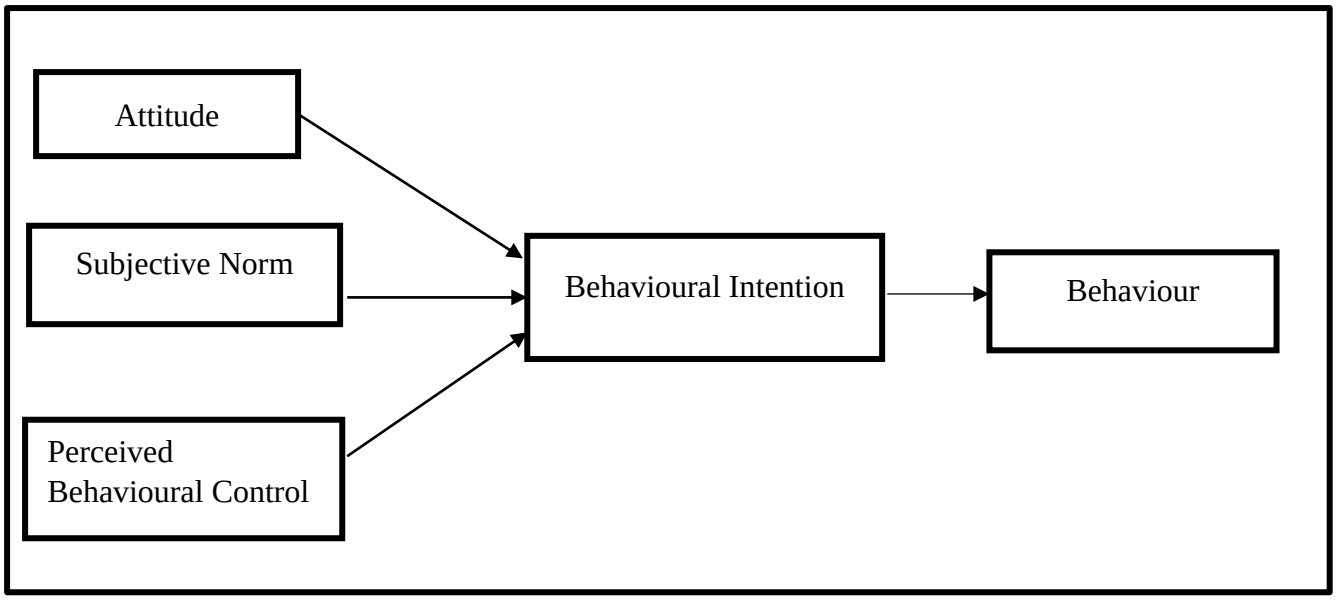


Figure 3.1. A schematic representation of theory of planned behaviour

Source: Adapted from Davis (1989)

The act of adopting a new technology is an expression of reasoned behaviour and can be explained by socio-psychological principles of human behaviour (Ajzen, 1988). Behavioral characters like social attitude and personality traits play a crucial role in attempting to predict and explain human behavior (see Ajzen, 1988). Behavioral intentions are influenced by the attitude about the likelihood that the behavior will have the expected outcome and the subjective evaluation of the risks and benefits of that outcome (Liebe et al., 2011). According to Ajzen et al. (1996), for a behaviour to be executed, the immediate determinant includes "the behavior of paying money for a good", leading to three factors that determine behavioral intention, i.e., perceived behavioral control, subjective norm and attitude toward behavior as shown in Figure 3.1 (Liebe et al., 2011).

The uptake of a cattle insurance product is a behavioural intention in the sense that consumers (i.e., cattle keepers) develop an attitude towards the non-market product of interest. The adoption of a

product of interest is expected to yield better returns than the current situation, i.e., consumers expect that taking up or paying for the new product will increase their consumption or, alternatively, make their lives better. Once the farmer has established a positive attitude towards livestock insurance, they consider taking it up in order to increase their utility (Tano et al., 2003). Eventually, the farmer will pay for the livestock insurance based on an implicit cost-benefit analysis playing in his mind. It is only after he is convinced that the benefits outweigh the costs that he eventually adopts the insurance product. Because in the study area livestock insurance is non-marketed to smallholder cattle keepers, their WTP for could only be appropriately evaluated by use of CA.

As indicated earlier, CA decomposes the good or service into characteristics or attributes that make it up (Lancaster, 1966). The abstract foundation of conjoint analysis is the Lancasterian consumer theory (Lancaster, 1966) that posits that utility is derived from the properties, attributes or characteristics embodied in the good rather than from the product itself (Hill, 2013; Tano et al., 2003). The utility of individual attributes is derived from part-worths of each attribute level, the summation of which gives the importance of a given attribute relative to others (Louviere, 1988; Tano et al., 2003). Preference ranks of individual attributes of a good or service signal to the researcher which attribute yields the highest utility to the respondent (or consumer) among alternative choices.

Thus, given a choice set C of a alternative attributes of a good or service, the ith consumer will choose a combination of attributes which maximizes his or her utility. Based on the random utility theory (RUT), the utility derived by the ith consumer from a specified attribute, j, can be expressed

as the linear sum of two components; a deterministic part, V_{ij}, that captures the observable components of the utility function, and a random error term, ε_{ij}, capturing the unobservable components of the function including measurement errors (Train, 2009). That is,

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{3.1}$$

where V_{ij} is the deterministic part and ε_{ij} is the stochastic error term. Therefore, the probability of choosing attribute *j* from choice set C_a is given by (Greene, 2012):

$$P(j|C_a) = P(U_{ij} > \max(U_{ik})) = P(V_{ij} + \varepsilon_{ij} > \max(V_{ik} + \varepsilon_{ik})) \qquad \forall j \neq k \in C_a \tag{3.2}$$

Equations 3.2 indicates that *C* contains all of the alternatives in the choice set. Different probabilistic choice models can be derived depending on the specific assumptions that are made about the distribution of the random error term (Train, 2009).

Assuming that the ε_{ij} are independent and follow a Gumbel (type-I extreme value) distribution, then, the conditional probability, $P(j|C_a)$, of choosing attribute *j* from the choice set C_a can be found using the following multinomial logit (Greene, 2012):

$$P(j|C_a) = \frac{\exp(V_{ij})}{\sum_{k \in C_a} \exp(V_{ik})} = \frac{\exp(\beta' x_{ij})}{\sum_{k=1}^{a} \exp(\beta' x_{ik})} \tag{3.3}$$

where x_{ij} is the vector of the levels of attribute *j* as perceived by the *i*th consumer.

In cases where the order of choice is of interest (such as in preference rankings or ratings), an ordered logit or ordered probit model is used (Daykin and Moffatt, 2002). In the current study, an

ordered probit model (OPM) was used to assess farmers' WTP for insurance policy attributes in the Central district of Botswana. Following Mackenzie (1993) and Tano et al. (2003), each insurance profile rank reflects an underlying utility, U, associated with the cattle keeper's preference for that profile. Thus, if U is above some threshold, say, γ_1, the respondent chooses the most preferred insurance policy profile. If U is below γ_1 but above another threshold, γ_2, the respondent chooses the second most preferred insurance policy profile and so on (Mackenzie, 1993). The respondent's insurance policy profile preference can therefore be represented as:

$$\begin{aligned} &R = 0 \text{ if } U < 0 \\ &R = 1 \text{ if } 0 < U < \gamma_1 \\ &R = 2 \text{ if } \gamma_1 < U < \gamma_2 \\ &.... \\ &R = w \text{ if } \gamma_{w-2} \leq U \end{aligned} \tag{3.4}$$

where R is a vector of preference rankings, U is a j×1 vector of unobservable utility, and γ's are threshold variables. Now, given a alternative attributes for preference ranking, the probability that the ith respondent places a particular attribute in the kth rank is given by (Mackenzie, 1993):

$$\begin{aligned} p_1 &= R + (1-R)\Phi(X'\beta) \\ p_2 &= (1-R)\Phi(\gamma_2 + X'\beta) - \Phi(X'\beta) \\ p_k &= (1-R)\Phi(\gamma_k + X'\beta) - \Phi(\gamma_{k-1} + X'\beta) \\ p_a &= (1-R)(1-\Phi(\gamma_{a-1} + X'\beta)) \end{aligned} \tag{3.5}$$

where p is the probability of observing the response, Φ is the cumulative standard normal distribution function, X is a vector of independent variables that include the attributes of the choice and the chooser, and interactions between the two sets of attributes; β is a vector of parameters to be estimated, while R and γ's are as previously defined.

3.2 Empirical Framework

3.2.1 To assess smallholder livestock keepers' knowledge and awareness of cattle insurance policy in Central District of Botswana

Descriptive statistics were used to characterize knowledge and awareness of livestock insurance policy by smallholder cattle keepers in the study area. Accordingly, respondents were characterized into two categories as those aware or unaware of the existing insurance policy. This information is important as it shows the knowledge distribution across the three study villages. Further, the source of knowledge and reasons for lack of cattle insurance uptake were also elicited to explain why the uptake of insurance policy is low among smallholder cattle keepers in the study area. The descriptive statistics were presented in charts (pie and bar chart) for easy comparison.

3.2.2 To characterize smallholder keepers' preferences for attributes of cattle insurance policy

3.2.2.1 Identification of cattle insurance attributes preferred by livestock keepers

In a preliminary survey, five focus group discussions (FGDs) were conducted in five villages: Palapye, Mahalapye, Serowe, Mogapinyana and Radisele in the Central District of Botswana (see the FGD guide in Appendix I). The FGDs were conducted to determine the main attributes of a cattle insurance policy that keepers would like to see in an insurance policy. Conducting FGDs in five different villages made two major contributions to the study. Firstly, a wide representation of cattle keepers in the Central District was attained because of the high numbers of villages included in the survey. Secondly, it ensured a possible inclusion of all the various insurance attributes that the cattle keepers would prefer in the insurance policy. Six insurance policy attributes were identified by the respondents: (a) Insurance Coverage, (b) Monthly Premium, (c) Type of

Insurance, (d) Payment plan, (e) Type of Compensation, and (f) Time of Compensation (Table 3.1). The attribute levels for insurance coverage were (i) per head and (ii) proportion of the cattle herd; monthly premium attribute had three levels being (i) $0.7, (ii) $1.40 and (iii) $2.10 per animal every month. For the type of insurance cover, the attribute levels were (i) weather index-based insurance and (ii) normal insurance, while payment plan's levels were (i) monthly and (ii) annual instalments. The type of compensation attribute had two levels (i) replacing a deceased animal with a live one and (ii) cash compensation for a dead animal. Finally, time of compensation attribute had three levels (i) compensation after one month, (ii) after three months and (ii) after six months.

Table 3. 1. Insurance policy attributes and their levels solicited from FGDs in Central District of Botswana

Product attribute	Attribute level
1. Insurance Coverage	A head
	Proportion of the herd
2. Monthly Premium	$0.70
	$1.40
	$2.10
3. Type of insurance	Weather index-based insurance
	Normal insurance
4. Payment Plan	Monthly
	Annually
5. Type of compensation	Replace with an animal
	Pay cash
6. Time of Compensation	After one month
	After three months
	After six months

Source: Author

3.2.2.2 Eliciting stimuli for conjoint analysis

The six cattle insurance policy attributes and their levels were offered to the orthogonal design procedure in SPSS (1997) to generate a factorial profile plan of 16 hypothetical cattle insurance

policy products shown in Table 3.2. All possible combinations of the attributes and their levels formed a full factorial design called profiles. Through minimal orthogonal designs, a fractional factorial design containing the least number of profiles needed for ranking (using the number of attributes and their levels) are generated (Kairu-Wanyoike et al., 2013). The four attributes varying at two levels and two attributes varying at three levels would produce $2^4 * 3^2 = 144$ possible insurance profiles. Because it would be impossible to rate all of the 144 profiles, the orthogonal factorial design was applied in SPSS Conjoint 8.0 (SPSS, 1997) to reduce redundancy. Ultimately, a total of 16 unique insurance profiles were created as shown in Table 3.2.

Table 3. 2. Orthogonal fractional insurance policy profiles generated using SPSS Conjoint 8.0 software

Card No	Type of compensation	Monthly premium($)	Type of Insurance	Payment plan	Insurance Coverage	Time of compensation (Months)
1	Cash	1.40	WIBI	Annually	Per head	6
2	Cash	0.70	NI	Annually	Proportion of a herd	6
3	Cash	0.70	NI	Monthly	Proportion of a herd	3
4	Cash	0.70	NI	Monthly	Per Head	1
5	Cow	1.40	NI	Annually	Proportion of a herd	1
6	Cow	1.40	NI	Monthly	Proportion of a herd	1
7	Cash	0.70	WIBI	Annually	Per Head	1
8	Cow	2.10	WIBI	Annually	Proportion of a herd	1
9	Cow	2.10	NI	Monthly	Per Head	6
10	Cash	0.70	WIBI	Monthly	Proportion of a herd	6
11	Cow	0.70	NI	Annually	Per Head	1
12	Cow	0.70	WIBI	Annually	Proportion of a herd	3
13	Cow	2.10	NI	Annually	Per Head	3
14	Cow	0.70	WIBI	Monthly	Per Head	1
15	Cash	2.10	WIBI	Monthly	Proportion of a herd	1
16	Cash	1.40	WIBI	Monthly	Per head	3

Source: Survey Data (2018)

3.2.2.3 Presentation of pictorial stimuli for preference ranking by livestock keepers

The 16 hypothetical cattle insurance policy products (or attribute profiles) were translated into pictorial representations. These pictorial profiles were then printed on cards and laminated for presentation to farmers during data collection. An example of Card No. 2 is shown in Figure 3.2. The card shows a normal insurance, covering only one animal in the cattle herd, costing a monthly premium of P20 (US$0.20) paid as an annuity instalments. Compensation should be paid in cash, six months after the loss of an animal. The use of pictorial designs has been widely used in conjoint analysis (e.g., see Irungu, 2011; Tetaz, 2014) to enable respondents in making informed choices because they are easier to understand (Tano et al., 2003). Fischer et al. (2008) and Geppert and Dufhues (2005) indicate that the use of pictorial stimuli in CA increases homogeneity of perceptions, reduces problems of misunderstanding and improves communication as they are more realistic.

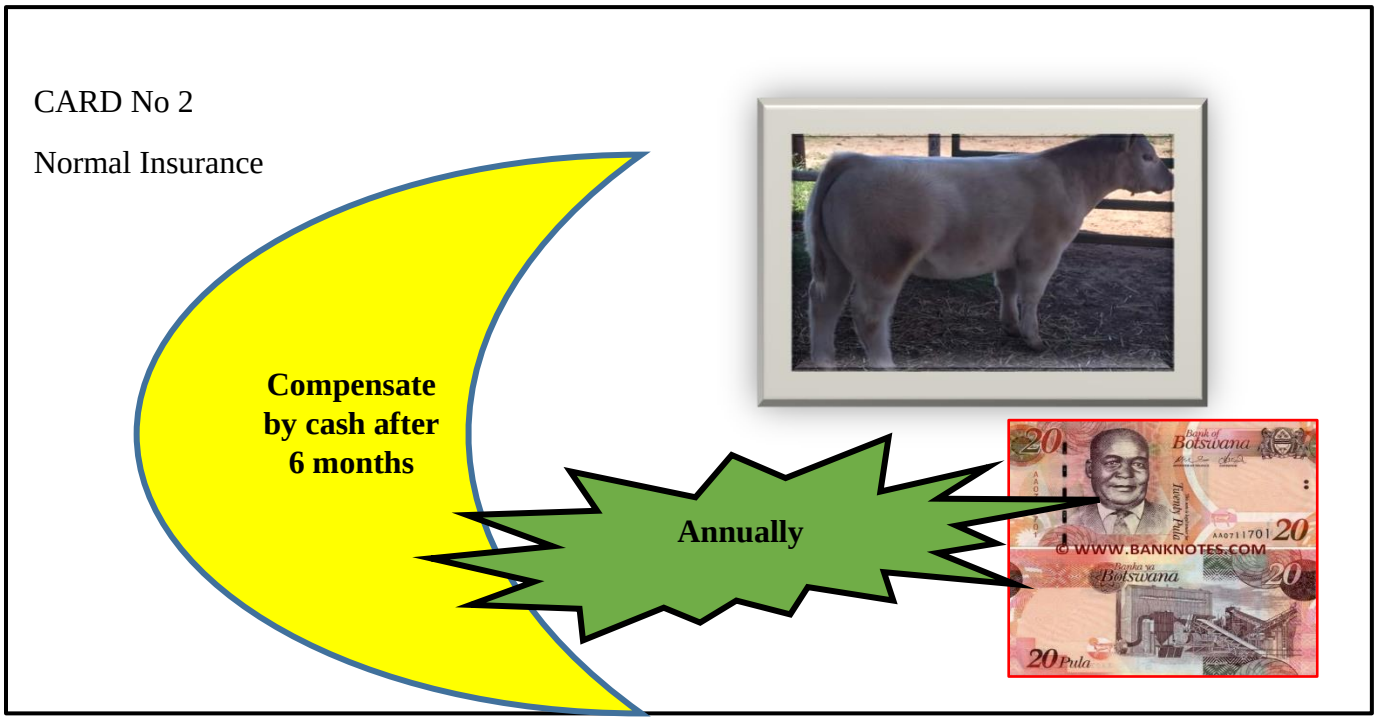


Figure 3. 2. An example of a pictorial design used to elicit WTP for hypothetical insurance products in Central District of Botswana
Source: Author (2018)

During the interview, the enumerator explained to the respondent what each card meant. This process was repeated until the respondent understood all the contents of each card. All the cards where placed evenly on a flat surface where they were noticeable to the respondent (see Figure 3.3). The respondent was then asked to pick his/her most preferred card first, then the second most preferred and so on until all the 16 cards were picked. To ensure that the preference rankings were properly undertaken, the respondents were asked to confirm their rankings by repeating the exercise. This exercise took 30-40 minutes.

Figure 3. 3. Presentation of cards for preference ranking by respondents in Mahalapye Village

Source: Survey Data (2018)

3.2.2.4 Calculation of attribute preferences

Equation 3.5 was operationalized as an ordered probit model to estimate the part-worth of each attribute level based on respondents' preference rankings (Tano et al et al., 2003; Kairu-Wanyoike et al., 2013):

$$R_{ip} = \alpha + \beta_k X_k + \varepsilon_i \quad (3.6)$$

where:

R_{ip} is the rank by the *i*th respondent of the *p*th insurance product (or profile), which is a combination of X_k attributes (k =1,…, n attributes) while β_k is the estimated part-worth or utility of the *k*th attribute and ε_i is the error term assumed to be identically, independently and normally distributed (Greene, 2012). Because the profile ranks reflect ordered choices, equation 3.7 was operationalized as an ordered probit model (Mackenzie, 1993; Daykin and Moffatt, 2002):

$$R_{ip} = a + \beta_1 COVER + \beta_2 TIME + \beta_3 PRICE + \beta_4 COV + \beta_5 COMP + \beta_6 PAY + \varepsilon_i \quad (3.7)$$

where:

R_{ip} is the rank of the *p*th insurance profile (card) by the *i*th smallholder cattle keeper. COVER is the type of insurance cover offered by an insurance policy with two levels 1=Per head and 2=Proportion of the herd; TIME is the duration before compensation after the loss of an animal with three levels 1=After one month, 2= After Three months or 3= After Six months, and PRICE is the monthly premium of the insurance policy with three levels; 1=$0.70, 2=$1.40 and 3=$2.10. COV is the type of insurance policy with two levels; 1=weather index-based insurance (WIBI) and 2=normal insurance (NI) while COMP is the type of insurance compensation with two levels 1=replace a dead animal with a live one and 2=Pay cash for the dead animal. PAY is the payment plan with two 1=monthly and 2=annual instalments while β_i is the estimated coefficient [also called *part-worth*] of the *i*th attribute, and ε_i is the random error term.

The relative importance scores were computed by obtaining the difference between the highest and lowest part-worth values and dividing that difference by the sum of all attribute ranges (see Tano et al., 2003; Ehmke et al., 2008; Cerda et al., 2012):

$$RI_j = \left[\frac{Utility\ range_j}{\sum_{j=1}^{n} Utilityrangeforallattributes}\right] * 100 \quad (3.8)$$

where:

RI_j is relative importance value (in percentage) of the *j*th attribute while "Utility range" is the difference of the highest and lowest estimated marginal value for each attribute given by: $Utility\ Range_j = [\max(\beta_j) - \min(\beta_j)]$ and "Utility range for all attributes" is the aggregate or summation of all the part-worth ranges across all the attribute (Hill, 2013). The relative importance scores provide an indication of attributes highly valued by the potential adopter (Tano et al., 2003).

3.2.3 Estimating smallholder cattle keepers' willingness-to-pay for cattle insurance attributes in the study area

From equation 3.7, the respondents' WTP for each insurance attribute was estimated by dividing the attribute coefficient with the negative coefficient of price attribute entered as a continuous variable as follows (Hill, 2013; Kairu-Wanyoike et al., 2014; Syrengelas, 2017):

$$WTP_j = -\beta_{\text{attribute}} \Big/ \beta_{\text{price}} \quad (3.9)$$

where WTP_j is the WTP for the *j*th insurance attribute, $\beta_{attribute}$ is the attribute coefficient of the *j*th attribute level, and β_{price} is the coefficient price.

3.2.4 Factors influencing farmers' WTP for cattle insurance policy

Following Kairu-Wanyoike et al. (2014), a respondent's WTP for cattle insurance attributes was estimated by applying an ordered probit model on 16 orthogonal designs ranked by each respondent. This gave the marginal WTP for each attribute for each respondent. The total WTP for each insurance profile [card] by each respondent was calculated by summing the marginal WTP for each attribute for that profile.

To assess the factors influencing cattle keepers' WTP for insurance policy profiles, the following ordinary least square (OLS) model was fitted to the data:

$$WTP_{ip} = \beta_0 + \beta_1 EDU + \beta_2 AGE + \beta_3 GENDER + \beta_4 DROUGHT + \beta_5 CROPSALES + \beta_6 MAINROAD + \beta_7 VET + \beta_8 OFFINV + \beta_9 DEP + \beta_{10} LANDSIZE + \beta_{11} VACCINE + \beta_{12} CATTLEINCOME + \beta_{13} CREDIT + \beta_{14} GROUP + \beta_{15} TLU + \varepsilon_i \quad (3.10)$$

where WTP_{ip} is the estimated WTP for the hypothetical insurance policy by the *i*th farmer. Table 3.3 describes how variables hypothesized to influence cattle keepers' WTP for the hypothetical cattle insurance policy were measured.

Table 3. 3. Description of variables in the empirical model and their hypothesized signs

Variable	Variable Description	Expected Sign
EDU	Number of years of education of the household head (Continuous variable)	+
AGE	Age of household head in years (Continuous variable)	+/-
GENDER	Sex of the household head (Dummy variable: 1=Male; 0 Otherwise)	+
DROUGHT	Amount of money or value lost due to drought in US$ (Continuous variable)	+
CROPSALES	Amount of money obtained from crop sales crops in US$ (Continuous variable)	+/-
MAINROAD	Distance to the nearest main tarmacked road in kilometers (Continuous variable)	-
VET	Access to veterinary services (Dummy variable: 1= Yes; 0 Otherwise)	+
OFFINC	Income from off-farm investments in US$ (Continuous variable)	-
DEP	Number of dependants on household head (Continuous variable)	-
LANDSIZE	Total land size owned in hectares (Continuous variable)	+
VACCINE	Total spending on cattle vaccination in US$ (Continuous variable)	+/-
CATTLEINCOME	Total income obtained from cattle sales (Continuous variable)	+
CREDIT	Access to credit (Dummy variable: 1=Yes; 0 Otherwise)	+/-
GROUP	Membership in a farmers' cooperative group (Dummy variable: 1=Yes; 0 Otherwise)	+
TLU	Total livestock units owned (Continuous variable)	+

Source: Author

3.2.4 Justification for inclusion of various regressors in the estimation of WTP

EDU: The number of years a household spent schooling, measured as a continuous variable. Well-educated smallholder keepers are likely to take up the livestock insurance policy because they know the insurance company will compensate in case of losses. Some consumers get jobs immediately after graduating from higher learning institutions and therefore have money to purchase new technologies (Owusu-Sekyere, 2014). Kairu-Wanyoike et al. (2014) showed that education positively influenced WTP for CBPP vaccine and vaccination programme in Narok County at Kenya. Khan et al. (2013) found that farmers with advanced level of education were more willing to insure their livestock because higher education was associated with ability to process and use information (Muatha et al., 2016).

AGE: Age of the household head, measured as a continuous variable. Joel (2018) and Ashimwe (2016) reported that age has an indeterminate relationship with the probability of adoption of new agricultural technologies. This is because elderly farmers may generally be unwilling to try out need technology due to the risk adversity. In addition, older farmers may also use previous experience to tackle any misfortune(s) that might befall them and therefore may exhibit a lower uptake of insurance products. Tolera et al. (2014) found that younger farmers in Ethiopia were more likely to pay for advisory services compared to older ones. In this study, age was expected to have an indeterminate association with farmers' WTP for livestock insurance attributes.

GENDER: This was coded as a dummy variable. Gender was expected to have a positive effect on farmers' WTP for livestock insurance policy. Male farmers are generally expected to be more willing to pay for livestock insurance than females because they understand the risks associated

with cattle keeping (Aina et al., 2018). In the current study, being male was hypothesized to increase WTP for cattle insurance attributes. Similarly, Masole (2018) notes that males have more assert endowment than women, which permits them to invest in risk coping mechanisms. Thus, it was hypothesized that being male would positively influence a farmer's WTP for cattle insurance in Botswana.

DROUGHT: This was coded as a continuous variable. Farmers who have previously been affected by drought or lost many cattle due to drought may be more willing to take up an insurance policy as a risk mitigating strategy than those who did not. An insurance policy guards against such natural disasters as natural death, hailstorms, droughts, floods, and predators (Singh and Hlophe, 2017). In this study, therefore, drought was expected to positively increase cattle keepers' WTP for livestock insurance policy. This hypothesis is supported by Djibo and Malam's (2018) finding that the negative effects of drought and irregular rainfall increase the likelihood of households participating in improved agricultural technology programmes.

CROPSALES: This was measured as a continuous variable denoting revenue collected from crop sale. Crop sales act as a source of alternative income, hence, would increase the availability of income in the farm. In this study, crop sales were expected to have an indeterminate association with farmers' WTP for cattle insurance attributes. On the one hand, income from crop sales was expected to be positively associated with cattle keepers' WTP for insurance attributes thereby enabling them afford the policy (Asamoah, 2019). On the other hand, crop sales were expected to act as a farm enterprise diversification strategy, thereby decreasing farmers' WTP for cattle insurance. Mohammed and Ortmann (2005) observed that dairy farmers with diversified income

did not purchase livestock insurance policy in Eritrea. This is because they used crop income to offset the risks encountered, which supported their production activities.

MAINROAD: This was coded as a continuous variable capturing the distance travelled from the farm or production area to the nearest tarmacked road in kilometers. Livestock keepers who travel a long distance to reach a tarmacked road were expected to be unwilling to purchase the cattle insurance policy because they are far from the service providers. Birinci and Tumer (2006) found that farmers located further from a paved road displayed a lower tendency of travelling to service providers, hence did not realize the importance of services and opportunities to be utilized. As a result of this behaviour, less farmers participated in agricultural insurance in Turkey (ibid). In this study, therefore, it was hypothesized that distance from the main road would be negatively related to cattle keepers' WTP for insurance attributes in the Central District of Botswana.

VET: This was coded as a dummy variable taking the value of one if the farmer had access to veterinary services and zero otherwise. It is through the work of veterinarians that farmers get information about livestock insurance policy in Botswana. For example, Ali (2013) found that extension services increased farmers' WTP for crop insurance in Pakistan. Kandel et al. (2018) also reported that access to agricultural extension personnel was positively correlated with farmer's uptake of livestock insurance in Nepal. In this study, therefore, VET was expected to be positively correlated with farmers' WTP for cattle insurance attributes.

OFFFARMINC: This was a continuous variable denoting income obtained from non-agricultural enterprises. Studies show that farmers with diverse income sources are less likely to take up

insurance policies because their multiple investments act as security against production risks (Abebe and Bogale, 2014; Aina et al., 2018; Takahashi et al., 2016). In Mozambique, Ng'ang'a et al. (2013) found that off-farm income provided households with alternatives for offsetting expected and unexpected expenditure. In Swaziland, off-farm income was negatively associated with adoption of livestock insurance because most farmers engaged in multiple off farm activities which provided income (Singh and Hlophe, 2017). In the current study, therefore, off-farm income was expected to have a negative relationship with keepers' WTP for cattle insurance attributes.

DEP: This was a continuous variable denoting the number people who depended on the household head for their upkeep. A high number of dependants in the household necessitate the household to look for ways of safeguarding its food security. One of these ways is taking up an insurance cover. For instance, Asamoah (2019) found that household size was positively associated with the likelihood of paying for cattle insurance in Ghana. Additionally, Kwadzo et al. (2013) found family size to significantly increase farmers' willingness to participate in crop insurance scheme in Ghana. In the current study, therefore, the number of dependants was hypothesized to have a positive association with cattle keepers' WTP for insurance attributes.

LAND SIZE: This was a continuous variable measuring the total size of land owned by the household. Owning a piece of land in Botswana indicates that one is investing in agriculture, and, most importantly, in asset accumulation (Mahabile et al. 2005). Farmers with large pieces of land are more likely to take up livestock insurance as a way of safeguarding their investment in cattle farming. The right of control over land is important because it determines access to other assets and benefits, such as credit and membership to farmer organizations (Miriti et al., 2013). In

Pakistan, landholding was found to have a positive association with adoption and WTP for index-based crop insurance. Ali (2003) found that farmers with large land sizes were more willing to participate in cash crop insurance schemes in Pakistan. Nahvi et al. (2014) found a positive relationship between farm size and farmer participation in a rice insurance scheme in Iran. Thus, in this study, land size was hypothesized to be positively correlated with farmers' WTP for cattle insurance attributes.

VACCINE: This was a continuous variable denoting cost of vaccine and drugs bought for livestock. A cattle keeper who spends more money vaccinating his/her cattle is more likely to take up an insurance policy to reduce the risk of their livestock succumbing to diseases. On the other hand, livestock keepers who frequently vaccinate their livestock against diseases may be heavily dependent on vaccination as a risk management strategy thereby would be generally unwilling to purchase an insurance policy. For example, in Ghana, farmers relied more on good agricultural practices they had adopted in their production areas than on formal insurance to reduce production risks (Nyaaba et al., 2019). In the current study, therefore, the cost of vaccine was hypothesized to have an indeterminate relationship with cattle keepers' WTP for insurance attributes in Botswana.

CATTLEINCOME: This was a continuous variable capturing the total amount of money a farmer gets from cattle sales. Higher cattle sales can stimulate farmers to take up livestock insurance as there is more money to pay for premiums and invest in new interventions. For example, farmers with higher farm income participated in agricultural insurance as a way of securing their farm products at Iran (Sargazi et al., 2013). Teweldemedhin and Kafidi (2009) found that the value of sales from previous season positively influenced the likelihood of participating in livestock

insurance as a risk management strategy in Namibia. It was therefore expected that income from cattle sales would positively influence farmers' WTP for cattle insurance attributes in this study.

CREDIT: This was coded as a dummy variable taking the value of one if a farmer had access to credit during the period of survey and zero otherwise. It was expected that having credit would increase the purchasing power of keepers by providing more funds to pay for the cattle insurance. Having access to credit had a negative effect on taking up livestock insurance in Nigeria (Aina et al., 2018). In Ghana, access to credit had a negative relationship with farmers' WTP for cattle insurance because access to credit increased cattle farmers' capacity to manage risks on their own (Asamoah, 2019). Regardless of the previous findings, in this study, access to credit was hypothesized to have a positive correlation with farmers' WTP for cattle insurance attributes in Botswana.

GROUP: This was coded as a dummy variable taking the value of one if the respondent belonged to a farmer group and zero otherwise. Being a member of a cooperative group helps in acquiring information about new interventions and technologies (King and Singh, 2018). For example, Heffernan et al. (2008) found that farmers who belonged to a social network in Bolivia had higher uptake of vaccines than their counterparts. In Rwanda, being a member of a farmer cooperative increased the likelihood of adoption of weather index-based insurance to hedge against weather-based shocks (Ashimwe, 2016). In the current study, belonging to a farmer cooperative group was expected to have a positive effect on the willingness of a cattle keeper to pay for an insurance policy.

TLU: This was a continuous variable. A livestock keeper with many cattle would be encouraged to take up livestock insurance to guard against loss in case of an insurable risk. Ng'ang'a et al. (2013) found that increasing the herd size raised the probability of a household's WTP for non-marketed benefits of cattle. Likewise, Irungu (1998) found that an additional TLU of cattle increased the probability of adopting Napier technology in Kiambu District. In this study, TLU was hypothesized to be positively associated with cattle keepers' WTP for cattle insurance attributes in Central District of Botswana.

3.2.5 Diagnostic Tests

a) Multi-collinearity

Multi-collinearity is a statistical phenomenon in which multiple independent or explanatory variables show high correlation between each other (Wooldridge, 2000). In the presence of multi-collinearity, the standard errors are high so that the confidence intervals of the coefficients become wide thus giving low t-values (Greene, 2002). This problem makes it difficult to reject the null hypothesis when it is true leading to type 1 error (Gujarati, 2009). In the current study, multi-collinearity among explanatory variables was assessed using the variance inflation factor (VIF). A common rule of thumb states that if VIF is greater than 5, then the correlation among explanatory variables is high (Greene, 2002). The VIF for each explanatory variable ranged between 1.32 and 2.63 with a mean of 1.67 (see Appendix III). Accordingly, it was concluded that there was no perfect linear relationship among the independent variables in the models.

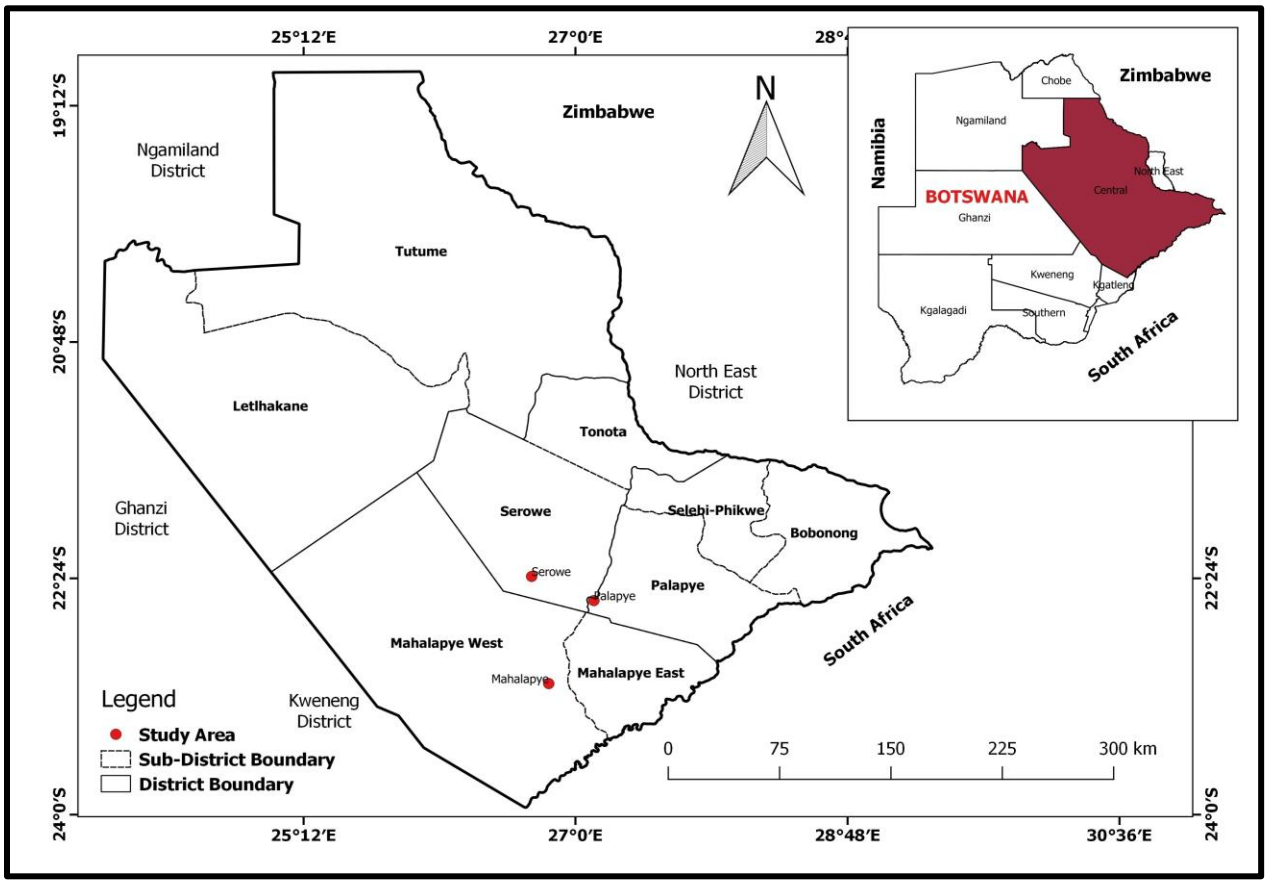
b) Heteroscedasticity

An important assumption in the classical linear regression model is that the error term should have a homoscedastic or constant variance (Gujarati, 2009). The violation of this assumption results in heteroscedasticity. Heteroscedasticity is mainly due to the presence of outliers in the data and/or omission of variables in the model, which results in the variance of the error terms differing across observations. Due to the presence of heteroscedasticity, the variance is larger than in the case of homoskedasticity (Gujarati, 2007). In this study, a White test was used to test the hypothesis of heteroscedasticity. The results showed no presence of heteroscedasticity, (χ^2=63.0, df=62, p= 0.4407).

3.3 Study Area

The study was conducted in Mahalapye, Palapye and Serowe villages, located in the Central District of Botswana (Map 3.1). Unlike the FGDs, data collection was conducted in only three villages because the other two villages were initially included in the FGDs to ensure a wide representation of respondents in the elicitation of preferred cattle insurance attributes. The district lies in the coordinates 21°16′S and 26°41′ E of Botswana (Map 3.1). It has mean maximum temperature of 35°C in summer and mean minimum temperature ranging between 2°C to 10°C during winter (Department of Meteorological Services [DMS], 2013). The mean annual rainfall is around 335mm (DMS, 2013), implying that the district has a semi-arid and thus mainly suitable for agro-pastoral livestock keeping. Residents keep livestock and also engage in arable crop production of millet, maize, pulses and melon (Statistics Botswana, 2018).

The Central District was chosen because it has the second largest traditional cattle population (after the Western District) of approximately 49 percent of the country's cattle population and it is free from FMD (Statistics Botswana, 2018). As such, livestock production is one of the main economic activities practiced in the district. This district is the largest in the country in terms of both area (147,730km^2) and human population (638,604 people) (Central Statistics Office, 2011). The area has numerous economic activities such as mining, tourism, agriculture and salt production. Currently, there are two major diamond mines (Letlhakane and Orapa) and a coal mine (Morupule) operating in the district, while Makgadikgadi Salt Pan produces salt and provides tourism services.



Map 3. 1. Location of Central District of Botswana

Source: www.mapsoftheworld.com

3.4 Data types and Analysis

3.4.1 Sampling procedure

The Central District of Botswana had approximately 409 cattle farmers of which 75 are commercial while 334 are smallholder in 2014 (Statistics Botswana, 2015). The sample size was determined using Yamane's (1973) formula which is appropriate when the population size is known:

$$n = \frac{\mathrm{N}}{1+\mathrm{N}(e)^2} \tag{3.11}$$

where *n* is the desired sample size, *e* is the desired margin of error which is 0.05 (at 95% interval) and *N* is the known population size of smallholder cattle keepers. Therefore:

$\mathrm{n} = \frac{334}{1+334(0.05)^2}$ =182 respondents.

The 182 smallholder cattle keepers were interviewed using a pre-tested questionnaire to estimate the WTP of the livestock insurance policy in the Central District of Botswana.

3.4.2. Sample selection

A multistage sampling technique was used in the study. The Central District was purposively selected because it has the second highest traditional cattle population in the entire country. Additionally, this district is in the FMD green zone (i.e., free from FMD) so cattle keepers can sell their livestock to both BMC and other districts around the country. Thus, they have the potential to improve their risk management strategies and commercialize their production. Within the Central District, three villages, i.e., Mahalapye, Palapye and Serowe were purposively selected

taking into account the distribution of livestock numbers in these villages. Thereafter, the proportionate-to-size approach was used to apportion the required sample size (182) to obtain the sample size for each village depending on the population of each village as shown in Table 3.4.

Table 3. 4. Distribution of sample size of smallholder cattle keepers in the three study villages in the Central District of Botswana

Village	Number of Keepers	Sample size
Mahalapye	135	74
Palapye	88	48
Serowe	110	60
Total	**338**	**182**

Source: Botswana Veterinary Services (2018)

From each of the three villages, a list of names of smallholder cattle keepers was obtained from the Livestock Advisory Office. Finally, simple random selection procedure was used by writing the names of cattle keepers on pieces of paper which were then folded and put in a bowl, shaken and one name drawn at a time without replacement until the desired sample size was attained. This sampling procedure was used because it gave each individual cattle farmer in the entire sampling frame an equal probability of being included in the sample (Kimalu et al., 2014; Kothari, 2004). Accordingly, 74, 60 and 48 respondents were selected in Serowe, Mahalapye and Palapye villages respectively (Table 3.4).

3.4.3 Data collection

Data collection was conducted in two stages. The first stage involved undertaking five FGDs to obtain the preferred livestock insurance policy attributes (see FGD guide in Appendix I). The FGDs were conducted in five different villages within the district to capture a wide representation of opinion of smallholder cattle keepers within the study district. The five villages were: Mahalapye, Palapye, Mogapinyana, Serowe and Radisele. Each FGD was to have ten smallholder cattle farmers, but due to circumstances beyond the researcher's control, two of the FGDs had only eight participants. The aim was to obtain information about the preferred attributes of an insurance livestock policy that traditional cattle keepers in the Central district would want to have. The researcher explained to the participants the purpose of the study then asked them to write down the attributes that they would prefer in an ideal livestock insurance policy.

In the second stage, a pre-tested semi-structured questionnaire (see Appendix III) was administered to 182 traditional cattle keepers in Palapye, Mahalapye and Serowe villages. The questionnaire that included the SPSS-derived factorial designs (see Section 3.2.2.1) was administered to cattle keepers to assess their WTP for different insurance policy attributes. It was administered by three trained enumerators in four weeks between April and May 2018. The enumerators had a three-day training on data collection and questionnaire administration techniques. Further practical training was conducted by pre-testing the questionnaire. The questionnaire was written in English but enumerators administered it to respondents in the local language (Setswana) for clarity and easy understanding. The information captured by the questionnaire included respondents' socio-economic characteristics, livestock production data, level of awareness of current cattle insurance policy, and perceptions of livestock insurance and the hypothetical cattle insurance policy profiles.

3.4.4 Data Analysis

The questionnaire data were captured in SPSS (version 16) and analyzed in STATA (version 14) software. The SPSS software utilized the Orthogonal Design procedure to generate factorial profile plans resulting in 16 valid cattle insurance profiles presented to farmers for preference ranking. Descriptive statistics (means, frequencies and standard errors) were computed and econometric analysis undertaken using STATA. An ordered probit model was used to compute the relative importance of various insurance attributes while its coefficients estimated cattle keepers' WTP for insurance attributes. The OLS was used to assess the factors influencing cattle keepers' WTP for insurance policy attributes.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Smallholder cattle farmers' socio-economic and demographic characteristics

Out of the sample of 182 respondents, 75 percent were male. This could be attributed to the fact that traditional cattle keeping in Botswana is male-dominated. Indeed, Statistics Botswana (2015) shows that 64.6 percent of farmers in the 2013 agricultural season were male. Of all the three villages surveyed, most (44%) females involved in cattle keeping were from Serowe village. This is a result of government intervention of empowering women to participate in agricultural activities. Moreki et al. (2010) established that majority participants of the LIMID were female as the programme addressed gender issues in agriculture.

As shown in Table 4.1, the average age of respondents across the three villages was 53 years, indicating that older people were involved in cattle rearing. This might be due to the fact Batswana usually venture into agriculture after retirement from formal employment. Additionally, most youth in Botswana do not participate in agricultural activities as they prefer white collar employment. Bahta and Baker (2015) found that the average age of smallholder beef producers in Botswana was 59 years, confirming that indeed agriculture is predominately practiced by older men and women. The age of respondents across the three villages was not statistically significant.

Table 4. 1. Summary statistics of socio-economic characteristics of smallholder cattle keepers in Central District of Botswana

Characteristic	Mahalapye n=60	Palapye n=48	Serowe n=74	Pooled results n=182
Age of household head (Years)	53 (2.1)	52 (2.2)	55(1.6)	53 (1.1)
Formal schooling (Years)***	11[ab] (0.6)	9[a] (0.8)	8[b] (0.5)	9(0.3)
Dependents in the household (No.)	5 (0.6)	5 (0.7)	5 (0.4)	5(0.3)
Livestock keeping experience (Years)	21.7 (1.7)	23.5 (2.6)	20.2 (1.9)	21.4 (1.2)
Land size owned (Ha)	16.4 (8.4)	10.3 (1.2)	19.8 (7.3)	16.2 (4.1)
Distance to nearest veterinary service provider (Km)	19.3 (4.0)	14.7 (2.8)	22.6 (4.5)	19.4 (2.4)
Distance from farm to main tarmac road (Km)**	24.9[a] (6.8)	7.8[a] (1.2)	13.5 (3.1)	15.74 (2.6)
Total Livestock Unit (TLU)	31.9 (39.16)	24.4 (30.5)	31.7 (33.6)	30.5 (27.4)
Total cost of vaccine ($)	58.3 (6.2)	59.1 (18.6)	60.5 (7.8)	59.4 (6.1)
Amount lost due to drought ($)	2921.8 (664.0)	3034.7 (850.0)	3432.8 (1046.5)	3117.50 (485.53)
Total annual income from ($):				
Cattle sales	1 .191.2 (214.4)	1 215.6 (328.1)	1 394.1 (350.8)	1214.20 (1492.60)
Other livestock species sales*	380.7[a] (124.3)	304.8 (96.5)	118.0[a] (42.2)	253.89 (51.6)
Crop sales	256.9 (178.3)	91.4 (64.2)	851.8 (827.0)	455.10 (34.12)
Off-farm investment***	4,618.6[ab] (737.3)	2,072.9[a] (495.9)	1,607.9[b] (318.0)	2723. 10 (319.10)

Source: Survey Data (2018)

Notes: [a,b]denotes significant differences at p<0.05 ***, **, * denote 1, 5 and, 10 percent respectively; Exchange rate: One Pula =US$9.97 at the time of the survey; S.E.= standard error; Numbers in brackets show standard error

On average, respondents had nine years of formal education, revealing that respondents had attained at least the lowest required education level prescribed by the GoB. Respondents in Mahalapye village were more educated than those in Palapye and Serowe villages by two and three years respectively (Table 4.1). Only 11 percent of respondents in the entire district had no formal education. The education level of cattle keepers was statistically different across the three villages.

On average, the distance travelled from the farm to the nearest tarmacked road was 15.6 km, with cattle keepers in Mahalapye village travelling the longest of 27.4 km to reach the nearest tarmacked road. In Botswana, Nkhori (2004) found that farmers travelled an average distance of 20km to reach the nearest tarmacked road. Cattle posts in Palapye village seemed to be on the vicinity of the tarmacked road, hence the shortest travel distance of 7.8 km from the production area to the tarmac road.

The average annual income from cattle sales were not statistically significant across the three villages. Not all respondents kept cattle only; some also reared goats, sheep and chicken. The average income from selling other livestock was US$253.89. Cattle keepers in Mahalapye village received more revenue (US$381) from trading in other livestock compared to the US$306 received in Palapye village. Trading in other livestock was not a common economic activity in Serowe village, as indicated by the lowest average annual income of US$118.

On average, crop sales yielded a revenue of U$455 per annum. This amount was expected because the Central District produced the highest crop yield in the 2012/2013 cropping season (Statistics Botswana, 2015). Respondents in Serowe village received the highest average crop revenue of US$851 per annum in comparison to those in Palapye and Mahalapye villages. This

could be contributed to the size of land owned by respondents in Serowe village. An average of 6.52 ha per person of cropping land was reported in Serowe village compared to 2.85 ha in South East District (Bahta et al., 2017).

The highest source of off-farm income was salaries and remittances. Majority of cattle keepers undertook economic activities that supplemented their income from cattle keeping. Statistics Botswana (2015) reported that 29.9 percent of smallholder farmers operated trading stores while 12.5 percent sold traditional beer to supplement their farm earnings. Mahabile et al. (2008) found that communal farmers had an average income of US$71.50 of remitted wages. The average off-farm income was statistically different across the three villages.

Based on the average annual income from diverse sources, poorer households resided in Serowe village. During the interview, respondents explained that the most recent drought that occurred between 2015 and 2017 negatively affected their farm production. On average, the annual income lost during the 2015/2017 drought in Serowe village was US$3,432 per household. These findings are supported by preliminary poverty results from the Botswana Multi-Topic Household Survey (BMTHS) conducted in 2015/2016 that revealed a headcount poverty incidence of 11.6 percent in Serowe village (Statistics Botswana, 2016). On the contrary at Palapye and Mahalapye villages respondents lost US$3034.70 and US$2921.80 respectively due to drought incidence. The BMTHS indicated that poverty level in Mahalapye village was 18.2 percent while that of Palapye village was not indicated.

4.2 Smallholder cattle keepers' knowledge of existing livestock insurance policy

4.2.1 Smallholder awareness of existing livestock insurance policy

Out of the 182 smallholder cattle keepers interviewed, only 20 (or 11%) were aware of the existing livestock insurance policy. Of these, 8, 6 and 6 cattle keepers were in Palapye, Serowe and Mahalapye villages respectively. The low awareness rate could be attributed to the fact that the existing insurance policy is still new in the market and mostly designed for commercial cattle keepers (ranchers) (van Engelen et al., 2013). As such, the information about its existence may have not reached the traditional cattle keepers due to poor communication channels. The technology adoption literature points out lack of unawareness of existence of new technology is largely by poor information dissemination by the technology providers (Mwololo et al., 2019).

Of the 11 percent cattle keepers who knew about the existing insurance policy, 50 percent had learned from radio, 15 percent from veterinary officers, 10 percent from newspapers and other sources, while the rest had learned from an insured farmer, farmer association group and radio (Figure 4.1). During the interview, most respondents indicated that they worked closely with veterinary officers. Despite this close working relationship, only 15 percent of respondents cited veterinary officers as the source of information about the existing livestock insurance policy. This could be attributed to the fact that the veterinary officers did not have adequate information about this insurance policy and hence did not share it with the cattle keepers. Most (50%) respondents learnt about the existing cattle insurance policy from the radio, which was the most common medium of communication to farmers in the study areas. Bahta et al. (2013) reported radio to be one of the major sources of agricultural information for smallholder livestock keepers in Botswana. In Zimbabwe, Nyareza and Dick (2012) found that 88 percent of smallholder farmers received useful farming information from Radio Zimbabwe.

In this study, 10 percent of respondents were informed by an insurance agent about the existing livestock insurance policy. This tallies with Singh and Hlophe's (2017) findings that 10 percent of farmers at Swaziland received knowledge of livestock insurance scheme from insurance agents. The low awareness from insurance agents can be attributed to the fact that insurance agents in Botswana do not have large communication coverage or impact compared to the media.

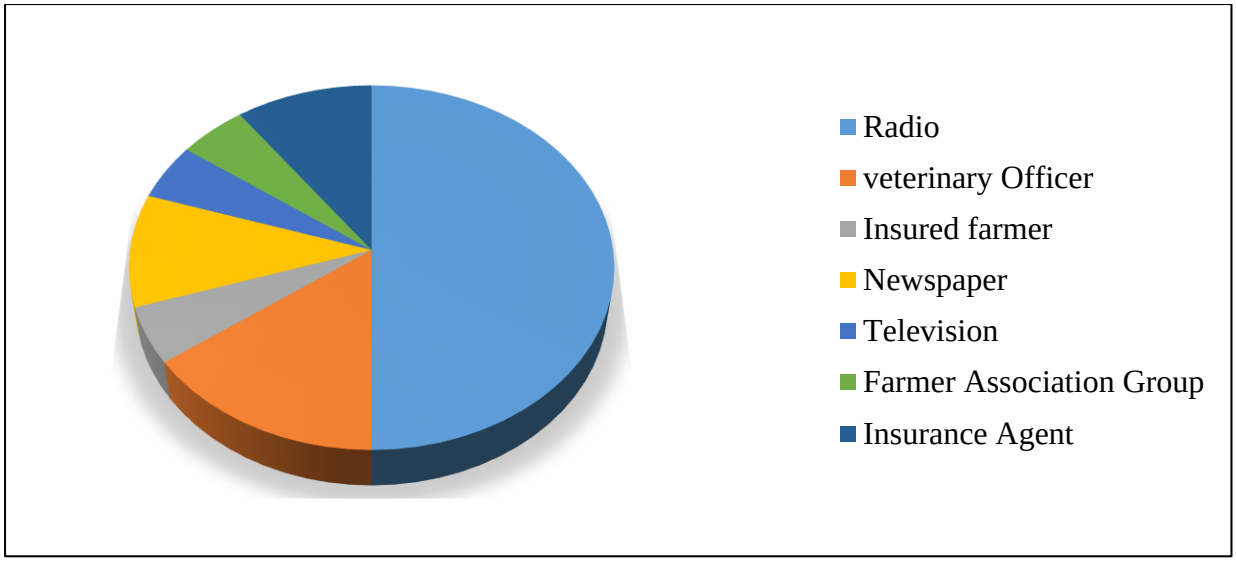


Figure 4. 1. Source of information about existing livestock insurance policy in the Central District

Source: Survey Data (2018)

As shown in Table 4.2, only a small proportion of smallholder cattle keepers (15%) knew that the existing livestock insurance policy was offered by the BIC while another 20 percent knew the types of insurance products offered, i.e., herd select, herd essential and stud animals. However, none of the respondents had adopted the policy at the time of the survey. Similar results were obtained from the FGDs, revealing that most cattle keepers were unaware of the existing livestock policy and lacked knowledge of its role in risk reduction in their cattle

production activity. Asamoah (2019), Singh and Hlophe (2017) and Kandel et al. (2018) indicate that low awareness of the existence of livestock insurance policy often limits cattle keepers from taking it up. In addition, low participation in livestock insurance is often caused by lack of awareness and inadequate publicity of the insurance scheme (Singh and Hlophe, 2017; Kandel et al., 2018).

Table 4. 2. Awareness of the existing livestock insurance policy amount cattle keepers in Central District of Botswana

Statement	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		Total	
	F	(%)	F	(%)	F	(%)	F	(%)	F	(%)	F	(%)
I know it is sold by (BIC)	1	5	3	15	0	0	5	25	11	55	20	100
I know where the BIC offices are	2	10	0	0	1	5	3	15	14	70	20	100
I know the amount charged to insurance cattle	0	0	1	5	0	0	3	15	14	80	20	100
I know the type of covers sold:												
Herd Select	0	0	1	5	1	5	2	10	14	80	20	100
Herd Essential	0	0	1	5	1	5	2	10	14	80	20	100
Stud animals	0	0	1	5	1	5	2	10	14	80	20	100
I know the benefits of the livestock insurance policy	1	5	4	20	2	10	3	15	10	50	20	100
I have been compensated by the insurance company	0	0	0	0	0	0	3	15	17	85	20	100

Source: Survey Data (2018)

F is frequency; % is percent

4.2.2 Reasons for smallholder keepers' failure to take up existing livestock insurance policy

The respondents gave the following reasons why they did not adopt the existing livestock policy: lack of interest in the policy (26.3%), lack of knowledge of the importance of the policy (26.3%), lack of knowledge of existing policy (15.8%), lack of funds to pay monthly premiums (10.5%), lack of trust in the policy (10.5%), and preference for diverse non-agricultural enterprises (10.5%) (Figure 4.2). The respondents' lack of interest in the livestock insurance policy could be attributed to lack of knowledge of the significance and benefits of the policy. A similar finding was made in Swaziland where farmers failed to adopt livestock insurance due to lack of knowledge of its existence (Singh and Hlophe, 2017). Similarly, in Ethiopia, majority of communal farmers did not take up insurance because they did not understand it well to purchase it (Takahashi et al., 2016).

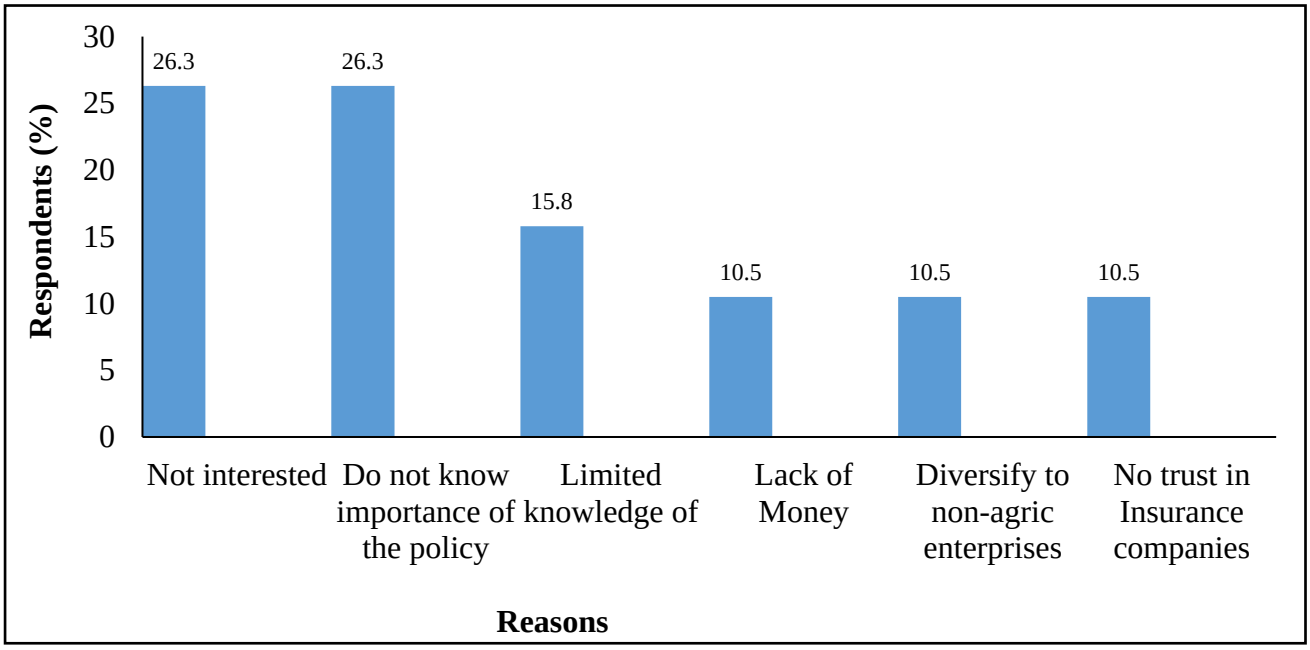


Figure 4. 2. Reasons for lack of adoption of existing livestock insurance policy in the Central District of Botswana

Source: Survey Data (2018)

In China, farmers considered cow insurance unimportant and hence did not participate in the insurance scheme (Xiu et al., 2012). Other farmers preferred venturing into less risky Small Micro and Medium and Enterprises and supporting their farming activity with off-farm income (Otieno et al., 2006; Kwadzo et al., 2013). Farmers' lack of money to pay insurance premiums has been observed in previous studies. For example, Kandel et al. (2018) found that farmers lacked capital to pay premiums in Nepal. In Indonesia, farmers disclosed that they do not have a budget for agricultural insurance and therefore were not willing to join it (Mutaqin and Usami, 2019). These farmers further explained that they did not need an insurance policy as they had other risk-coping strategies (ibid).

Kandel et al. (2018) found that communal famers in Nepal did not participate in livestock insurance because they did not trust insurance companies. In the current study, respondents' lack of trust of BIC could be attributed to lack of understanding of the conditions of the existing livestock insurance policy. This misunderstanding of what the insurance policy requires and what the cattle keepers expect in return causes farmers to lose trust in the insurance companies. Previous studies (e.g., Takalashi et al. (2016); Mutaqin and Usami (2019); Kandel et al. (2018)) acknowledge that farmers generally do not want to participate in livestock insurance, and most of their reasons are similar to the ones given in the current study. This leads to an assumption that smallholder livestock keepers have homogenous characteristics in Africa.

4.3 Livestock keepers' preference for cattle insurance attributes

4.3.1 Relative importance of cattle insurance attributes

As indicated in Chapter 3, the relative importance of different cattle insurance attributes was obtained by comparing the increase in utility from the least preferred to the most preferred level of each attribute. Of the six hypothetical cattle insurance attributes offered for preference

ranking, monthly premium was deemed the most important with relative importance of 55 percent (Figure 4.3). It was followed by type of insurance cover (21.2%), type of compensation (6.7%), time of compensation (6.4%), payment plan (5.3%) and insurance coverage (5%).

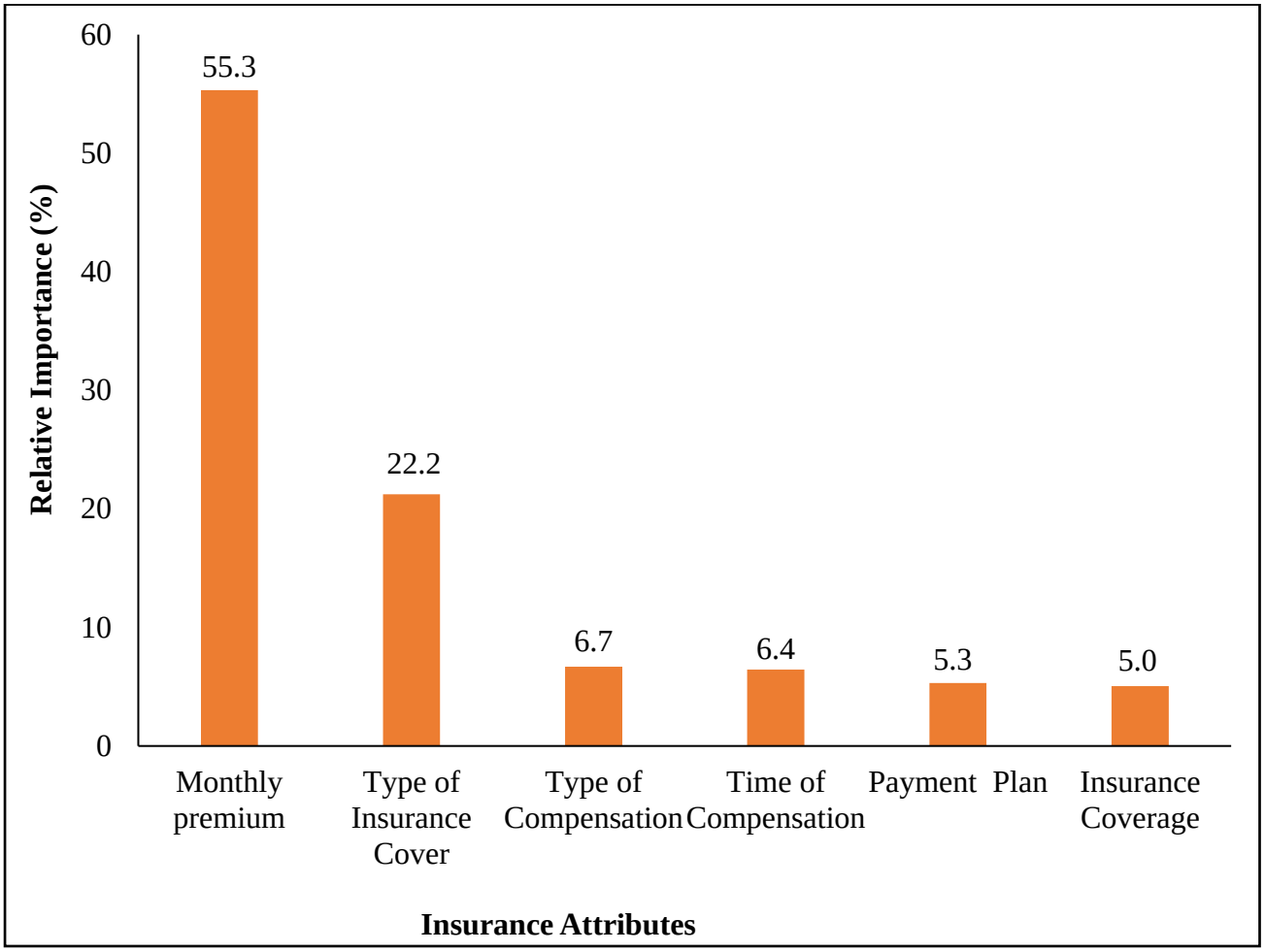


Figure 4. 3. Relative importance of cattle insurance policy in Central District of Botswana

Source: Survey Data (2018)

The high relative importance of monthly premium suggests that price had the most influence on the choice of the insurance attribute. This could be attributed to the fact that a cattle keeper considering to purchase an insurance policy must first consider how affordable it is. In Louisiana State of USA, beef producers identified price as the most important attribute that determines their decision to purchase livestock insurance (Fields and Gillespie, 2008).

"Type of insurance cover" was the attribute with the second highest relative importance. Within this attribute, respondents preferred "weather index-based insurance" (WIBI) attribute level relative to "normal insurance" (NI). The high preference for this attribute could be attributed to the adverse climatic conditions in Botswana that are characterized by re-occurring droughts. Currently, cattle keepers in Botswana are only compensated after culling their animals in case of an FMD incursion (Masole, 2018) but not drought (Mogotsi et al., 2016). The high preference for WIBI corroborates the findings of Sibiko et al. (2018) who found that smallholder farmers in Kenya prefer WIBI cover.

Cattle keepers considered payment plan as one of the least important of the six cattle insurance attributes evaluated. In this attribute, making annual payments was more preferred to monthly premiums. This suggests that a lumpsum instalment was the preferred payment plan relative to singular instalments. According to Fischer and Buchenrieder (2009), smallholder farmers in Vietnam preferred yearly payment as they were easier to make relative to monthly premiums.

"Insurance coverage" was the least important attribute ranked by respondents. Given the relatively low number of cattle holding (average of 30 cattle per farmer) in Central District, there could be a reluctance to sign up for insurance because of reliance on previous experience of dealing with loss as majority of keepers are old aged. Interestingly, the number of cattle to be insured was of high priority to respondents because covering a proportion of the herd was more preferred to covering only one cow.

4.3.2 Preference for individual insurance attribute levels

As shown in Table 4.3, the most preferred attribute levels were (1) monthly premium, (2) WIBI cover, (3) insuring a proportion of the herd, (4) annual premium payment, (5) cash compensation, and (6) compensation within a month. Because the insurance attributes of the current study are unique and have never been taken into consideration before, it makes difficult to relate these findings those of previous studies.

Table 4. 3. Part-worths of individual attribute levels in Central District of Botswana

Attribute	Level	Utility estimate	t-value
Type of insurance	WIBI	0.127	3.329
	NI	-0.127	
Insurance Coverage	Proportion of herd	0.039	1.058
	Per head	-0.039	
Payment plan	Monthly	-0.032	-0.840
	Annually	0.032	
Type of compensation	Replace with live cow	-0.030	-0.780
	Pay cash	0.030	
Time of compensation	1 month	0.003	
	3 months	-0.039	-0.859
	6 months	-0.037	0.789
Monthly premium	0.70	0.433	
(US$)	1.40	-0.208	-4.406
	2.10	-0.225	-4.711

Source: Survey Data (2018)

The findings in Table 4.3 suggest that more utility was derived from paying the lowest monthly premium of $0.70. During the FGDs, many farmers indicated that they were only able to pay small premiums to insure their cattle. From the Table, as the monthly premiums increased, a negative utility (indicated by the negative coefficients on US$1.40 and US$2.10 attribute levels) was realized, further confirming that respondents were sensitive to high insurance

prices. The part-worths for this insurance attribute are in line with the law of demand (Nicholson and Snyder, 2012). In Ethiopia, Kebede et al. (2020) found the starting bid price to have a negative effect on the demand for livestock insurance.

The cattle keeper's utility from WIBI cover and disutility from NI as indicated by the contrasting signs on their coefficients. Given that Botswana's climate is semi-arid and characterized by frequent droughts (Tselaesele et al., 2018; Bahta et al., 2017; Temoso et al., 2015), it is understandable why cattle keepers preferred WIBI to NI. In Kenya, Sibiko et al. (2018) found that smallholder farmers preferred WIBI than traditional insurance as it paid out compensation based on the realization of an objectively measured weather variable correlated with production losses. Hence suggesting the findings of this study corroborates with findings of other studies conducted in Africa.

Between insuring one animal and a proportion of the herd, cattle keepers derived more utility from the latter than from the former. This is in line with the monotonic nature of preferences that more is always preferred than less (Nicholson and Snyder, 2012). Masole (2018) established that cattle keepers in Botswana did not have any means of formal risk management strategy. Therefore, their preference for insuring proportion of the herd could be an indication that they would adopt the cattle insurance policy.

For the payment plan attribute, respondents preferred annual payment to monthly payment. This result is consistent with the findings of Fischer and Buchenrieder (2009) that paying yearly premium is considered easier to perform. Therefore, paying an annual premium would give respondents ample time to raise the required funds for the premium as compared to the case of monthly payment. Cattle keepers in Botswana usually sell their produce to their main buyer,

BMC, once annually thereby have cattle income available once a year. This practice further justifies their preference for the annual instalment payment.

The respondents derived more utility from cash compensation than from the replacement of a dead cow. In this regard, farmers could be avoiding a situation where an insurance company would purchase a cow that they do not desire; hence, being compensated in cash would give them the opportunity to purchase a cow of their own choice.

The respondents preferred compensation within a month to either three or six months after the loss of the animal. The negative sign on the latter two coefficients shows that the respondents were not pleased with delayed compensation. During the FGDs, most respondents indicated that it is better to get the compensation money within a short period of time as a "bird in hand is worth two in the bush". Kiguru et al. (2018) found that respondents expressed a negative attitude towards uptake of agricultural insurance in Kenya because compensation took long to pay out.

4.3.3 Preference for insurance policy profiles

The part-worths (from Section 4.3.2) for each attribute were used to calculate the total utility for each profile. Because utilities are ideally respondents' preferences, the profile utilities were used to rank the cards to derive the preference of all the hypothetical insurance policies presented to smallholder cattle keepers in the three study sites. The results are presented in Table 4.4. From the 16 hypothetical insurance profiles, eight profiles (i.e., card numbers 7, 12, 10, 14, 2, 3, 11 and 4) had positive utilities signifying their acceptance by keepers. The rest had negative utilities, implying that they were rejected by the respondents.

Table 4.4. Total utility of insurance profiles ranked by cattle keepers in Central District of Botswana

Profile No	Type of Insurance	Insurance Coverage	Payment Plan	Type of compensation	Time of compensation	Monthly premium ($)	Total utility
7	0.127	-0.039	0.032	0.03	0.003	0.433	0.586
12	0.127	0.039	0.032	-0.03	-0.039	0.433	0.562
10	0.127	0.039	-0.032	0.03	-0.037	0.433	0.56
14	0.127	-0.039	-0.032	-0.03	0.003	0.433	0.462
2	-0.127	0.039	0.032	0.03	0.037	0.433	0.444
3	-0.127	0.039	-0.032	0.03	-0.039	0.433	0.304
11	-0.127	-0.039	0.032	-0.03	0.003	0.433	0.272
4	-0.127	-0.039	-0.032	0.03	0.003	0.433	0.268
8	0.127	0.039	0.032	-0.03	0.003	-0.225	-0.054
15	0.127	0.039	-0.032	0.03	0.003	-0.225	-0.058
1	0.127	-0.039	0.032	0.03	-0.037	-0.208	-0.095
16	0.127	-0.039	-0.032	0.03	-0.039	-0.208	-0.161
6	-0.127	0.039	0.032	-0.03	0.003	-0.208	-0.291
5	-0.127	0.039	-0.032	-0.03	0.003	-0.208	-0.355
9	-0.127	-0.039	-0.032	-0.03	-0.037	-0.225	-0.49
13	-0.127	-0.039	-0.032	-0.03	-0.039	-0.225	-0.492

Source: Survey Data (2018)

As shown in Table 4.4, card (profile) number 7 had the highest utility of 0.586 and hence the most preferred insurance policy. This suggests that smallholder cattle keepers in Central District of Botswana preferred a WIBI insurance covering only one animal with a monthly premium of US$0.70 payable as an annuity. In addition, the compensation was to be in cash paid out within a month of a loss of an animal. The fact that card number 7 was the most preferred was expected because it had the most desirable attributes such as the lowest monthly premium as livestock keepers in Botswana are known to be price sensitive (Mahabile, 2014). Other desired attributes of profile 7 include paying premiums on annual instalment, the shortest payback period of one month by cash after the loss of an animal.

The second most preferred profile was profile number 12 with a total utility of 0.562. In this regard, cattle keepers would purchase a WIBI cover, paying a monthly premium of US$0.70 on annual instalments basis to cover a portion of the cattle herd and compensation within three months. The distinguishing attributes between the two profiles (card numbers 7 and 12) are the type of compensation, time of compensation, and insurance coverage.

Card number 13 was the least preferred hypothetical insurance policy profile with a total utility of -0.492. It comprised of a normal insurance covering only one cow with US$2.10 monthly premium payable monthly with compensation done by replacing a cow in the case of a loss. Other rejected or non-preferred insurance profiles were numbers 8, 15, 1, 16, 6, 5 and 9 with a total utility range of -0.054 to -0.49.

4.4 Willingness-to-pay for cattle insurance policy attributes

4.4.1 WTP for individual insurance policy attributes

The coefficient estimates of the ordered probit model (OPM) for WTP for individual cattle insurance policy attributes are presented in Table 4.5. The log likelihood for the random parameters probit model was -8063.63, which is substantially higher than the -8073.7784 for the random parameters probit model initially presented. The price was used as a continuous variable enabling it to have only one price coefficient in calculating WTP in accordance with Hill (2012) and Kairu-Wanyoike (2014). Type of insurance and time of compensation attributes were statistically significant at 1 percent level. The overall estimated WTP amount for the insurance policy was US$11.45 per animal per month. The mean WTP is relatively affordable for livestock keepers to pay because it is less than the average monthly cattle sales income of US$101 (see Table 4.1).

The signs on coefficient estimates can be interpreted as preference for individual attribute levels of insurance policy similar to those shown in Table 4.3. Only three out of eleven attribute levels had a positive WTP value, signifying preference for those attribute levels. Accordingly, the respondents preferred to be compensated with a live cow and were willing to pay US$1.12 to obtain that attribute level. It is worth noting that the cattle keepers did not prefer to be compensated in cash as indicated by the negative coefficient (-0.009). This could be because cattle keepers follow the tradition of keeping large herds of cattle as a sign of wealth (Mahabile, 2014) and therefore, would prefer replacing the lost cow with a live one. This also guards against instances where insurance companies may compensate them with less than the value of the lost animal.

Table 4.5. WTP for cattle insurance attributes in Central District of Botswana

Attribute	Attribute level	Coefficient	t-value	WTP (US$)
Type of compensation	Replace with a live cow	0.009	0.812	1.12
	Pay cash[b]	-0.009		
Type of insurance	WIBI	0.141	0.00***	17.77
	NI[b]	-0.141		
Payment Plan	Monthly	-0.032	0.386	-4.09
	Annually[b]	0.032		
Insurance Coverage	Proportion of herd	0.056	0.134	7.07
	Per head[b]	-0.056		
Time of Compensation	After 3 months	-0.077	0.092*	-9.76
	After 6 months	-0.005	0.909	-0.66
	After 1 month[b]	0.083		
Monthly Premium	Premium	-0.008	0.806	
Overall WTP				**11.45**

Source: Survey Data (2018) n=2912 Log Likelihood=-8063.636 Pseudo R^2 =0.0013
***, **, * denote 1, 5 and 10 percent significance level respectively. $WTP = -\beta_{\text{attribute}} / \beta_{price}$
1USD=P9.97, n= (182 respondents*16 insurance profiles), b-the base levels in the OPM model

As shown in Table 4.5, respondents preferred WIBI to normal insurance and were willing to pay US$17.77 to obtain a WIBI insurance cover. This insurance attribute level allowed cattle keepers to get compensation in the case of a loss of cattle due to adverse weather changes, which is not the case with the current government compensation scheme (Mogotsi at al., 2016). A national agricultural survey conducted in 2015 reported that smallholder cattle keepers in the Central District lost 429 cattle to drought (Statistics Botswana, 2018). This is an indication that smallholder

keepers frequently lose their cattle due to drought, which somewhat justifies the reason for their preference for the WIBI relative to normal insurance.

Respondents preferred covering a proportion of the herd and were willing to pay US$7.07 to acquire this attribute level. Smallholder livestock keepers are mostly dependent on cattle for source of income and livelihood (Bahta et al., 2017). Therefore, insuring a proportion of their herd would ensure that their wealth is protected against risk. Insuring a large number of cattle in a herd yields higher utility to smallholder cattle keepers in the Central District than insuring only one animal.

None of the other eight attribute levels were preferred by the respondents as indicated by the negative sign on their coefficients. As such, the cattle keepers were not willing to pay a monthly payment plan and compensation payout after 3 and 6 months. In addition, they were not willing to pay for an insurance policy where premiums were paid on monthly installments but preferred annual premium. The reason given for this preference is that paying premiums on monthly instalments is tiring and not convenient to keepers who stay far away from service providers (Fisher and Buchenrieder, 2009). Likewise, respondents were not willing to wait long periods before being compensated for their loss. This finding tallies with that of Kiguru et al.'s (2018) who reported a negative attitude towards agricultural insurance with long compensation period in Kenya. In India, livestock farmers discontinued using livestock insurance because of delays in claim processing (Chand et al., 2016). During the survey, the respondents indicated that long compensation period would interfere with their cattle keeping processes.

4.4.2 WTP for hypothetical insurance policy profiles

Using the attribute level WTP values shown in Table 4.5, the WTP for each of the 16 hypothetical insurance policy profiles was calculated by summing up the coefficients for each attribute and dividing it with the price coefficient. The WTP values for individual insurance policy attributes are shown in Table 4.6. Out of the 16 insurance profiles (cards) nine profiles had positive WTP values. A negative WTP means that respondents were not willing to pay for the insurance combination. The WTP amount for different insurance policy products ranged between US$4.13 and US$40.88 which is quite wide. Juxtaposed against the respondents' monthly income of US$101, it seems possible that the respondents could afford to pay up the US$40.88 for an insurance policy. In a similar study, Asamoah (2019) found a WTP range of between US$0.87 and US$5.17 per animal per month in Ghana. The exceptionally low WTP amounts stated at Ghana in comparison to the amounts found in this study could be attributed to different magnitudes and nature of risks encountered and value attached to cattle in the two countries. In Nigeria, Aina et al. (2018) found a WTP value of US$5.44 per animal per month for WIBI. This amount is within the range of the WTP obtained in this study.

As shown in Table 4.6, the insurance policy profile number 8 had the highest WTP of US$ 40.13 followed by profile numbers 15, 7 and 12 with US$29.88, US$23.88 and US$20.13 respectively. Interestingly, the profiles with the highest WTP were not the most preferred (see Table 4.4) indicating that there were differences between what respondents preferred and what they were actually willing to pay for. For example, while profiles 2, 3, 11 and 4 were preferred on the basis of utility ranking, respondents were generally unwilling to pay for them. In contrast, even though

the respondents did not prefer profiles 8, 15, 1, 5 and 6 on the basis of utility ranking, they were actually willing to pay for them.

Table 4.6. Willingness-to-pay for insurance policy profiles in Central District of Botswana

Profile No	Type of Insurance	Insurance Coverage	Payment Plan	Type of compensation	Time of compensation	Total Utility	Premium (US$)	WTP (US$)
8	0.141	0.056	0.032	0.009	0.083	0.321	-0.008	40.13
15	0.141	0.056	-0.032	-0.009	0.083	0.239	-0.008	29.88
7	0.141	-0.056	0.032	-0.009	0.083	0.191	-0.008	23.88
12	0.141	0.056	0.032	0.009	-0.077	0.161	-0.008	20.13
10	0.141	0.056	-0.032	-0.009	-0.005	0.151	-0.008	18.88
14	0.141	-0.056	-0.032	0.009	0.083	0.145	-0.008	18.13
1	0.141	-0.056	0.032	-0.009	-0.005	0.103	-0.008	12.88
5	-0.141	0.056	0.032	0.009	0.083	0.039	-0.008	4.88
6	-0.141	0.056	0.032	0.009	0.083	0.039	-0.008	4.88
16	0.141	-0.056	-0.032	-0.009	-0.077	-0.033	-0.008	-4.13
2	-0.141	0.056	0.032	-0.009	-0.005	-0.067	-0.008	-8.38
11	-0.141	-0.056	0.032	0.009	0.083	-0.073	-0.008	-9.13
4	-0.141	-0.056	-0.032	-0.009	0.083	-0.155	-0.008	-19.38
3	-0.141	0.056	-0.032	-0.009	-0.077	-0.203	-0.008	-25.38
9	-0.141	-0.056	-0.032	0.009	-0.005	-0.225	-0.008	-28.13
13	-0.141	-0.056	-0.032	0.009	-0.077	-0.297	-0.008	-37.13

Source: Survey Data (2018)

The difference between preference ranking and WTP of various insurance profiles was plausibly brought about by the discrepancy in the magnitude and signs of the part-worths given in Table 4.3 and those given in Table 4.5. For example, the magnitude of the part-worths for "type of compensation" attribute levels "replace with a live cow" and "pay cash" was not only higher in Table 4.3 (i.e., -0.030 and 0.030 respectively) than those in Table 4.5 (i.e., 0.009 and -0.009 respectively) but also had the opposite signs. Additionally, while price was entered as a single continuous variable in the ordered probit for the computation of WTP as recommended in the literature (e.g., see Kairu-Wanyoike (2014)), its attribute levels were entered separately in the calculation of part-worths (see Table 4.3).

Therefore, the total utility given in Table 4.4 capture all the three price attributes whereas the WTP for the various insurance profiles in Table 4.6 does not. This somewhat reduce the total WTP for each insurance profile by the magnitude and sign of the price levels. Based on the total WTP numbers given in Table 4.6, only profiles 5 and 6 were affordable profile policy to the respondents as they less than the mean WTP of US$11.45. The next affordable profile was number 1 with US$12.88 even though it was slightly higher than the mean WTP by a margin of U$1.43.

4.4 Factors influencing cattle keepers' WTP for livestock insurance policy

To identify the factors influencing smallholder farmers' WTP for hypothetical cattle insurance policy, an OLS model was employed as shown in equation 3.12. As shown in Table 4.7, the R-squared of 0.4 indicates that the response variables explained 40 percent variation in the data, which is a relatively good model fit for cross-sectional data (e.g., see Gujarati (2007)). Out of

fifteen variables considered in the model, eight were statistically significant. Distance to the nearest tarmacked road, off-farm investment, land size owned and total livestock units positively influenced respondents' WTP for insurance profiles. On the other hand, age of household head, annual crop sales income, vaccine cost and access to credit were negatively correlated with respondents' WTP for cattle insurance policy.

Table 4.7. OLS parameter estimates of factors influencing WTP for cattle insurance policy in Central District of Botswana

Variable	Coefficient	S.E.	t-value
Formal schooling (Years)	0.0056	0.0257	0.2181
Age of household head (Years)	-0.0144**	0.0061	-2.3745
Gender (Male)	0.1787	0.2081	0.8585
Amount lost due to drought (US$)	3.3106	2.2106	1.4976
Annual crop sale income (US$)	-0.0000169**	8.5606	-0.0000
Distance to nearest tarmac road (Km)	0.0050***	0.0019	2.5714
Access to veterinary services (Yes)	-0.0023	0.0041	-0.5581
Off-farm income (US$)	7.4106***	2.1206	3.4946
Dependents in the household (No.)	-0.0093	0.0207	-0.4496
Land size owned (Ha)	0.0036*	0.0021	1.7218
Vaccine cost (US$)	-0.0021*	0.0011	-1.8617
Annual cattle sales income (US$)	-4.8706	4.6206	-1.0541
Access to credit (YES)	-0.8480***	0.2737	-3.0979
Membership in cooperative group (YES)	0.4325	0.4842	0.8933
Total livestock unit (TLU)	0.0056*	0.0033	1.6774
Constant	2.3863	0.7185	3.3213

Source: Survey Data (2018) ***, **, * denote 1, 5 and 10 percent significance level respectively;

R-squared= 0.4022; n= 182

Although the relationship between the age of household head and cattle keepers' WTP for insurance policy was expected to be indeterminate, it turned out to be negative suggesting that a 1 percent increase in the age of the household head would lead to a 1.4 percent reduction in the WTP for livestock insurance policy, *ceteris paribus*. This might be because old keepers rely on

traditional response measures to combat disease and/or climate-based risks and therefore are insensitive to take up formal risk strategies. Teweldemedhin and Kafidi (2009) found that age had a negative effect on adoption of livestock insurance in Namibia; older farmers relied on diversification of both farm activities and non-farm income to deal with risk. A similar finding was made by Abebe and Bogale (2014) and Mahboob et al. (2019) for WTP for livestock insurance in Ethiopia and Pakistan respectively.

While crop sales income was expected to have an indeterminate relationship with cattle keepers' WTP for insurance policy, it turned out negative. A 1 percent increase in revenue from selling crops would reduce cattle keepers' WTP for the insurance policy by 0.0017 percent. This could be attributed to the fact that revenue from crop sales could cushion cattle keepers against environmental hazards such that they would not see the need to purchase cattle insurance policy. This finding is consistent with that of Mohammed and Ortmann's (2005) and Asamoah's (2019) who reported a negative correlation between farm diversification and adoption of livestock insurance policy at Eritrea and Ghana. Asamoah (2019) noted that farm diversification results in lower income variability since high income generating enterprises compensate those enterprises operating at a loss.

Contrary to a priori expectation, distance to the nearest tarmacked road was positively associated with higher farmers' WTP for cattle insurance policy. As distance travelled to the nearest tarmacked road increases by 1 percent, the desire of a keeper to purchase an insurance policy would increase by 0.5 percent. The unexpected result may be because cattle keepers in remote areas are more vulnerable and exposed to environmental hazards such as drought and predators (Mogotsi et

al., 2016) and therefore would be more willing to pay for cattle insurance policy as it is the best approach to mitigate risk. This finding tallies with that of Ng'ang'a et al. (2013) who observed a positive correlation between distance to the market and household WTP for cattle non-market benefits in Namibia. The tendency of keepers in remote areas to show a strong desire to take up livestock insurance policy indicates their risk averse character and reflects aspirations to adopt formal risk mitigating strategies.

Although off-farm income had been hypothesized to be negatively associated with cattle keepers' WTP for insurance policy, it turned out positive. As such, a 1 percent increase in off-farm income would lead to a 740 percent increase in WTP for livestock insurance policy. The positive relationship between off-farm income and WTP for cattle insurance policy could be due to the fact that cattle keepers use additional income from different non-agricultural investments to support their cattle enterprise. This finding corroborates that of Musaba's (2010) who noted a positive relationship between off-farm income and willingness to procure livestock management technologies in Namibia. In addition, off-farm income was used to support livestock farming by financing farm operations in emerging commercial farms in Namibia (Teweldemedhin and Kafidi, 2009).

As expected from theory, land size was positively associated with respondents' WTP for cattle insurance policy. Accordingly, a 1 percent increase in land size would increase respondents' WTP for cattle insurance policy by 0.36 percent. This is consistent with the finding of Mahboob (2019) who reported a significant positive relationship between participation in livestock insurance and land holdings in Pakistan. Owning a piece of land in Botswana is a sign of asset accumulation.

Kwadzo et al. (2013) also found a positive correlation between land size and participation in crop insurance in Ghana.

It had been expected *a* priori that total vaccine cost would have an indeterminate associated with cattle keepers' WTP for insurance policy in the Central District of Botswana. However, total vaccine cost turned out to have a negative sign, implying that high vaccine costs reduce the willingness of keepers to take up the cattle insurance. A 1 percent increase in vaccine cost would decrease respondents' WTP for the cattle insurance policy by 0.21 percent. This could be attributed to the fact that vaccinating cattle acts as a risk-mitigating strategy against diseases. Hence, cattle keepers may not see the need or importance to purchase the insurance policy when they have already protected their cattle through vaccination. This results corroborates that of Mohammed and Ortmann (2005) who observed that farmers who adopt alternative risk management strategies tend not to take up or participate in livestock insurance policies.

Contrary to a priori expectations, access to credit was negatively associated with cattle keepers' WTP for insurance policy. Having access to credit would lead to a 0.85 decrease in the uptake of cattle insurance. Credit affords cattle keepers the purchasing power to offset risk on their own instead in relying on the insurance policy. In Ghana, Asamoah (2019) found that credit reduced farmers' willingness to participate in cattle insurance because access to credit increases cattle farmers' capacity to manage risks themselves. While assessing the WTP for crop insurance in Pakistan, Ghazanfar et al. (2015) found availability of credit to be negatively correlated with farmers' participation in crop insurance. In Pakistan, all farmers who get agricultural credit from

financial institutions automatically get insured under a crop loan insurance scheme therefore they were not willing to pay extra premium for an additional crop insurance program.

As expected a priori, total livestock unit (TLU) was positively associated with cattle keepers' WTP for insurance policy in the study area. Given that respondents indicated preference for covering a proportion of the herd, an increase in TLU would increase the willingness of taking up cattle insurance policy in an attempt to protect as many cattle as possible. The thought of encountering an enormous loss of cattle in the case of a catastrophe drives keepers with a lot of cattle to be more willing to participate in cattle insurance. Accordingly, a 1 percent increase in TLU would increase herders' WTP for cattle insurance policy by 0.56 percent. This finding is consistent with that of Kandel et al. (2018), who observed a positive relationship between the number of dairy animals and adoption of livestock insurance at Pakistan. Therefore, the larger the herd size the greater the demand for cattle insurance policy.

4.5 Cattle keepers' ability to pay for insurance attributes

Comparison between respondents' WTP and their ability to pay for the insurance attributes was made in order to assess their behavioural intention towards taking up the cattle insurance policy. The respondents were classified according to their income categories, i.e., low (US$0-US$2400), middle (US$2401-US$6000) and high (US$6001-US$15000) income. As shown in Figure 4.4, majority (70%) of respondents were not willing to pay for the cattle insurance policy even though 30% had the means to pay for it.

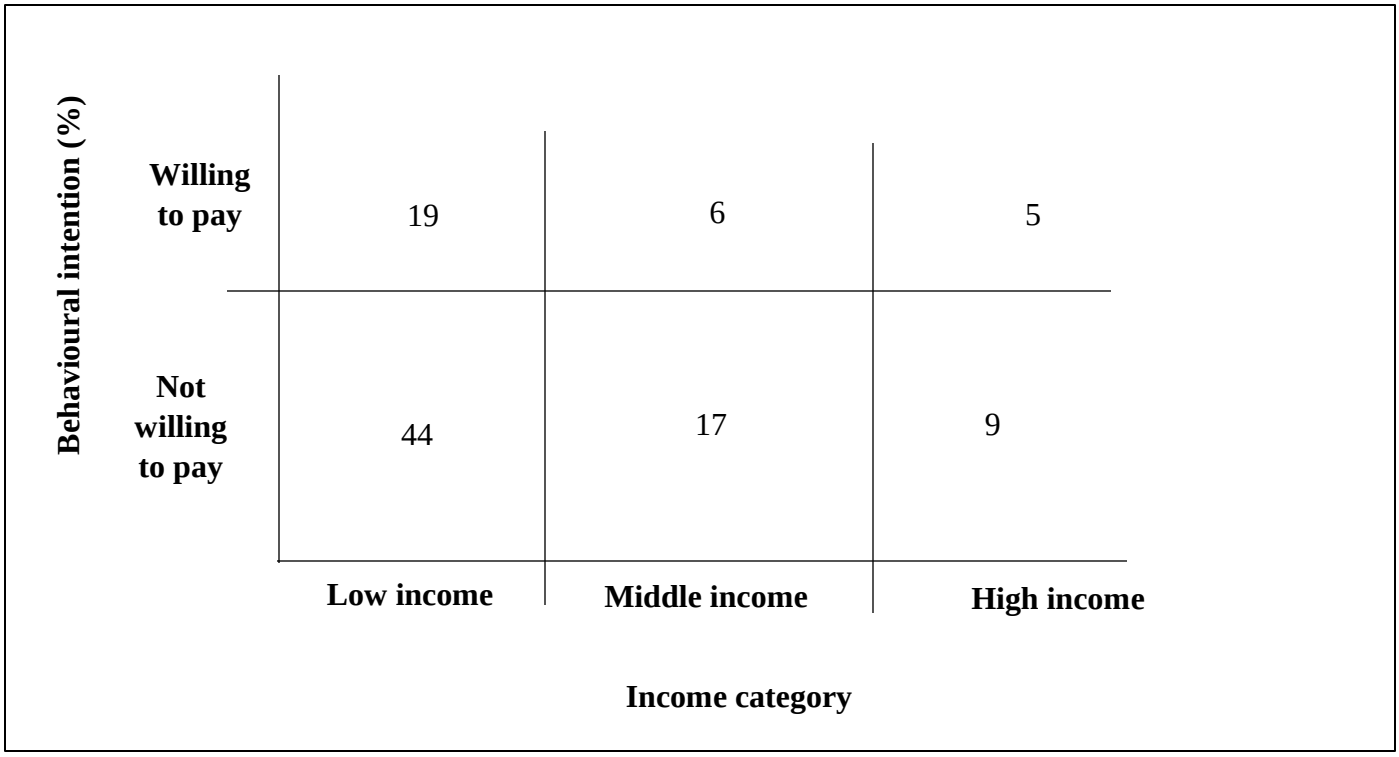


Figure 4. 4. Percentage of cattle keepers in Central district of Botswana who expressed their behavioral intention by income category

Source: Author (2018)

Most (74%) respondents in the middle income category were not willing to pay for the cattle insurance although they could afford it as their income was above the sample mean income. The reluctance to take up the insurance policy could be attributed to their old age. The mean age of these respondents was 53 years, hence could have relied more on experience in farming and informal risk management strategies than take up insurance policy. This finding tallies with those for Asamoah (2019) and Singh and Hlophe (2017) who observed a negative relationship between farmers' age and their WTP for cattle insurance in Ghana and Swaziland.

A small percentage (14%) of cattle keepers classified as high income earners, could afford the policy considering that their annual income was above the sample mean income. Of these, only 36 percent were willing to pay for the insurance policy while 64 percent rejected it. This could be attributed to the likelihood that these respondents were wealthy and therefore did not value cattle keeping as their sole livelihood source. This finding tallies with those of Mohammed and Ortmann (2005) and Singh and Hlophe (2017) who reported that farmers with multiple streams of income invested less on cattle insurance policies in Eritrea and Swaziland respectively.

With regard to location, respondents in Mahalapye village (12%) were more willing to pay for the hypothetical cattle insurance policy (Table 4.8) in comparison to respondents in Palapye and Serowe villages. This could probably be because they had high revenue from off-farm investment which could enable them to use this revenue and support their cattle enterprise in the case it would experience some loses as evident from the (Table 4.1). Also of the three villages, Mahalapye village had the highest TLU and it was proved to encourage keepers to participate in livestock insurance policy with the hope of protecting as many cattle as possible.

The respondents in Palapye and Serowe village showed lower interest in the WTP for the hypothetical insurance policy. Cattle keepers in Serowe engaged in crop production and received the highest revenue from crop sales (Table 4.1) than those in Palapye and Mahalapye villages. The revenue from crop sales acts a cushion against cattle loss. An assumption can be drawn from the OLS results (Table 4.7) that crop sales reduces the participation of livestock insurance policy. This was also noted by Asamoah (2019) in Ghana that farm diversification results in negative correlation for participating in livestock policy. Also cattle keepers in Palapye and Serowe village

experienced high vaccine costs as a way of curbing animal loss. These keepers used vaccination as a substitution method for risk management.

Table 4.8. Proportion of respondents who were willing/not willing to pay for the cattle insurance in each village in Central District of Botswana

Village	Willing to pay (%)	Not willing to pay (%)
Mahalapye	12	28
Palapye	8	20
Serowe	10	22
Total	**30**	**70**

Source: Author

Generally, 70 percent of the respondents across the three villages were not willing to pay for the cattle insurance eventhough 11 percent had the ability to pay. This could be attributed to the reasons given by keepers for failure to take up livestock insurance (see Figure 4.2). Some of the reasons include lack of trust in insurance companies (Chand et al., 2016; Kandel et al., 2018) and preference to venture into less risky Small Micro and Medium Enterprises (Kwadzo et al., 2013). This is because such reasons do not pertain to lack of funds to purchase an insurance policy.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Botswana's agriculture is a risky enterprise because it mainly depends on variable climatic conditions. The negative consequences of climate change include loss of livestock due to re-occurring droughts, excessive temperatures (heat waves) and frequent disease outbreaks. Smallholder livestock keepers are the most affected by loss of livestock as they largely depend on livestock for their livelihood. They also have low risk-bearing ability due to high dependence on variable biophysical resources. Additionally, their traditional risk management strategies are largely unsustainable due in part to their informality. This study was motivated by the need to provide alternative sustainable formal risk mitigation strategies smallholder cattle keepers in the rural areas of Botswana. The study was conducted in the Central District of Botswana to assess cattle keepers' awareness of cattle insurance policy as well as to characterize their preferences for hypothetical insurance policy attributes. The study also estimated cattle keepers' WTP for hypothetical insurance policy and evaluated the factors influencing their WTP.

To meet the objective of the study, a total of 182 smallholder cattle keepers were randomly selected in three villages (Palapye, Mahalapye and Serowe) in Central District and interviewed using a pre-tested semi-structured questionnaire. Five focus group discussions (FGDs) were conducted to identify the preferred livestock insurance policy attributes. From the FGDs, six product attributes and their respective levels were generated. Some attributes had two levels while others had three levels i.e., insurance coverage (per head, proportion of the herd), monthly premiums (US$0.70, US$1.40 and US$2.10), type of insurance [weather index-based insurance (WIBI) and normal insurance (NI)], payment plan (monthly and annual payment), type of compensation (replace with

live cow and cash payment) and time of compensation (after one, three and six months). The six insurance attributes were offered to the SPSS Orthogonal Design (SPSS, 1997) to generate factorial profile plans, which were later translated into pictorial representations for easy understanding. The card profiles were presented to potential respondents for preference ranking.

Descriptive statistics were used to characterize the socio-economic demographics of respondents, as well as to assess the farmers' awareness and knowledge of existing livestock insurance policy. Ranking data were analyzed using an ordered probit to generate utilities for each insurance attribute level. Those utilities enabled the calculation of the part-worth relative importance of each insurance attribute. An ordinary least squares regression was employed to assess factors influencing the WTP for cattle insurance attributes among the cattle keepers.

The results showed that cattle keeping in Central District is male-dominated by relatively old keepers (53 years old) with more than primary education. The majority of cattle keepers used off-farm income to support their livestock production activities. Eventhough they practiced arable farming, it contributed less to their household income. Less than a quarter of the respondents knew about the existing cattle insurance scheme operated by the Botswana Insurance Company. Those who knew the about the scheme were not interested to buy (26.3%) and did not know its importance (26.3%).

Monthly premium and type of insurance were perceived the most importance attributes. The most preferred insurance attributes were to cover proportion of the herd, WIBI cover, payment of an annual premium, compensated in cash, monthly premiums of US$1.40 and US$2.10 and

compensation payout within 1 month after the loss of an animal. The three most preferred insurance profiles were numbers ranked in descending order according to aggregate utility. The WIBI attribute had the highest WTP amount of US$17.77, followed by proportion of herd at US$7.07 and replacement of dead cow with a live cow at US$1.12. The attributes mostly preferred by the respondents also aggregated the highest WTP, showing homogeneity between preference ranking and WTP for attributes levels. Nine insurance profiles (i.e., numbers 8, 15, 7, 12, 10, 14, 1, 5 and 6) had positive WTP values. However, out of these, only profile numbers 7, 12, 10 and 14 were most preferred in that order. Although profile number 8 had the highest WTP of US$40.13, it was not preferred. The WTP amounts for the most preferred profiles (i.e., numbers 7, 12, 10 and 14) were US$23.88, US$20.13, US$18.88 and US$18.13 respectively, higher than the estimated overall mean WTP of US$11.45. This suggests that respondents have a wide range of prices (between US$18.13 and US$23.88) to choose from for specific cattle insurance profiles. Therefore, the designers of the cattle insurance policy can design different policy products based on the wide price range.

The factors that positively influenced cattle keepers' WTP for cattle insurance were distance to the nearest main tarmac road, off-farm income, total land size owned by the respondent and total livestock units (TLU). The age of the household head, income from crop sales, access to credit and vaccine cost negatively influenced the WTP for livestock insurance. Thus, having extra income, land and many cattle would increase the uptake of livestock insurance. Being an old farmer, who vaccinates livestock and diversifies farm enterprises (crop sales) reduces the uptake of cattle insurance policy. Overall, it seems cattle keepers in Central district were risk averse as they preferred to insure a proportion of their herd instead of insuring only one animal.

Majority (70%) of cattle keepers were not willing to pay for the cattle insurance policy because they lacked substantial information to convince them to uptake the livestock insurance policy. The 30 percent who were willing to pay preferred paying between US$4.88 and US$40.13 per animal per month. Only insurance profile number 5 was affordable to the keepers because it cost US$4.49 which is less than the overall mean WTP of US$11.45.

5.2 Recommendations

Based on the findings, the study recommends that:

1. There is need for the insurance provider (BIC) to disseminate more information to smallholder cattle keepers about the existing cattle insurance products as majority of the smallholder cattle keepers were unaware of its existence. Such information could be disseminated through field days, mass media (radio, television and newspapers) and farmer cooperatives.
2. Smallholder cattle keepers preferred most insurance profile numbers 7, 12, 10 and 14 with WTP values of US$23.88, US$20.13, US$18.88 and US$18.13 per unit respectively. Accordingly, the BIC could design cattle insurance products with a price range between US$18.13 and US$23.88 per animal. The ideal policy should have the attributes of profile number 7, i.e., have a 1-month compensation period, cover a portion of the cattle herd, be weather index-based at a monthly premium of US$0.7 paid as an annuity, and compensate keepers with a live animal in case of a loss.

3. Eventhough distance to the nearest tarmac road increases WTP for cattle insurance policy, the government can upgrade the road infrastructure to reduce transaction costs that cattle keepers may incur while travelling to source for insurance providers.

5.3 Areas for further research

1. The current study focused solely on estimating WTP for cattle. A further study can be conducted to include other livestock species such as goats and sheep particularly now that the government of Botswana is supporting small stock production via the Livestock Management and Infrastructure Development programme.

2. This study only characterized cattle insurance policy attributes in the Central District of Botswana. This could be complemented by a cattle insurance market segmentation study to provide the BIC with the characteristics of market niches to target with different cattle insurance products. This could enhance the uptake of the cattle insurance policies.

REFERENCES

Abebe, T. H., and Bogale, A. (2014). Willingness to pay for rainfall based insurance by smallholder farmers in Central Rift Valley of Ethiopia: The case of Dugda and Mieso Woredas. *Asia Pacific Journal of Energy and Environment,* 1(2):121-155.

Adah, O. C., Chia, J. I., and Shaibu, M. U. (2016). Assessment of rural farmers' attitudes toward agricultural insurance scheme as a risk management strategy in Kogi State, North Central Nigeria. *Journal of economics and sustainable development,* 7(14):33-38.

Aina, I., Ayinde, O. E., Thiam, D., and Miranda, M. (2018). Willingness to Pay for Index-Based Livestock Insurance: Perspectives from West Africa. Presented on 30th *International Conference of Agricultural Economics* July 28-August 2, 2018, Vancouver.

Ajzen, I. (1991). The theory of planned behavior: Organizational behaviour and human decision processes, 50:179-211

Ajzen, I., Brown, T.C. and Rosenthal, L.H. (1996). Information bias in contingent valuation: effects of personal relevance, quality of information, and motivational orientation. *Journal of Environmental Economics and Management,* 30(1):43-57.

Akintunde, O. K. (2015). Determinants of poultry farmers' participation in livestock insurance in Southwest Nigeria. *Asian Journal of Poultry Science*, 9(4):233-241.

Ali, A. (2013). Farmers' willingness to pay for index based crop insurance in Pakistan: a case study on food and cash crops of rain-fed areas. *Agricultural Economics Research Review*, 26(347-2016-17088):241-248.

Asamoah, J. O. (2019). Livestock farmers' willingness to pay for cattle insurance in the Northern Region of Ghana (Masters Dissertation, University of Ghana).

Ashimwe, O. (2016). An economic analysis of impact of weather index-based crop insurance on household income in Huye District of Rwanda (Unpublished Master's dissertation, University of Nairobi).

Bahta, S. and Baker, D. (2015). Determinants of profit efficiency among smallholder beef producers in Botswana. *International Food and Agribusiness Management Review*, 18:107-130.

Bahta, S., Wanyoike, F., Katjiuongua, H., and Marumo, D. (2017). Characterisation of food security and consumption patterns among smallholder livestock farmers in Botswana. *Agriculture and Food Security*, 6(1):65-76.

Bahta, S.T., Baker, D. and Marobela, O. (2013). Competitive smallholder livestock in Botswana: Results of a livestock value chain survey in the Central district of Botswana. Nairobi, Kenya: International Livestock Research Institute.

Batson, C. D., Ahmad, N., and Stocks, E. L. (2011). Four forms of prosocial motivation: Egoism, altruism, collectivism, and principlism. *Psychology Press*. 103-106.

Birinci, A. and Tumer, E.I. (2006). The attitudes of farmers towards agricultural insurance: The case of Erzurum, Turkey. *Bodenkultur-Wien and Munchen*, 57(1/4):49-55.

Botswana Incurance Company (2016). Agricultural Insurance Policy Guidelines, (Unpublished, Botswana).

Breidert, C., Hahsler, M. and Reutterer, T. (2006). A review of methods for measuring willingness-to-pay. *Innovative Marketing*, 2(4):8-32.

Bridges, J.F., Hauber, A.B., Marshall, D., Lloyd, A., Prosser, L.A., Regier, D.A., Johnson, F.R. and Mauskopf, J. (2011). Conjoint analysis applications in health—a checklist: a report of

the ISPOR Good Research Practices for Conjoint Analysis Task Force. *Value in Health*, 14(4):403-413.

Carson, R.T., Flores, N.E. and Meade, N.F. (2001). Contingent valuation: controversies and evidence. *Environmental and Resource Economics*, 19(2):173-210.

Castro Caldas, J. M., Rodrigues, J., and Carvalho, L. F. (2003). Economics and social psychology on public goods: experiments and explorations. *Notas Economicas*, 18:31-45.

Central Statistics Office [CSO] (2011). Household Income and Expenditure Survey Statistics Brief, Government Printer, Gaborone.

Cerda, A. A., García, L. Y., Ortega-Farías, S., and Ubilla, Á. M. (2012). Consumer preferences and willingness to pay for organic apples. *Ciencia e Investigación Agraria*, 39(1):47-59.

Chand, S., Kumar, A., Bhattarai, M., and Saroj, S. (2016). Status and determinants of livestock insurance in India: A micro level evidence from Haryana and Rajasthan. *Indian Journal of Agricultural Economics*, 71(3):335-346.

Danso-Abbeam, G., Addai, K.N. and Ehiakpor, D. (2014). Willingness to pay for farm insurance by smallholder cocoa farmers in Ghana. *Journal of Social Science for Policy Implications*, 2(1):163-183.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(2): 319-340.

Daykin, A. R., and Moffatt, P. G. (2002). Analyzing ordered responses: A review of the ordered probit model. *Understanding Statistics: Statistical Issues in Psychology, Education, and the Social Sciences*, 1(3):157-166.

Djibo O. and Malam M. N. (2018). Determinants of agricultural technology adoption: Farm household's evidence from Niger. *Journal of Development and Agricultural Economics* 11(1):15-23.

DMS. (2013). Department of Meteorological Service, Forecasting Division. Botswana, Gaborone.

Dofonsou, S.G. and Lowenberg-DeBoer, J. (2008). Ex ante non-market valuation for novel product: literature review (Purdue University), Working Paper No 08-02.

Ehmke, M. D., Lusk, J. L., and Tyner, W. (2008). Measuring the relative importance of preferences for country of origin in China, France, Niger, and the United States. *Agricultural Economics*, 38(3):277-285.

Fields, D., and Gillespie, J. (2008). Beef producer preferences and purchase decisions for livestock price insurance. *Journal of Agricultural and Applied Economics*, 40(3): 789-803.

Fischer, I. and Buchenrieder, G. (2009). Insurance preferences of smallholders: results from an adaptive conjoint analysis in Northern Vietnam. *Centre of Agriculture and Social Sciences in the Tropics and Subtropics*, Discussion Paper No. 05/2008.

Geppert, M. and Dufhues, T.B. (2005). Visualizing rural financial market research in Northern Vietnam through pictures. Discussion Paper No 02/2003:1439-4952.

Ghazanfar, S., Wen, Z., Abdullah, M., Ahmad, J., and Khan, I. (2015). Farmers' willingness to pay for crop insurance in Pakistan. *Journal of Business Economics and Finance*, 4(2):166-179.

Gillinson, S. (2004). Why Cooperate? A Multi-Disciplinary Study of Collective Action.: Overseas Development Institute, London. Working Paper, No 234.

Girma, M. and Abebaw, D. (2012). Patterns and determinants of livestock farmers' choice of marketing channels: micro-level evidence. Ethiopian Economics Association or Ethiopian Economics Policy Research Institute. Working Paper, No 1/2012:1-55.

Greene, W.H., (2002). Econometric Analysis. Fourth Edition, Mc Graw Hill, New Delhi.

Greene, W.H., (2012). Econometric Analysis. Seventh Edition, International edView, New Delhi

Gujarati, D.N. (2007). Basic Econometrics. Tata McGraw Hill Publishing Company Limited, New Delhi.

Gujarati, D.N. (2009). Basic Econometrics. Tata McGraw-Hill Education.

Hanley, N., Ryan, M. and Wright, R. (2003). Estimating the monetary value of health care: lessons from environmental economics. *Health Economics*, 12(1):3-16.

Heffernan, C., Thomson, K. and Nielsen, L. (2008). Livestock vaccine adoption among poor farmers in Bolivia: Remembering innovation diffusion theory. *Vaccine*, 26(19):2433-2442.

Hill, J. I. (2013). Consumers' preferences for goat meat in the United States: an application of choice-based conjoint analysis (PhD Dissertation, Louisiana State University).

Hole, A.R. and Kolstad, J.R. (2012). Mixed logit estimation of willingness to pay distributions: a comparison of models in preference and WTP space using data from a health-related choice experiment. *Empirical Economics*, 42(2):445-469.

Irungu, P. (1998). An economic analysis of factors affecting the adoption of Napier grass in smallholder dairying in Kiambu District, Kenya (Masters dissertation, University of Nairobi).

Irungu, P. (2011). An Economic Analysis of Adoption Potential of a New Tsetse Fly Repellent Technology in Kajiado and Narok Districts of Kenya, (PhD Dissertation, University of Nairobi).

Joel, H.M. (2018). Consumer Willingness-to-pay for chicken meat derived from chicken fed on insect-based feed in Kenya (Master's dissertation, University of Nairobi).

Kairu-Wanyoike, S. W., Kaitibie, S., Taylor, N. M., Gitau, G. K., Heffernan, C., Schnier, C., Kiara, H., Taracha, E., and McKeever, D. (2013). Exploring farmer preferences for contagious bovine pleuropneumonia vaccination: A case study of Narok District of Kenya. *Preventive Veterinary Medicine,* 110(3-4):356-369.

Kairu-Wanyoike, S.W., Kaitibie, S., Heffernan, C., Taylor, N.M., Gitau, G.K., Kiara, H., and McKeever, D. (2014). Willingness-to-pay for contagious bovine pleuropneumonia vaccination in Narok South District of Kenya. *Preventive Veterinary Medicine,* 115(3-4):130-142

Kandel, G., and Timilsina, R. H. (2018). Factors affecting the adoption of livestock insurance by dairy farmers in Nawalparasi District, Nepal. *Nepalese Journal of Agricultural Sciences*, 16:59-67.

Kebede, J. G., Entele, B. R., and Derege, A. E. (2020). Households' willingness-to-pay for livestock insurance in Karrayyu pastoralist community: an attempt for risk reduction. *Ethiopian Journal of Sciences and Sustainable Development*, 7(1):63-78.

Kgathi, D.L., Mmopelwa, G., Mashabe, B. and Mosepele, K. (2012). Livestock predation, household adaptation and compensation policy: a case study of Shorobe Village in Northern Botswana. *Agrekon,* 51(2):22-37.

Kgosikoma, K. and Malope, P. (2016). Determinants of market participation and the institutional constraints: case study of Kweneng West, Botswana. *Journal of Agricultural Extension and Rural Development,* 8(9):178-186.

Kgosikoma, O.E. and Batisani, N. (2014). Livestock population dynamics and pastoral communities' adaptation to rainfall variability in communal lands of Kgalagadi South, Botswana. *Pastoralism*, 4(19):1-9.

Khan, M.A., Chander, M. and Bardhan, D. (2013). Willingness to pay for cattle and buffalo insurance: an analysis of dairy farmers in Central India. *Tropical Animal Health Production*, 45:461 – 468.

Kiguru, D., Ateka, J., Mbeche, R., and Wamuyu, C. (2018). Attitudes and uptake of agricultural insurance in Trans Nzoia county, Kenya. *JKUAT Annual Scientific Conference Proceedings*: 207-215.

Kimalu, P.K. and Marimba, K. (2014). Research Methods Monitoring and Evaluation. Kamumi Enterprises Limited, Nairobi.

King, M., & Singh, A. P. (2018). Understanding farmers' valuation of agricultural insurance: Evidence from Viet Nam, WIDER Working Paper. No.93/ 2018:1-37.

Kothari, C.R. (2004). Research methodology: Methods and techniques. New Age International.

Krystallis, A., and Ness, M. (2005). Consumer preferences for quality foods from a South European perspective: A conjoint analysis implementation on Greek olive oil. *International Food and Agribusiness Management Review*, 8(2):62-91.

Kwadzo, G.T., Kuwornu, J.K. and Amadu, I.S. (2013). Food Crop Farmers' Willingness to Participate in Market-Based Crop Insurance Scheme: Evidence from Ghana. *Research in Applied Economics*, 5(1):1-21.

Lancaster, K.J. (1966). A new approach to consumer theory. *Journal of Political Economy*, 74(2):132-157.

Liebe, U., Preisendörfer, P. and Meyerhoff, J. (2011). To pay or not to pay: Competing theories to explain individuals' willingness-to-pay for public environmental goods. *Environment and Behavior*, 43(1):106-130.

Louviere, J.J. (1988). Conjoint analysis modelling of stated preferences. *Journal of Transport Economics and Policy,* 22(1):93-119.

Lusk, J. L., and Schroeder, T. C. (2004). Are choice experiments incentive compatible? A test with quality differentiated beef steaks. *American Journal of Agricultural Economics*, 86(2):467-482.

Mabaya, E., Jordaan, D., Malope, P., Monkhei, M. and Jackson, J. (2010). Attribute preferences and willingness to pay for fortified cereal foods in Botswana. *Agrekon*, 49(4):459-483.

Mackenzie, J. (1993). A comparison of contingent preference models. *American Journal of Agricultural Economics*, 75(3):593-603.

Madzwamuse, M., Schuster, B., and Nherera, B. (2007). The real jewels of the Kalahari: drylands ecosystem goods and services in Kgalagadi South District, Botswana. Bonn (Switzerland): IUCN. Report (Botswana):1-50.

Mahabile, M. (2014). Measuring transaction costs in marketing cattle in Southern Botswana. *Botswana Journal of Agricultural and Applied Science*. 9 (2):75-81.

Mahabile, M., Lyne, M.C. and Panin, A. (2005). An empirical analysis of factors affecting the productivity of livestock in southern Botswana. *Agrekon, 44*(1):99-117.

Mahabile, M., Lyne, M.C., Panin, A. (2008). The effect of land policy on cattle productivity in Botswana: An application of Principal Component Analysis. *Botswana Journal of Agriculture and Applied Sciences,* 4(2): 110-118.

Mahboob, M. H., Rehman, Q. M., Hamid, K., and Saeed, M. Y. (2019). Insured and non-insured livestock farmers' perception toward livestock insurance-a case study of Faisalabad-Pakistan. *Journal of Livestock Science,* 10: 48-52.

Masole, C., (2018). Economic losses and ex-post response to foot and mouth disease outbreak among smallholder beef producers in North-East District, Botswana (Master's dissertation, Egerton University).

McFadden, D. L. (1984). Econometric analysis of qualitative response models. *Handbook of Econometrics*, 2:1395-1457.

Miriti, L., Wamue, N., Masiga, C., Miruka, M. and Maina, I. (2013). Gender concerns in banana production and marketing: their impacts on resource poor households in Imenti south District, Kenya. *African Journal of Horticultural Science*, 7:36-52.

Mogotsi, K., Kgosikoma, O.E. and Lubinda, K.F. (2016). Wildlife-livestock interface, veterinary cordon fence damage, lack of protection zones, livestock theft and owner apathy: Complex socio-ecological dynamics in Foot and Mouth disease control in southern Africa. *Pastoralism*, 6(21):1-12.

Mohammed, M.A. and Ortmann, G.F. (2005). Factors influencing adoption of livestock insurance by commercial dairy farmers in three Zobatat of Eritrea. *Agrekon*, 44(2):172-186.

Moreki, J. C., Mokokwe, J., Keboneilwe, D., and Koloka, O. (2010). Evaluation of the livestock management and infrastructure development support scheme in seven Districts of Botswana. *Livestock Research for Rural Development*, 22(5).

Moroka, N. (2017). Vision 2036: Achieving prosperity for all. *Botswana documents*.

Muatha, I.T., Otieno, D.J. and Nyikal, R.A. (2016). Factors influencing smallholder farmers' awareness of agricultural extension devolution in Kenya: A binary logit analysis. A paper presented at the *5th International Conference of the African Association of Agricultural Economists,* 23-26 September 2016, Addis Ababa, Ethiopia.

Musaba, E. C. (2010). Analysis of factors influencing adoption of cattle management technologies by communal farmers in Northern Namibia. *Livestock Research for Rural Development,* 22(6),104:1-11.

Mutaqin, D. J., and Usami, K. (2019). Smallholder farmers' willingness-to-pay for agricultural production cost insurance in rural West Java, Indonesia: A contingent valuation method (CVM) *Approach. Risks*, 7(2), 69:1-18.

Mwololo, H.M., Nzuma, J.M., Ritho, C.N., Ogutu, S.O. and Kabunga, N. (2019). Determinants of actual and potential adoption of improved indigenous chicken under asymmetrical exposure conditions in rural Kenya. *African Journal of Science, Technology, Innovation and Development*, 10(1) 1-11.

Nahvi, A., Kohansal, M.R., Ghorbani, M. and Shahnoushi, N. (2014). Factors affecting rice farmers to participate in agricultural insurance. *Journal of Applied Science and Agriculture*, 9(4):1525-1529.

Ng'ang'a, S.K., Ritho, C., Nzuma, J., Moyo, S. and Herrero, M. (2013). An assessment of the factors influencing household willingness to pay for non-marketed benefit of cattle in the

agro-pastoral systems of Mozambique. *African Journal of Agricultural Research*, 8(18):1949-1957.

Nicholson, W., and Snyder, C. M. (2012). *Microeconomic theory: Basic principles and extensions*. Twelve edition, Nelson Education.

Nkhori, P.A. (2004). The impact of transaction costs on the choice of cattle markets in Mahalapye District, Botswana (Doctoral dissertation, University of Pretoria).

Nyaaba, J. A. Nkrumah-Ennin, K., and Anang, B. T. (2019). Willingness to pay for crop insurance in Tolon District of Ghana: Application of an endogenous treatment effect model. *Agriculture and Food*, 4(2): 362–375.

Nyareza, S., and Dick, A. L. (2012). Use of community radio to communicate agricultural information to Zimbabwe's peasant farmers. Emerald Group Publishing Limited. *In Aslib Proceedings*, 64(5):494-508.

Okwu, O. J., Kuku, A. A., and Aba, J. I. (2007). An assessment of use of radio in agricultural information dissemination: a case study of radio Benue in Nigeria. *African Journal of Agricultural Research*, 2(1):14-18.

Orlowski, D. and Sigwele, H. (2014). Agriculture public expenditure review 2000-2013 Botswana, *Gates Open Res*, 3(31):1-119.

Orme, B.K., Alpert, M.I. and Christensen, E. (1997). Assessing the validity of conjoint analysis–continued. In Sawtooth Software Conference Proceedings, University of Texas, 209-226.

Ostrom, E. (2000). Collective action and the evolution of social norms. *Journal of Economic Perspectives*, 14(3):137-158.

Otieno, D.J. (2011). Economic analysis of beef cattle farmers' technical efficiency and willingness to comply with disease free zones in Kenya. (Doctoral dissertation, Newcastle University, UK).

Ouma, E. A., Obare, G. A., and Staal, S. J. (2003). Cattle as assets: Assessment of non-market benefits from cattle in smallholder Kenyan crop-livestock systems, Proceedings of the 25th *International Conference of Agricultural Economists (IAAE)*, 16-23 August 2003, Durban, South Africa.

Owusu-Sekyere, E. (2014). Consumer preferences and willingness to pay for beef attributes in Ghana (Doctoral Dissertation, University of the Free State).

Ramasubramanian, A.J. (2012). Willingness-to-pay for index based crop micro-insurance in India. (Unpublished Doctoral Dissertation, University of Sussex, United Kingdom).

Rohani, M. (2013). Freshwater values framework. *A Review of Water Valuation Methods Utilised within Total Economic Valuation. Auckland Council Working Report*, WR2013/001, Auckland: Auckland Council.

Rudee, A. (2011). Comparative ecology and population dynamics of ungulates in Botswana. (Master's Dissertation, University of California, United States).

Sargazi, A., Mashalla, S. and Mehd, I.M. (2013). Effective factors on the demand of insurance of agricultural crops in sistan area of Iran. *Journal of Agricultural Economics and Development*, 2(3):90-94.

Scarpa, R., Ruto, E. S., Kristjanson, P., Radeny, M., Drucker, A. G., and Rege, J. E. (2003). Valuing indigenous cattle breeds in Kenya: an empirical comparison of stated and revealed preference value estimates. *Ecological Economics*, 45(3):409-426.

Schwartz, S. H. (1977). Normative influences on altruism. *Advances in Experimental Social Psychology*, 10:221-279.

Sibiko, K.W., Veettil, P.C., and Qaim, M. (2018) Small farmers' preferences for weather index insurance: insights from Kenya. *Agriculture and Food Security*, 7(53):1-36.

Singh, A. J., and Hlophe N. M. (2017). Factors affecting adoption of livestock insurance: a case study of livestock farmers in Manzini Region, Swaziland. *Research Journal of Agriculture and Forestry Science*, 5(8):6-14.

SPSS, I. (1997). SPSS Conjoint 8.0. Chicago: SPSS. United States of America.

Statistics Botswana. (2015). Annual Agricultural Survey Report 2013. Gaborone, Botswana.

Statistics Botswana. (2016). Multi-Topic Household Survey 2015/16. Economic Activity.

Statistics Botswana. (2018). Annual Agricultural Survey Report 2015. Gaborone, Botswana.

Syrengelas, K. G., DeLong, K. L., Grebitus, C., and Nayga Jr, R. M. (2017). Is the natural label misleading? Examining consumer preferences for natural beef. *Applied Economic Perspectives and Policy*, 40(3):445-460.

Takahashi, K., Ikegami, M., Sheahan, M., and Barrett, C. B. (2016). Experimental evidence on the drivers of index-based livestock insurance demand in Southern Ethiopia. *World Development*, 78:324-340.

Tano, K., Kamuanga, M., Faminow, M.D. and Swallow, B. (2003). Using conjoint analysis to estimate farmer's preferences for cattle traits in West Africa. *Ecological Economics*, 45(3):393-407.

Temoso, O., Villano, R. and Hadley, D. (2015). Agricultural productivity, efficiency and growth in a semi-arid country: A case study of Botswana. *African Journal of Agricultural and Resource Economics*, 10(311-2016-5636):192-206.

Tetaz, M. (2014). An alternative to even swaps for modeling decision in a multi attribute problem: The case of labor formality. *Ciencias Administrativas*, 2(2314 – 3738): 1-17.

Teweldemedhin, M.Y. and Kafidi, L. (2009). Risk management strategies of cattle farmers in Namibia-Case study from Omaheke and Otjozondjupa region. *Journal of Agricultural Extension and Rural Development*, 1(2):063-070.

Tolera, T., Temesgen, D., Rajan, D.S. (2014). Factors affecting farmers' willingness to pay for agricultural extension services: The case of Haramaya District, Ethiopia. *International Journal of Agricultural Science Research*, 3(12):268-277.

Train, K. E. (2009). Discrete choice methods with simulation. Cambridge university press.

Tselaesele, N.M., Bagwasi, N., Lepetu, J., Bahta, S. and Oladele, I.O. (2018). Training needs assessment for transformation of smallholder livestock farming in Botswana. *South African Journal of Agricultural Extension*, *46*(1): 92-105.

Union, A. (2014). Malabo declaration on accelerated agricultural growth and transformation for shared prosperity and improved livelihoods. *African Union: Malabo, Guinea Bissau*, 20150617-2.

Vaca Moran, F.F. (2014). Application of choice-based conjoint analysis to determine consumers' preferences and willingness to pay for grass fed beef in the United States, (Doctoral Dissertations, Louisiana State University).

van Engelen, A., Malope, P., Keyser, J. and Neven, D. (2013). Botswana agri-food value chain project: beef value chain study. *Food and Agricultural Organization*: Rome, Italy.

Wan, W. (2014). Farmers' willingness to pay for breeding sow insurance: evidence from China's Hubei province. (Master's Dissertation- University of Kentucky, UK).

Wooldridge, J.M. (2000). Introductory Economics, a Modern Approach. Second edition. South Western College Publishing, Mason.

Xiu, F., Xiu, F. and Bauer, S. (2012). Farmers' willingness to pay for cow insurance in Shaanxi Province, China. *Procedia Economics and Finance,* 1:431-440.

Yamane, T. (1973). Elementary Sampling Theory. New Jersey: Prentice Hall.

Yaron, G., Moepeng, P., Mmopelwa, D., Mookodi, L., and Lekobane, R. (2012). A study of the contribution of sustainable natural resource management to economic growth, poverty eradication and achievement of NDP 10 goals. Sector assessments: tourism and agriculture, Discussion Paper for UNEP-UNDP PEI, BIDPA and GY Associates, Gaborone, Botswana.

APPENDICES

Appendix I: Checklist of questions for focus group discussion

1. What are the challenges that you have experienced in the last 12 months?
2. What are the risk mitigating strategies that you have employed for the challenges that you face as a farmer?
3. Suppose a cattle insurance policy was to be introduced in Central District, what are the features or characteristics that you would like it to have?
4. How much would you be willing to pay for this insurance policy
5. Do you think livestock insurance is important to smallholder livestock farmers?

Appendix II: Questionnaire

CONSENT

My name is Oreeditse Shirley Ramolefhe, a master's student at University of Nairobi (Kenya). I am undertaking a study entitled: **WILLINGNESS TO PAY FOR CATTLE INSURANCE BY SMALLHOLDER FARMERS IN BOTSWANA: CASE OF CENTRAL DISTRICT.** The information generated by this study will DO WHAT? [TELL THEM HOW THEY WILL BENEFIT FROM THE STUDY]. All the information that I will collect shall be treated with utmost confidentiality.

May I proceed with the interview? YES [ ] NO [ ] [***Tick* (√) *as appropriate***]

Thank you very much.

Enumerator's Name: _____ Village Name: _____

Date of interview: _____

A: LIVESTOCK HERD STRUCTURE

Please give relevant figures for the information below for the past 12 months

A1. Livestock Species	**A2. Total number owned**	**A3. Total births**	**A4. Total deaths**	**A5. Main Cause of death**	**A6. Gift out**	**A7. How often do you sell**	**A8. Marketing Channel used**	**A9. Reason for sale**
Cattle								
a) Local								
b) Cross								
c) Exotic								
Goats								
Sheep								
Poultry								
Donkey								
Horse								

Main Cause of death: 1=disease (bolwetse), 2=still born, 3=Predators (dibatana**)**

Frequency of sales: (1=once a month, 2=only when I need cash, 3=during dry seasons/ drought seasons) **Market channel**: 1=butchery, 2=BMC, 3=individuals, 4=feedlots, 5= Abattoir (Matlhabelo), 6=traders, 7=others)

Reasons: (1=drought, 2=to meet household expenses, 3=livestock trading as business, 4=culling (old age) 5=to buy feed and drugs)

B: LAND

B1. Do you own any land? 1= Yes **[ ]** 2=No **[ ]**

If ***No***, whose land do you use and how do you use the land?

B2. Size of land (Ha)	**B3. Land use**	**B4. Land owner/tenure**
1.		
2.		
3.		
4.		
5.		

Land use: (0=idle land, 1=cropping, 2=livestock grazing, 3=mixed activities) **Owner/tenure**: (1=self, 2=kin/relative, 3= community, 4=syndicate or cooperative group, 5=Rented land, 6= other)

C. PRODUCTION CHALLENGES

Water

C1.What is the main source of water for the livestock? 1=borehole **[ ]** 2=rainwater **[ ]**

3=community water **[ ]** 4=Tap water [ ]

C2. How frequently do you give water to your livestock during:

C2.1 Rainy seasons [ ] C2.1 Dry seasons [ ]

1=Everyday [ ] 2=skip a day [ ] 3=once in seven days [ ] 4=Never [ ]

Drought

C5. Have you been affected by drought? 1=Yes **[ ]** 2=No **[ ]**

C6. In which year did the last drought occur? _____

C7. Estimate the value of loss due to this drought. P_____

Diseases

Please indicate the three main diseases of cattle in your neighborhood, number of animals you lost in the past 24 months (2 years) due to diseases and measure you have taken to prevent or treat the diseases in the table below.

C8. Disease	**C9. Number of cattle lost**	**C10.Preventive Measure taken**	**C10. Cost of measure (P)**
1			
2			
3			

Disease: 1=Tlhako le molomo (FMD), 2=Lekgwafo(CPPP), 3=Nkokomane (Lumpy skin), 4=Metsi-a-pelo(Heart water),6=Madi(Pasterellosis), 7=Serotswana(black quarter),8=Sebete(Calf parathyroid),9=Kwatsi(Anthrax), 10=Mokokomalo(Botulism), 11=Specify[……..]

Preventative Measures: 1=Vaccination. 2=dipping, 3=Supplementary feeding, 4=isolation of sick animal, 5=controlled grazing, 6=de-worming, 7=specify [……]

Pests

Please complete the table below indicating the three main pests of cattle in your neighborhood, number of animals you lost in the past 12 months due to pest outbreak and measure have you taken to prevent or treat the pests.

C11. Pest	**C12. Number of cattle lost**	**C13. Measure taken**	**C14. Cost of measure (P)**

1			
2			
3			

Pests: 1=Dinwamadi tsa Sebete (Liver fluke), 2=Tsetse fly, 3=Dibokwana (Worms/helminthosis), 4=Dikgofa (ticks), 5=Specify […….]

Feeding

F15. Which are the main feeding systems that you used on cattle for the past 12 months? 1=Free range only **[ ]** 2=Free range grazing and supplementary feeding **[ ]**

F16.Which supplementary feed do you use? 1=Moroko (Bran) **[ ]** 2=lotlhaka (crop residue) **[ ]** 3=Fodder(Lucern/Lab-lab) **[ ]** 4=Letswai(salt) **[ ]** 5=Molasses **[ ]** **6=specify [……]**

D: AWARENESS AND PERCEPTION ABOUT LIVESTOCK INSURANCE

D1. Do you know anything about livestock insurance in this District? 1=Yes **[ ]** 2=No **[ ]** **If NO skip to Willingness to pay on page 6.**

D2. IF **yes** how did you get to know about it? Through: 1=Radio **[ ]** 2=Television **[ ]** 3=an insured farmer **[ ]** 4=Farmer association group **[ ]** 5=Newspaper **[ ]** 6=BIC insurance agent **[ ]** 7= Government extension worker (Mokenti) **[ ]**

D3. What do you know about the livestock insurance??

Statement	**1=strongly Agree**	**2=Agree**	**3=Neutral**	**4=Disagree**	**5=Strongly Disagree**
1. I know it is sold by Botswana Insurance Company (BIC)					

2. I know where the offices of BIC					
3. I know how much the company charges to insurance cattle					
4. I know the type of covers sold:					
Herd Select					
Herd Essential					
Stud animals					
5. I know the benefits of the livestock insurance policy					
6. I have been compensated by the insurance company					

D4. Have you adopted livestock insurance policy? 1=yes **[ ]** 2=no **[ ]**

D5. If **No** why? 1=lack of money [ ] 2=not aware of the scheme [ ] 3=not interested [ ] 4= Scheme is too expensive [ ] 5=I do not know the importance of the scheme [ ] 6=its best to diversify and do non agric business than to insure [ ] 7=I do not trust the insurance companies [ ] 8=Not enough government subsidy [ ]

D6. If **YES** please name the insurance company that provides services?

_____

D7. Name the insurance cover you have adopted? _____

D8. When did you adopt the insurance cover? _____

D9. How much are you paying per annum? P_____

D10. Have you encountered any challenges with the insurance providers? 1=Yes **[ ]** 2=NO **[ ]**

D11. Please list the challenges below:

1._____ **6.**_____
2._____ **7.** _____-
3._____ **8.** _____
4._____ **9.** _____
5._____ **10.** _____

D12. **If you terminated the insurance policy**: What are the main reasons for terminating the policy?

(a) _____
(b) _____
(c) _____

E: CONJOINT RATING

Introduction

There are 16 cards here which show different attributes of a cattle insurance policy.

ENUMERATOR: DESCRIBE THE CONTENTS OF EACH CARD TO THE RESPONDENT AS CLEARLY AS POSSIBLE. PAUSE. THEN ASK HIM/HER WHETHER S/HE HAS UNDERSTOOD WHAT S/HE NEEDS TO DO. IF S/HE HAS NOT, REPEAT THE EXPLANATION ALL OVER AGAIN UNTIL S/HE DOES.

ENUMERATOR: ONCE THE RESPONDENT HAS FINISHED THE RATING, GO THROUGH EACH CARD AGAIN AND ASK HIM/HER TO CONFIRM HIS/HER ANSWER.

CARD 1 Type of Insurance: Index Weather based Insurance Coverage: A head Time to compensation: 6 months Payment period: Annually Type of compensation: Cash Monthly premium: 14 Rating:
CARD 2 Type of Insurance: Normal insurance Coverage: Proportion of a herd Time to compensation: 6 months Payment period: Annually Type of compensation: Cash Monthly premium: 7 Rating:
CARD 3 Type of Insurance: Normal insurance Coverage: Proportion of a herd Time to compensation: 3 months Payment period: Monthly Type of compensation: Cash Monthly premium:7 Rating:
CARD 4 Type of Insurance: Normal insurance Coverage: A head Time to compensation: 1 month Payment period: Monthly Type of compensation: Cash Monthly premium:7 Rating:
CARD 5 Type of Insurance: Normal insurance Coverage: Proportion of a head Time to compensation: 1 month Payment period: Annually Type of compensation: Cow Monthly premium: 14 Rating:
CARD 6 Type of Insurance: Normal insurance Coverage: Proportion of a herd Time to compensation: 1 month Payment period: Annually Type of compensation: Cow Monthly premium: 6 Rating:
CARD 7 Type of Insurance: Index Weather based Insurance Coverage: A head Time to compensation:1 month Payment period: Annually Type of compensation:Cash Monthly premium:7 Rating:
CARD 8 Type of Insurance: Index Weather based Insurance Coverage: Proportion of a herd Time to compensation:1 month Payment period: Annually Type of compensation: Cow Monthly premium:21 Rating:
CARD 9 Type of Insurance: Normal insurance Coverage: A head

F:

Time to compensation: 6 months Payment period: Monthly Type of compensation: Cow Monthly premium:21 Rating:	
CARD 10 Type of Insurance: Index Weather based Insurance Coverage: Proportion of a herd Time to compensation:6 months Payment period: Monthly Type of compensation:Cash Monthly premium:7 Rating:	
Card 11 Type of Insurance: Normal insuranceCoverage: A head Time to compensation:1 month Payment period: Annually Type of compensation:Cow Monthly premium:7 Rating:	
CARD 12 Type of Insurance: Index Weather based Insurance Coverage: Proportion of a herd Time to compensation: 3 months Payment period: Annually Rating Type of compensation:Cow Monthly premium:7	
CARD 13 Type of Insurance: Normal insurance Coverage: A head Time to compensation: 3 months Payment period: Monthly Type of compensation: Cow Monthly premium:21 Rating:	
CARD 14 Type of Insurance: Index Weather based Insurance Coverage: A head Time to compensation: 1 month Payment period: Monthly Type of compensation:Cow Monthly premium:7 Rating:	
CARD 15 Type of Insurance: Index Weather based Insurance Coverage: Proportion of a herd Time to compensation:1 month Payment period: Monthly Type of compensation:Cash Monthly premium:21 Rating:	
CARD 16 Type of Insurance: Index Weather based Insurance Coverage: A head Time to compensation: 3 months Payment period: Monthly Type of compensation: Cash Monthly premium: 14 Rating:	

ECONOMIC ACTIVITIES/FINANCIAL STATUS

F1. What are your sources of income and how much do you earn from them

F1. source	**F2. Amount earned(monthly)**
1.Livestock sales: a) Cattle,	

b) Goats	
c) Sheep	
d) Poultry	
e) Donkey	
f) Horse	
2.Crop sales: a) Sorghum	
b) Maize	
c) Beans	
d) watermelon	
3.Employment	
4.Business	
5.Remitances	
6.Gifts	
7.Government package/voucher	

G: HOUSEHOLD CHARACTERISTICS

G1. Name Of household Head: _____ G2. Cellphone #:_____

G3. Age: _____ G4. Sex: 1=Male [ ] 2=Female **[ ]** G5. Number of dependents living in the respondent's house:

Below 10 years [ ] 11-20 years [ ] 21-30 years [ ] >31 years [ ]

G6. Occupation: 1=Government employee **[ ]** 2=Private company **[ ]** 3=Farmer **[ ]**

4=Private Entrepreneur **[ ]** 5=Other (specify) _____

G7. Number of years of formal education: ____ 1=Primary school [ ] 2=Secondary school [ ] 3=College [ ] 4=University [ ]

G8. Number of years of cattle farming experience? _____ Years

G9. What is the distance to the nearest market from your farm? ……km

G10. Distance to nearest main road: …….km

G11. What is the distance of the farm to the nearest extension/veterinary service? .....km

G12. What type of labour do you use on the farm? 1=hired labour [ ] 2= family labour [ ] both family and hired 3 = [ ]

G13. Do you have a farm manager who coordinates livestock operations at the farm? 1=yes [ ] 2=no [ ]

G14. Are you in any cooperative group (motshelo)? 1=yes **[ ]** 2=No **[ ]**

If yes, what is the role of this cooperative group?

G15. **Cooperative Group**	**G16. Role of the group**
1.	
2.	
3.	
4.	
5.	

Role: 1=marketing information, 2=financial/ credit assistance, 3=advice on agricultural production, 4=social benefits, 5=information on cattle insurance

G17. Do you have access to credit? 1=yes **[ ]** 2=no **[ ]**

G18. Have you obtained credit for cattle purposes over the last 12 months? 1=yes **[ ]** 2=no **[ ]**

G20. If yes, How much was the credit? P _____

G19.Where did you obtain the credit? 1=bank **[ ]** 2=private source **[ ]**

3=cooperative group (motshelo) **[ ]** 4= micro-finance institution [**]**

5=CEDA/Youth Grant [**]**

G21. What was the purpose of the credit? 1=Buy new cow(s) **[ ]** 2=drill a borehole in the farm **[ ]** 3=startup capital for the farm **[ ]** others 4=specify_____

H. Household and agricultural equipment

H1. Asset		**H2. Total number owned**
1. Housing Type	Mud wall	
	Brick wall	
	Stone-wall	
	Congregated iron-wall	
	Timber-wall	
2. Functioning Television		
3 . Functioning Radio (seromamowa)		
4. Refridgerator (setsidifatsi)		
5. Car (koloi)		
6. Truck (teraka)		

7. Tractor (terekere)	
8. Bicycle (baesekele)	
9. Animal drawn cart(kotsekara)	
10. Kraal (lesaka)	
11. Borehole (sediba)	
12. Plough (mogoma)	
13. Dipping equipment	
14. Laptop (sebalamakgolo)	
15. Mobile phone (mosokela tsebeng)	

THANK YOU!!!!!! KE A LEBOGA!!!!!

Appendix III: VIF results

Variable	VIF
EDU	1.76
DROUGHT	1.17
GENDER	1.17
CROPSALES	1.23
MAINROAD	1.58
VET	2.07
OFFINV	2.08
AGE	1.31
DEP	1.42
LANDSIZE	1.83
VACCINE	1.32
CATTLEINCOME	1.57
CREDIT	2.47
GROUP	1.49
TLU	2.63
Mean VIF	1.67

Appendix IV: Heteroskedasticity results

White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity

$Chi^2(62) = 63.00$
$Prob > Chi^2 = 0.4407$
Cameron & Trivedi's decomposition of IM-test

Source	Chi^2	df	P
Heteroskedasticity	63.00	62	0.4407
Skewness	14.79	15	0.4669
Kurtosis	0.15	1	0.6988
Total	77.94	78	0.4807

Appendix V: Cattle population in the Central District according to villages

Village	Traditional cattle population
Serowe/Palapye	148, 341
Mahalapye	130, 390
Bobonong	68,768
Boteti	113, 768
Tutume	151, 016