The 84th Annual Conference of the Agricultural Economics Society

Edinburgh

29 – 31 March, 2010

Cattle farmers' preferences for Disease Free Zones: a choice experiment analysis in Kenya

David J. Otieno*, Eric Ruto and L. J. Hubbard

*Corresponding author: d.j.otieno@ncl.ac.uk

School of Agriculture, Food and Rural Development, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK

Abstract

Management of food-borne illnesses is important in ensuring food safety to consumers in both domestic and export markets. In livestock trade, various measures are prescribed under the Sanitary and Phytosanitary Standards (SPS) agreement of the World Trade Organization (WTO). With regard to food safety, the SPS agreement recommends establishment of Disease Free Zones (DFZs) in order to manage the spread of trans-boundary cattle diseases. DFZs have been successfully implemented in major beef exporting countries such as Australia, Botswana, Brazil and Namibia. In Kenya however, the DFZs are still in a pilot stage and it is important to understand farmers' preferences on the type of DFZ that would be readily acceptable to them. A choice experiment survey was conducted in Kenya using a *D-optimal* design to determine the main attributes that farmers prefer in a DFZ. A total of 343 farmers were interviewed and the data analysed using random parameter logit models. Results showed that farmers would be willing to participate in a DFZ where they are provided with adequate training on pasture development, record keeping and disease monitoring skills; cattle are properly labelled for ease of identification; market information and sales contract opportunities are guaranteed; and some monetary compensation is provided in case cattle die due to severe disease outbreaks. Preferences for the DFZ attributes are heterogeneous across different cattle production systems in Kenya. These findings have important implications for policy on the design of DFZ programmes in Kenya and other countries that face cattle disease challenges.

Key words: Farmer preferences, Disease Free Zone, choice experiment, Random Parameter Logit, Kenya

1. Introduction

Production and trade in cattle and cattle products is an important source of livelihood for many people in various parts of the world. In Kenya, the cattle enterprise provides food and income for about 80 percent of the population, especially those residing in the remote rural and marginal or dry areas. The sub-sector also contributes over 35 percent of the livestock Gross Domestic Product (GDP). The share of livestock output in national GDP is estimated to be 10 percent (KIPPRA, 2009). However, frequent outbreaks of trans-boundary cattle diseases in Kenya, especially Foot and Mouth Disease (FMD), and the associated zoonotic food-borne illnesses often cause considerable losses (Otieno, 2008). Due to the disease-endemic status, besides other supply-side constraints, Kenya has lost major export markets for beef (e.g., Japan) and even failed to utilize preferential export market access in the European Union (EU) (Gitu, 2005). Management of food-borne illnesses is important in ensuring food safety to consumers in both domestic and export markets.

In order to contain the spread of four main trans-boundary cattle diseases that are officially recognized by the World Organization for Animal Health (OIE) as fatal - FMD, Contagious Bovine Pleuropneumonia (CBP), Bovine Spongiform Encephalopathy (BSE) and Rinderpest - various measures are prescribed under the Sanitary and Phytosanitary Standards (SPS) agreement of the World Trade Organization (WTO) requirements. With regard to food safety in livestock trade, the SPS agreement recommends establishment of Disease Free Zones (DFZs) (WTO, 1995; OIE, 2003). This may be described as a programme whereby a country or region is demarcated into sub-units on the basis of the level of cattle disease incidence; safe and non-safe areas, and various disease control strategies are applied in the different regions or zones. The zoning may also consider existing geographic features and/or production systems, for ease of programme administration and policy coherence. Disease zoning or regionalization may be used to separate a diseased area in an otherwise disease-free country or as a way to secure a free area in an otherwise infected country (Zepeda *et al*., 2005). In order to ensure that the DFZ is effective in assuring safe and stable beef supply, producer participation in complying with regulations therein is mandatory. Otherwise, the demarcation may create a price differential between regions, and cause a potential incentive for farmers to smuggle cattle during a disease outbreak from a low-priced infected region to a high-priced disease-free area, and this may lead to eventual collapse of the DFZ programme (Loppacher *et al*., 2006).

As a disease control strategy, DFZs have been successfully implemented in some of the major beef exporting countries such as Australia, Botswana, Brazil and Namibia. In Kenya however, the design of DFZs is still in a pilot stage and mainly focuses on rehabilitation of previous livestock holding grounds, upgrading of abattoirs and separation of wildlife from livestock ranches (Republic of Kenya, 2008). It is important to understand farmers' preferences on the features that they would like to be included in the DFZs. Information on farmers' preferences is useful to policy makers on two grounds; to enable assessment of potential acceptability of the DFZ programme, and to provide insights on some of the issues that may affect its implementation, considering potential differences in production systems and relative resource endowment between farmers in Kenya and elsewhere.

We use a choice experiment (Louviere, 2001) to investigate farmers' preferences for key attributes in the design of DFZ. In the last decade, choice experiments (CE) have been increasingly applied to value quality changes in environmental attributes (Garrod and Willis, 1999; Hanley *et al*., 2001), to analyse consumer preferences for beef steak attributes (Tonsor *et al*., 2005) and to estimate farmers' preferences for genetic attributes of indigenous livestock in developing countries (Roessler *et al*., 2008; Ruto *et al*., 2008). More recently, CEs have been used to investigate cow-calf producer preferences for alternative voluntary traceability systems in the United States of America (USA) (Schulz and Tonsor, 2010). A notable development in the method is to define attributes in terms of different aspects of policy design, rather than in terms of the characteristics of the goods themselves (Hanley *et al*., 2003; Ruto and Garrod, 2009; Espinosa-Goded *et al*., 2010). This is the approach taken by this study. We employ the CE to estimate beef cattle farmers' preferences for key elements of DFZ design and particularly to investigate the trade-offs that farmers are willing to make between various attributes of DFZ and money (i.e., Willingness to Pay – WTP). Estimates of the trade-offs would be useful in the design of demand-driven DFZs that reflect farmers' preferences and investment priorities. To the best of our knowledge, the analysis of beef cattle farmers' preferences for DFZ attributes has not received any attention in the literature; this is the gap that our study looks to address, through a choice experiment approach in a developing country context.

The paper is organized into six sections. Section two discusses the design and implementation of the choice experiment. Sampling procedure and the data collection approach used are explained in section three. In the fourth section, the choice models applied in data analysis are presented, while the fifth section reports the findings of the study. Some key conclusions are made in section six.

2. Choice experiment design

Following Lancastrian economics of separable utility functions, farmers' preferences for DFZs can be measured by presenting the programme in the form of its component attributes, rather than the aggregate package (Lancaster, 1966). This process involves choice experiment (CE) design, whereby statistical theory is applied to combine the attributes (or their levels) into various choice alternatives or profiles that can be presented to respondents in a choice exercise (Louviere, 2001; Adamowicz *et al*., 1994). Formally, two main criteria exist on the design of CEs (i.e., orthogonality and efficiency). However, there is controversy in the literature about the choice of which of these to use in generating the "best" CE design (Scarpa and Rose, 2008). Proponents of orthogonality argue that given its zero correlation property (i.e., statistical independence between variables or attributes), orthogonal designs have three merits: they are easy to construct; they allow independent estimation of each attribute's contribution to variations in the dependent variable; and they maximize the ability of the model to show statistically significant relationships at any given sample size (Louviere and Hensher, 1982; Kuhfeld *et al*., 1994). Statistical efficiency of a CE design, on the other hand, entails optimizing the design to minimize the sample size (and cost of data collection), while generating adequate information for accurate estimation (Huber and Zwerina, 1996). Efficient designs are considered to maximize the information from each choice situation (Rose and Bliemer, 2009). In addition, Scarpa and Rose (2008) argue that due to differences in the variance-covariance matrices between linear and non-linear models, efficient designs (and not the orthogonal ones) are well suited for estimation of non-linear models commonly applied in discrete choice studies. The current study makes a distinctive contribution to the debate on CE design, by using both the orthogonality and efficiency criteria in a complementary manner, rather than treating them as competing approaches as is the case in the literature.

The selection of attributes to include in a CE design requires an extensive review of the literature, together with qualitative research (such as focus group discussions) to validate the attributes. This helps to refine the choice profiles so that they may exhaustively describe the good or service to be analysed and also reflect real preferences in a practical context (Boxall *et al*., 1996). Furthermore, the attributes chosen must readily fit within the realms of policy control, besides bearing potentially significant influence on the probability of observed choice behaviour (Ruto and Garrod, 2009).

In this paper, we conceptualise DFZs to have two sets of features; compulsory regulations and optional features. The compulsory requirements are those that must be adhered to by all farmers in a DFZ and all other people living in the neighbourhood (but not necessarily members of the DFZ), in order to prevent spread of diseases into the DFZ. The 'must' features include: controlled grazing system; regular monitoring and prompt reporting of disease occurrence to veterinary officers; no movement of animals into or from a DFZ during a disease outbreak; and compulsory slaughter and safe disposal of all infected cattle in case of an outbreak. The optional features are those that farmers would choose at levels they preferred; these are the ones that enter the CE design matrix.

In our study we selected five DFZ attributes based on a combination of a review of the literature on DFZ implementation in other countries (for example see Mapitse, 2008), focus group discussions with farmers in Kenya and interviews of officials from the Ministry of Livestock development. These are: labelling of cattle for ease of traceability; an annual membership fee (cost) per animal; training of farmers on pasture development, monitoring and reporting of disease occurrence; provision of market support; and compensation to farmers. Payment of the membership fee would guarantee farmers' access to veterinary drugs and services in the DFZ at all times without any extra charges. This would also enhance sustainability of the programme in terms of continued ability to finance its operations in the long-run, considering that governments in developing countries such as Kenya are unlikely to be able to provide full funding for DFZs compared to the developed countries.

We envisaged that due to differences in levels of access to livestock extension and veterinary advisory services in Kenya, some farmers would need training in order to fully comply with the compulsory DFZ requirements, such as disease monitoring and reporting. Moreover, provision of market support was considered as an important strategy that would enable farmers to earn better incomes, recover the money they spend on DFZs and sustain their long term participation in the programme. In addition, a compensation scheme (in case of a fatal disease outbreak) that is supported by membership fee was introduced as an incentive that would boost farmers' participation, bearing in mind that currently such a scheme does not exist in Kenya (and farmers usually loose substantially from disease outbreaks). The five attributes used in the CE design and their respective levels are shown in Table 1. The selected attributes and levels were further validated through Focus Group Discussions (FGDs) and key informant interviews with farmers and other stakeholders in Kenya.

Table 1: Attributes and attribute levels in DFZ choice experiment design

DFZ Attribute	**Attribute levels**
Labelling of cattle	No labelling
	Label cattle but don't include owner's identity
	Label cattle and include owner's identity
Market support	No market support
	Provide market information only
	Provide market information and guarantee for contract sale
Training	Training is provided
	No training
Annual membership fee per cattle (in Kenyan currency; Kshs)	150
	300
	450
Compensation for cattle losses	10 percent of the value of cattle lost
	25 percent of the value of cattle lost
	50 percent of the value of cattle lost

In order to ensure design efficiency is maintained during analysis, it is important to start the design process using parameter priors that are as close as possible to the true, though unknown population parameters (Bliemer and Rose, 2010). In our case, we used a two-stage CE design approach to achieve this: first, an orthogonal design was generated from the attributes selected and applied in a preliminary survey of 36 farmers to obtain prior coefficients. The *priors* were then used in the second stage to generate an efficient design, which could estimate both main effects and interaction effects. The design had a relatively good level of *D-optimality* (i.e., *D-efficiency* measure of 85 percent). A design is said to be *D-efficient* or *D-optimal* if it has a small determinant of the variance-covariance matrix *(*th*e D-error)*. This implies that the data gathered using such a design enables estimation of parameters with as low as possible standard errors, i.e., significant t-ratios (Kuhfeld, 2005). In addition, the design had good utility balance (i.e., a *B-estimate* of 77 percent). This indicates that there was a low likelihood (23 percent) of dominance by any alternative in the choice situations. Essentially our design fulfilled the minimum threshold (*B-estimate* of 70 percent) required for utility balance in efficient designs. Note that many CE designs rarely achieve good *D-efficiency*, utility balance and orthogonality together, for most attribute combinations, attribute levels, choice alternatives and model parameter specifications (Huber and Zwerina, 1996).

The design was generated using a relatively new statistical software; NGENE (ChoiceMetrics, 2009). This study is one of the few applications in the literature involving the use of more recent and robust software to obtain an efficient CE design, especially for modelling a choice problem in a developing country.

The design had 24 paired choice profiles that were randomly blocked into six sets of four choice tasks. Respondents were randomly assigned to one of the six sets each with four choices tasks. An important objective in the design of CE is that of easing the choice tasks for respondents. A number of studies have investigated the influence of CE design dimensions (particularly number of attributes/level, number of alternatives and choice situations) on respondents' ability to choose. Overall, our design is in line with the optimum CE design dimensions discussed in Caussade et al. (2005). A pilot exercise also showed that respondents could comfortably manage anything up to eight choice tasks. Each paired choice profile provided respondents with a choice of two alternative DFZ types (A and B). A third 'choose neither' option (*status quo,* indicated by alternative C) was included in the CE design in order to make the choice options collectively exhaustive and therefore consistent with demand theory (Hanley *et al*., 2001). An example of a choice set generated from the CE design is shown in Figure 1. Before the respondents were presented with the choice sets, the purpose of the proposed DFZ was explained to them, and a clear description of the attributes and their levels was made using a card. The compulsory regulations were also highlighted.

Figure 1: Example DFZ choice set

We would like to request you to choose your most preferred type of DFZ from the following three alternatives.			
DFZ Attribute	**Alternative A**	**Alternative B**	**Alternative C**
Training	Training	No training	No training
Market support	No market support	Market information and contract	No market support
Compensation	25%	10%	No compensation
Labelling	Cattle and owner	No labelling	No labelling
Annual membership fee (Kshs)	150	450	No membership fee
Which ONE would you prefer?			

3. Sampling procedure and data collection

The study was conducted in four sites (i.e., Kajiado, Kilifi, Makueni and Taita Taveta districts) that are representative of Kenya's three main cattle production systems; nomadic pastoralism, agro-pastoralism and ranches. These production systems can be distinguished on the basis of level of sedentarisation, dependence on cattle compared to other agro-enterprises, and commercial orientation. Nomadic pastoralists are generally less sedentary and seasonally migrate with cattle in search for pasture and water. They are less commercialised and derive a large share of their livelihood from cattle and other livestock. In contrast, the agro-pastoralists are sedentary; they keep cattle and other livestock, besides cultivating various crops; and they are fairly commercialised. Finally, ranches are sedentary and purely commercial livestock enterprises; and may also grow a few crops for use as on-farm fodder or for sale (Omiti and Irungu, 2002). The ranches mainly use controlled grazing system on their private land. However, both the nomads and agro-pastoralists generally practice an open grazing system, which often tends to cause conflicts with other land users when cattle farmers encroach on private or public protected land. In the last decade, many conflicts arising from encroachment by cattle farmers have often led to confiscation of cattle or penalties such as fines (Obunde *et al*., 2005). It is important to understand how different grazing systems might influence preference for DFZ attributes, particularly labelling of cattle (which would indirectly deter trespass). The areas sampled in the study represent different agro-ecological zones and are contiguous, hence logistically more accessible. These sites also provide an opportunity to indirectly capture farmers' views about a pilot DFZ programme that the government of Kenya introduced in Taita Taveta in October, 2009, while the study was on-going.

A multi-stage cluster (area) sampling approach was used. This involved a combination of cluster sampling, simple random sampling and systematic random sampling techniques, whereby a series of selections were made from progressively smaller geographic units. Multi-stage cluster (area) sampling is appropriate in situations where the population is scattered over a large geographic area and there is no comprehensive list of the sampling units or sampling frame (as is the case in Kenya). Multi-stage cluster (area) sampling was preferred due its relative convenience, economy and efficiency compared to other sampling techniques (Horppila and Peltonen, 1992). Using this approach, four districts were selected in the first stage; Kajiado, Kilifi, Makueni and Taita Taveta. As alluded to earlier, the four districts were selected because they represent the main production systems in Kenya (i.e. nomadic pastoralism, agro-pastoralism and ranches) and also because they represent some of the areas in which the government has initiated a pilot DFZ programme. In the second stage, divisions (smaller administrative units) were randomly selected from lists of all divisions in each of the chosen districts, taking into account the general distribution of cattle in the study area. The third stage involved simple random selection of smaller administrative units (locations and then sub-locations) from lists of all locations and sub-locations in the selected divisions. Further, individual farmers were selected (during a survey) using a systematic random approach following the main transects in the sub-locations (starting from a landmark feature e.g., river or market and subsequently selecting every fifth or tenth farmer, in sparse or densely populated areas, respectively).

Data were gathered through a CE survey that was administered using face-face interviews of farmers between July and December 2009. A pre-test survey was first undertaken on a different trial sample of 36 farmers (excluding those who had participated in the preliminary survey for choice experiment design mentioned earlier) to refine the *D-optimal* design. Following the pre-tests and subsequent final revision of the questionnaire, a total of 343 farmers comprising 71 ranchers, 119 nomadic pastoralists and 153 agro-pastoralists, were interviewed in the final survey. The CE section formed part of a broader questionnaire that was used to gather information on cattle production and marketing. In order to reduce respondents' cognitive burden and enhance reliability of the information obtained from the choice tasks, a limited number of choice sets were presented to the respondents so that they would be able to consider trade-offs between all attributes, rather than focusing on only a sub-set of the attributes in their choice decisions (Hensher, 2006). Thus, each farmer completed four choice tasks in a series, from randomly presented choice sets.

4. The Choice Modelling approach

The analysis of CE data commonly referred to as Choice Modelling (CM), follows Random Utility (RU) theory. The RU framework considers utility as unobservable (to the analyst), i.e., a random variable, which can be measured as a probability that rational consumers make observable choices of goods or services from which they obtain the highest utility in any given choice set (McFadden, 1973). Thus, the utility that farmer n derives from choosing the most preferred DFZ alternative i from a choice set C $(c = i,j,\ldots C)$, can be expressed as:

$$U_{in} = \beta X_{in} + \varepsilon_{in} \qquad (1)$$

where X is a vector of observable DFZ attributes, β are the unknown parameters to be estimated, while ε is the stochastic component of utility (Manski, 1977). Equation (1) is a general choice model from which several discrete choice models can be derived depending on the assumptions made on the distribution of the random component ε. In practice however, the logit model originally introduced by Luce (1959), is preferred to linear or probit functional forms because it has a closed form, which entails less complexity in computation than other expressions. Formal applications usually follow the Multinomial Logit (MNL) specification that assumes an extreme value type I (*Gumbel*) distribution where the location parameter (mean) is zero and μ is the scale parameter (the μ is assumed to equal 1 so that the *β's* can be identified). The probability that individual n chooses alternative i from the choice set C is given by the conditional logit model (McFadden, 1973):

$$\Pr(in) = \frac{\exp(\beta X_{in})}{\sum_{j \in C} \exp(\beta X_{jn})} \quad (2)$$

Despite its relative simplicity of estimation, the MNL model has quite restrictive assumptions; homogeneity of preferences in the population, Independence from Irrelevant Alternatives (IIA) (Hausman and McFadden, 1984) and independence of error terms across time or choice situations. Ideally, preferences are unobservable to the researcher and at least some variability would be expected in consumer preference patterns due to individual-specific decision rules employed by the respondents to process choice tasks, even if they tend to have similar socio-demographic characteristics (Swait and Bernardino, 2000). Imposing an assumption of preference and response homogeneity when, in fact, there is heterogeneity, results in biased and inconsistent parameters and choice probability estimates (Chamberlain, 1980).

In recent literature, heterogeneity has typically been accounted for by characterising the distribution of preferences in the sampled population through either a mixed logit (Train, 1998; McFadden and Train, 2000) or Latent Class Model – LCM (Wedel and Kamakura, 2000). Accounting for taste heterogeneity is important because it enables estimation of unbiased and consistent models, and improves the accuracy and reliability of analytical results (Greene, 2003). In addition, understanding the extent and form of heterogeneity in preferences provides useful information on the distributional effects and other policy impacts of resource use and management decisions (Boxall and Adamowicz, 2002). The mixed logit model, also known as Random Parameters Logit (RPL) was introduced by Boyd and Mellman (1980) and Cardell and Dunbar (1980), and assumes that individual preferences are heterogeneous and continuously distributed random variables for the entire population. The LCM on the other hand, considers the population as comprising unobservable (latent), finite and discrete segments or classes, which are heterogeneous in their preference patterns across the segments, but have a homogeneous set of preferences within each segment. We now turn our focus to the specification of the RPL model which has been applied in this paper.

By allowing model coefficients of the observed variables to vary randomly over individuals, the RPL eliminates the restrictive IIA property and permits approximate representation of any substitution pattern exhibited by the data. Thus, in the RPL model, the inclusion of, or change to, an alternative affects the ratio of the probabilities of any other two alternatives in the choice set (Morey and Rossman, 2003). The RPL allows considerable flexibility in estimating mean utility levels (Revelt and Train, 1998). In addition, when the unobserved individual-specific parameters are allowed to vary, correlation is induced between choice alternatives (and over time) in the random component of utility. The RPL specification captures this correlation and allows efficient estimation when there are repeated choices by the same individuals (Revelt and Train, 1998; McFadden and Train, 2000). The benefit of allowing correlation over choice alternatives is that two pair-wise choices (one from each of two individuals) provide more information than two choices from the same individual (Morey and Rossman, 2003).

Following Revelt and Train (1998), the utility obtained by individual *n* from alternative *i* in choice situation (or time period) *t* is expressed as:

$$U_{\text{int}} = \beta_n X_{\text{int}} + \varepsilon_{\text{int}} \qquad (3)$$

where X_{int} is a vector of observable variables, β_n is an unobserved coefficient vector for each decision maker and varies in the population with a density function $f(\beta_n | \theta)$ whereby θ are the (true) parameters of this distribution. The ε_{int} is an unobserved random term distributed as IID extreme value independent of β_n and X_{int}. Conditional on β_n, the probability that individual *n* chooses alternative *i* in choice situation *t* (t = 1,2,…4 in this study) is given by the standard MNL model (slight modification of equation 2):

$$L_{\text{int}}(\beta_n) = \frac{\exp(\beta_n X_{\text{int}})}{\sum_{j \in C} \exp(\beta_n X_{jnt})} \qquad (4)$$

Let $i(n,t)$ denote the alternative chosen by individual *n* in choice situation *t*. The probability of individual *n*'s observed sequence of choices (conditional on β_n) is simply the product of standard MNLs assuming that the individual tastes, β_n do not vary over choice situations for the same individual in repeated choice tasks (but are heterogeneous over individuals):

$$G_n(\beta_n) = \prod_t L_{\text{int}}(\beta_n) \qquad (5)$$

The unconditional probability for the sequence of choices made by individual *n* is expressed as:

$$P_n(\theta) = \int G_n(\beta_n) f(\beta_n | \theta) d\beta_n \qquad (6)$$

Two sets of parameters are noteworthy in this expression: β_n is a vector of parameters specific to individual *n* (representing the individual's tastes, which vary over people) and θ are parameters that describe the density of the distribution of the individual-specific parameters β_n (for instance, θ represent the mean and covariance of β_n). The objective in RPL is to estimate the θ. This is normally done through simulation (because the integral in Equation 6 cannot be computed analytically due to the lack of a closed mathematical form) and maximization of the simulated log-likelihood function. The log-likelihood function is specified as:

$$LL(\theta) = \sum_n \ln P_n(\theta) \tag{7}$$

The $P_n(\theta)$ is approximated by a summation over randomly chosen values of β_n. For a selected value of the parameters θ, a value of β_n is drawn from its distribution and $G_n(\beta_n)$, i.e., the product of standard MNLs, is computed. Repeated calculations are done for several draws and the average of the $G_n(\beta_n)$ is considered as the approximate choice probability:

$$SP_n(\theta) = \left(\frac{1}{R}\right)\sum_{r=1}^{R} G_n\left(\beta_n^{\ r|\theta}\right) \tag{8}$$

where R is the number of draws of β_n, $\beta_n^{\ r|\theta}$ is the *r-th* draw from $f(\beta_n | \theta)$ and SP_n is the simulated probability of individual *n*'s sequence of choices. Following Train (2003), the simulation was based on Halton intelligent draws, which has been shown to yield more accurate results compared to independent random draws. Up to 100 Halton draws were used in the simulations. The simulated log-likelihood function is constructed as:

$$SLL(\theta) = \sum_n \ln\left(SP_n(\theta)\right) \tag{9}$$

The estimated parameters are those that maximize $SLL(\theta)$. The ultimate aim of a CE study is to establish the welfare effects of a programme on the society. This was made possible through the inclusion of price or cost as one the choice attributes, and subsequently the computation of the Marginal Rate of Substitution (MRS) or simply the trade-offs between attributes and money, i.e., WTP (Hanemann, 1984):

$$WTP = -1 * \left(\frac{\beta_k}{\beta_p}\right) \tag{10}$$

where β_k is the estimated coefficient for an attribute level in the choice set and β_p is the price coefficient. Estimation of the models was done in LIMDEP version 9.0/NLOGIT version 4.0 software (Greene, 2007).

5. Results and discussion

The findings from this study are presented in the two parts that follow in this section: descriptive statistics of farmers' profiles and then results from econometric estimation.

5.1 Farmer characteristics

Descriptive results of farmer profiles show that on average, ranchers have bigger herds and relatively larger farms, than the nomads and agro-pastoralists. The agro-pastoralists mainly keep crossbreeds and pure exotic breeds, while most of the nomads and ranchers have indigenous (local) cattle breeds such as the *Zebu* and *Boran*. A higher percentage of ranchers and nomads depend on cattle as the main source of income, and most of them experience disease-related cattle losses compared to the agro-pastoralists. Thus, introduction of a DFZ may be a timely intervention that would possibly enable farmers to manage the cattle disease challenge and cushion the livelihoods affected. Ranchers enjoy relatively better access to livestock extension and veterinary advisory services, compared to nomads and agro-pastoralists. This differential access confirms to some extent, the logic for our inclusion of training as a DFZ attribute. More than three quarters of the farmers sampled have some formal education (completed at least primary education). A summary of these farmer characteristics is presented in Table 2.

Table 2: Farmers' socio-demographic profiles

Characteristic	Nomads (n = 119)	Agro-pastoralists (n = 153)	Ranches (n = 71)	Pooled sample (N = 343)
Average herd size	63.1[b]	14.1[c]	172.6[a]	63.9
Average farm size (acres)	93.9[b]	13.1[c]	407.9[a]	123.8
Loss of cattle from diseases (% of farmers affected in the past year)	76.5[a]	52.3[b]	74.6[a]	65.3
Access to livestock extension services (% of farmers)	49.6[b]	38.6[c]	78.9[a]	50.7
Access to veterinary advisory services (% of farmers)	49.6[b]	52.9[b]	88.7[a]	59.2
Percentage of farmers who derive more than half of income from cattle	79.0[b]	39.2[c]	94.4[a]	64.4
Main cattle breed is indigenous	68.1[a]	30.7[c]	54.9[b]	48.7
Main cattle breed is exotic/crossbreed	31.9[c]	69.3[a]	45.1[b]	51.3
Formal education (% of farmers)	70.6[b]	86.9[a]	83.1[a]	80.5

[a,b,c] Different letters denote significant differences in variables across the production systems in a descending order of magnitude at 10% level.

5.2 Farmers' preferences for Disease Free Zones

We use a comparative approach in our discussion of the econometric results to highlight the main similarities and differences in farmer preferences for DFZs in the three production systems. The variables used in the DFZ analysis are shown in Table 3. A likelihood ratio (LR)[1] test clearly shows that parameters are not equal across the production systems. Nonetheless, for purposes of completeness of the analysis and the benefit of more degrees of freedom, we also show the pooled sample results. The paper focuses on results of RPL analysis, which offer a better chance (than MNL models) to capture preference heterogeneity across different production systems. A production system is a relatively stable variable (at least in the short run) and is therefore more tractable for policy design and implementation than many other farm characteristics (e.g., breed or herd size) that change quite often. Essentially, focusing on the production system rather than individual features therein as the entry point for policy intervention would enable formulation of more economical and coherent policy packages that address observed heterogeneity in a holistic manner.

Table 3: Description of variables used in the choice analysis

Variable	Description
TRAINING	Training is provided (1 = Yes; 0 otherwise)
MKSN	No market information or contract (1 = Yes; 0 otherwise)
MKIF	Market information is provided (1 = Yes; 0 otherwise)
MKFC	Market information is provided and sales contract is guaranteed (1 = Yes; 0 otherwise)
COMPEN	Compensation (continuous levels: 10%, 25% or 50%)
LABN	No labelling of cattle (1 = Yes; 0 otherwise)
LABC	Label cattle only (1 = Yes; 0 otherwise)
LABW	Label cattle and include owner's identity (1 = Yes; 0 otherwise)
COST	Annual membership fee per animal (continuous levels: 150, 300 or 450)

The results of the RPL models are reported in Table 4. The utility parameters for all DFZ attributes were entered as random parameters assuming a normal distribution, except the cost attribute which was specified as fixed. The models were estimated using maximum simulated likelihood procedures

[1] The likelihood ratio (LR) statistic is calculated as -2{*L*(pooled) – (*L*1+*L*2+*L*3)} where L(pooled) is the log likelihood function for the pooled sample and L1, L2 and L3 are the log likelihood functions for the sub-samples (nomadic pastoralists, agro-pastoralists and ranchers respectively). It has been shown that the LR statistic is distributed chi-square with degrees of freedom equal to the number of parameters in the estimated (Greene, 2003). The test strongly rejects the hypotheses that the parameters are equal across the three production systems with LR statistic of 68.54 against 18.48 the chi-square critical value at 1% level and 7 degrees of freedom.

in Limdep version 9.0/Nlogit version 4.0 (Greene, 2007) using 100 Halton draws for the simulations. Considering differences in scale parameters for models estimated using different samples, we discuss the pooled sample coefficients in general and only make comparisons between the various production systems based on the Willingness to Pay (WTP) estimates. It can be noted from the pooled sample results that, on average, farmers prefer training on pasture development, monitoring and reporting of cattle diseases (Table 4). This observation has two important implications for policy: it directly reveals preferences for the DFZ programme; and it also indirectly captures farmers' lack of satisfaction with the current livestock extension service provision system. As expected, preferences for the market support attribute are fully consistent with the choice axiom of transitivity; thus, market information and contract are preferred to market information only or no market support. Sales contracts are important in enabling farmers to obtain steady and increased income through an assured market, and reduced input and output price risks (MacDonald *et al.*, 2004).

Also, the estimated coefficient for compensation is positive and significant as expected for incentives such as money. There is a higher preference for labelling cattle only, than for labelling cattle and showing the owner's identity. This might be due to farmers' fear of penalties (e.g., fines) that are normally charged on those who practice open grazing systems and encroach on private or public protected farms; thus farmers would want to conceal their identities. As noted by Schulz and Tonsor (2010), acceptance of a complete system of cattle labelling by most farmers would be useful for verification of animal health as well as for market access purposes. The significance of the cost parameter (annual membership fee) with the expected negative sign permits computation of trade-offs between each attribute and money. The estimated models for the separate production systems, as well as the pooled sample all exhibit good explanatory power (pseudo-R^2 values between 35 percent and 41 percent).

The results also show that all the attribute coefficients (except labelling cattle with or without owner's identity, in the agro pastoralist model) have highly significant standard deviations; implying that there are, indeed, heterogeneous preferences for these attributes in the population of cattle farmers. The estimated means and standard deviations of the normally distributed coefficients also provide information on the proportion of the population that places a positive value on a particular attribute and the proportion that places a negative value (i.e., the probability distribution).

Table 4: Random parameter estimates for DFZ attributes

Variable	Coefficient (t-ratio)			
	Nomads	Agro pastoralists	Ranches	Pooled sample
TRAINING	4.788 (6.270)***	15.298 (3.038)***	5.195 (3.896)***	5.022 (9.272)***
MKIF	3.013 (4.954)***	10.336 (3.077)***	3.398 (3.174)***	3.278 (7.878)***
MKFC	3.736 (5.220)***	9.720 (3.470)***	5.303 (3.762)***	3.952 (8.632)***
COMPEN	0.053 (3.978)***	0.164 (2.806)***	0.060 (3.084)***	0.055 (6.241)***
LABC	2.288 (2.950)***	0.071 (0.055)	1.569 (1.730)*	1.152 (3.368)***
LABW	1.518 (3.317)***	-0.819 (-0.716)	2.264 (3.021)***	0.955 (4.043)***
COST	-0.004 (-3.533)***	-0.019 (-3.045)***	-0.005 (-2.855)***	-0.006 (-7.183)***
Standard deviations of parameter distributions (t-ratio)				
sdTRAINING	2.471 (4.353)***	6.076 (2.926)***	2.414 (2.659)***	2.276 (6.936)***
sdMKIF	0.111 (0.105)	6.357 (2.940)***	2.463 (2.724)***	1.865 (4.171)***
sdMKFC	1.280 (1.699)*	7.519 (2.649)***	2.459 (2.621)***	2.227 (5.836)***
sdCOMPEN	0.041 (2.484)**	0.164 (2.348)**	0.022 (0.826)	0.045 (4.219)***
sdLABC	0.046 (0.044)	3.005 (2.097)**	0.087 (0.070)	0.457 (1.022)
sdLABW	1.049 (1.411)	4.183 (2.279)**	0.487 (0.647)	0.010 (0.020)
Log-likelihood	-190.533	-277.636	-124.270	-626.707
Adjusted pseudo-R^2	0.414	0.375	0.354	0.358
N (respondents)	119	153	71	343
N (choices)	476	612	284	1372

Notes: *** Significant at 1%, ** significant at 5%, * significant at 10%. Corresponding t-ratios for the attribute coefficients and their distributions are shown in parentheses.

For parsimony, we only show the proportion of farmers who place a positive value on the DFZ attributes (Table 5). Generally, over 90% of farmers had a positive preference for each of the attributes included in the choice experiment. Perhaps unexpected is a proportion (though only 11%) that have a negative preference for compensation. This result is difficult to comment on and is perhaps an artefact of the normal distribution. A majority of farmers highly preferred the DFZ attributes included in the choice experiment; this perhaps shows that collectively the attributes used in the CE design fully captured respondents' preference range for DFZs. Indeed, these probability distribution patterns may possibly suggest there is greater acceptability of the DFZ programme.

Table 5: Positive probability distribution of preferences for DFZ attributes

Variable	Nomads (% of farmers)	Agro pastoralists (% of farmers)	Ranches (% of farmers)	Pooled sample (% of farmers)
Training	97.4	99.4	98.4	98.6
Market information only	100.0	94.8	91.6	96.1
Market information and contract	99.8	90.2	98.5	96.2
Compensation	90.2	84.1	99.7	88.9
Labelling cattle only	100.0	50.9	100.0	99.4
Labelling and including owner's identity	92.6	42.2	100.0	100.0

The results on WTP show that farmers have heterogeneous preferences for all the DFZ attributes (Table 6). In the pooled sample estimates, farmers are willing to pay between Kshs 694 to Kshs 1,021 per animal annually for inclusion of training in a DFZ; Kshs 418 to Kshs 702 for provision of market information only; Kshs 530 to Kshs 820 for provision of market information and sales contract guarantee; Kshs 7 to Kshs 12 in order to receive compensation equivalent to one percent of the value of cattle lost due to a disease occurrence; Kshs 82 to Kshs 312 for labelling of cattle without showing owner's identity; and Kshs 86 to Kshs 240 for including owner's identity in the cattle label. The estimated WTP values for all the DFZ attributes are reasonable because they all fall below the average prices of cattle in the study sites (between Kshs 10,000 to Kshs 30,000). A relative ranking of the attributes on the basis of the WTP values shows farmers' order of preferences as: training; market information and contract; market information only; labelling cattle only; and then labelling cattle with owner's identity. Note that compensation is not included in the preference ranking because it was entered as a continuous variable indicating the proportion of the value of cattle lost due to a disease outbreak hence not directly comparable to the other variables, which were entered in the model as discrete binary variables.

On average, nomads are willing to pay relatively more money in order to have training in the DFZ compared to the ranchers and agro-pastoralists. These results suggest that farmers who have formal education would require less training to enable them to implement some of the compulsory requirements in the DFZ, such as monitoring and reporting of disease occurrence. In addition, while these results reflect the differences in access to livestock extension and veterinary advisory services (see results in Table 2), they generally indicate that farmers would prefer cattle-specific training in the DFZ, which the existing formal education and livestock development programmes do not seem to adequately provide at the moment. Two further explanations may be used to interpret the finding on the nomads' relatively high WTP for training: first, it may be argued that due to their low level of sedentarisation, nomads have relatively limited chances of acquiring cattle production skills in formal livestock-specific training schemes, and they would therefore be more willing to have such training incorporated in their pastoral way of life through a DFZ programme. The second explanation may be associated with relative time allocation in various enterprises by farmers in the three production systems. It might be the case that the multiple (livestock and non-livestock) enterprises undertaken by agro-pastoralists and ranchers put a significant constraint on their time, thereby resulting in their relatively low WTP for specific training on the cattle enterprise (which would also require considerable time). For the nomads, attending the training would possibly fit in their time schedule because they keep cattle and other livestock as one herd.

Table 6: Marginal WTP estimates for DFZ attributes

Variable	Marginal WTP (95% confidence interval)			
	Nomads	Agro pastoralists	Ranches	Pooled sample
TRAINING	1244.80	791.81	1061.01	857.50
	(644.88 – 1844.72)	(609.47 – 974.15)	(534.79 – 1587.23)	(693.72 – 1021.28)
MKIF	783.41	535.02	694.02	559.77
	(355.74 – 1211.08)	(405.46 – 664.58)	(228.23 – 1159.81)	(417.94 – 701.60)
MKFC	971.36	503.10	1082.97	674.76
	(467.13 – 1475.59)	(377.84 – 628.36)	(507.65 – 1658.29)	(529.80 – 819.72)
COMPEN	13.89	8.48	12.31	9.34
	(5.58 – 22.20)	(5.97 – 10.99)	(5.18 – 19.44)	(6.67 – 12.01)
LABC	594.79	-	320.44	196.78
	(161.65 – 1027.93)		(-70.60 – 711.48)	(81.59 – 311.97)
LABW	394.70	-	462.36	163.05
	(134.92 – 654.48)		(152.95 – 771.77)	(86.36 – 239.74)

Both nomads and ranchers are willing to pay more for provision of market information and sales contract guarantee than for market information only, while the agro-pastoralists have a somewhat illogical preference order for market support. The higher WTP for market information and contract among the nomads and ranchers can be explained by their relatively high dependency on cattle for livelihoods, as well as the higher disease incidence on their farms than among the agro-pastoralists (consistent with results in Table 2).

The agro-pastoralists' low WTP for compensation may indicate that they would still be able to achieve substantial gains at lower costs, due to the relatively high value of the cattle breeds (crosses and exotic) that most of them keep compared to farmers in the other production systems. Intuitively, the nomads and ranchers would have to pay more money per animal in order to obtain better compensation because a higher percentage of their herd is composed of the relatively low valued local breeds (the indigenous zebu and Boran). The results also show that agro-pastoralists do not prefer labelling of cattle with or without the owner's identity. This could be associated with their relatively small farms, hence a preference to continue practising open grazing (while concealing identity to avoid penalties in case of encroachment/trespass). The nomads would be willing to pay more for labelling cattle only than for labelling with owner's identity; perhaps implying that they would also still prefer some degree of open grazing. In order to prevent re-infection of cattle in a DFZ and potential collapse of the DFZ programme, it would be necessary to ensure that farmers in these two production systems adopt a controlled grazing system.

Finally, the results indicate that ranchers would be willing to pay more for labelling cattle with their identities than just labelling. This reflects the current situation where most ranchers already practice some form of cattle labelling and confined grazing system; this finding clearly suggests that the ranchers would fully support traceability of cattle as a key DFZ attribute.

6. Conclusions

This is the first study that has focused on analysis of farmer preferences for DFZs, and provides important insights to policy and future research on the design of DFZ programmes. The results showed that farmers in Kenya prefer establishment of effective DFZs in order to help them manage disease challenges in cattle production. Compared to the current disease control programmes, such as the pilot DFZ recently introduced by the government (mainly focusing on the rehabilitation of previous livestock holding grounds, upgrading of abattoirs and separation of wildlife from livestock ranches), farmers would prefer to have a DFZ in which they are provided with adequate training on pasture development, record keeping and disease monitoring skills; cattle are properly labelled for ease of identification; market information and sales contract opportunities are guaranteed; and some monetary compensation is provided in case cattle die due to severe disease outbreaks. The design of DFZs should therefore be refined to include these features in order to enhance the acceptability of such programmes. Results also showed (indirectly) that farmers are not satisfied with the livestock extension service provision system in Kenya; and hence more improvements are required in this regard. Moreover, there is a higher likelihood of acceptance of DFZs that have the desired attributes.

Results clearly show that there is heterogeneity in farmer preferences across various production systems. Because of their relatively high dependence on cattle for income and the higher disease incidence, nomads and ranchers are willing to pay more in order to have market information and contract included in the DFZ compared to the agro-pastoralists. Farmers in these two production systems also have a higher willingness to pay for compensation due to relatively low value of the indigenous cattle kept, than their agro-pastoralist counterparts who mainly keep high value breeds of cattle (crosses and exotic). There are variations in WTP for training, perhaps due to differences in access to livestock extension and veterinary advisory services, levels of sedentarisation and time allocation in various production systems.

In order to ensure acceptance of cattle traceability among the agro-pastoralists and nomads, it is imperative to emphasize that inclusion of cattle owner's identity in the labelling is not meant to penalize farmers for trespass, but rather a key element in enhancing disease control. Moreover, improving farmers' understanding of the purpose of each attribute is important for a DFZ programme, whose successful implementation requires a great extent of collective farmer participation in one or more production systems. Future research may focus on identifying preference segments for DFZs in various production systems. Complementary application of orthogonality and efficiency criteria also seems to be an interesting area, more so in improving the statistical appeal of CE designs.

Acknowledgements

Special thanks to the Commonwealth Scholarship Commission (CSC) and the School of Agriculture, Food and Rural Development (AFRD) at Newcastle University, for financial support.

References

Adamowicz, W. L., Louviere, J. and Williams, M. (1994). Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities. Journal of Environmental Economics and Management, 26:271-292.

Bliemer, C. J. and Rose, J. M. (2010). Construction of experimental designs for mixed logit models allowing for correlation across choice observations. Transportation Research Part B (2010), doi:10.1016/j.trb.2009.12.004.

Boxall, P. C. and Adamowicz, W. L. (2002). Understanding Heterogeneous Preferences in Random Utility Models: A Latent Class Approach. Environmental Resource Economics, 23:421-446.

Boxall, P. C., Adamowicz, W. L., Swait, J., Williams, M. and Louviere, J. J. (1996). A comparison of stated preference methods for environmental valuation. Ecological Economics, 18:243-253.

Boyd, J. and Mellman, J. (1980). The effect of fuel economy standards on the U.S. automotive market: a hedonic demand analysis. Transportation Research, 14A(5-6):367-378.

Cardell, N. and Dunbar, F. (1980). Measuring the societal impacts of automobile downsizing. Transportation Research, 14A(5-6):423-434.

Caussade, S., Ortuzar, J. D., Rizzi, L. I. and Hensher, D. A. (2005). Assessing the influence of design dimensions on stated choice experiment estimates. Transportation Research Part B, 39:621-640.

Chamberlain, G. (1980). Analysis of Covariance with Qualitative Data. The Review of Economic Studies, 47(1):225-238.

ChoiceMetrics (2009). Ngene 1.0 User Manual and Reference Guide. The Cutting Edge in Experimental Design, Version 17/03/2009, www.choice-metrics.com

Espinosa-Goded, M., Barreilo-Hurle, J. and Ruto, E. (2010). What Do Farmers Want From Agri-Environmental Scheme Design? A Choice Experiment Approach. Journal of Agricultural Economics, doi:10.1111/j.1477-9552.2010.00244.x

Garrod, G. D. and Willis, K. G. (1999). Economic valuation of the environment, methods and case studies. Cheltenham: Edward Elgar.

Gitu, K.W. (2005). Market Access of Kenya's Livestock and Livestock Products to the European Union Market. Consultancy Report prepared for the Ministry of Trade and Industry KEPLOTRADE Project, Nairobi.

Greene, W. H. (2003). Econometric Analysis, 5th edition. Prentice Hall, ISBN: 0-13-110849-2.

Greene, W. H. (2007). LIMDEP version 9.0/NLOGIT version 4.0 Econometric Modelling Guide. Plainview, NY: Econometric Software.

Hanemann, W. M. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics, 66:332-341.

Hanley, N., MacMillan, D., Patterson, I. and Wright, R. E. (2003). Economics and the design of nature conservation policy: a case study of wild goose conservation in Scotland using choice experiments. Animal Conservation, 6(2):123-129.

Hanley, N., Mourato, S. and Wright, R. E. (2001). Choice Modelling Approaches: A Superior Alternative for Environmental Valuation? Journal of Economic Surveys, 15(3):436-462.

Hausman, J. and McFadden, D. (1984). Specification Tests for the Multinomial Logit Model. Econometrica, 52(5):1219-1240.

Hensher, D. A. (2006). How do respondents process stated choice experiments? Attribute consideration under varying information load. Journal of Applied Econometrics, 21:861-878.

Horppila, J. and Peltonen, H. (1992). Optimizing sampling from trawl catches: contemporaneous multistage sampling for age and length structures. Canadian Journal of Fisheries and Aquatic Science, 49:1555-1559.

Huber, J. and Zwerina, K. (1996). The Importance of Utility Balance in Efficient Choice Designs. Journal of Market Research, 33(3): 307 - 317.

KIPPRA (2009). Kenya Economic Report: Building a Globally Competitive Economy. Kenya Institute for Public Policy Research and Analysis (KIPPRA), Nairobi.

Kuhfeld, W. F. (2005). Marketing Research Methods in SAS: Experimental Design, Choice, Conjoint, and Graphical Techniques (software manual), SAS 9.1 Edition, TS-722.

Kuhfeld, W.F., Tobias, R. D. and Garratt, M. (1994). Efficient experimental design with marketing research applications. Journal of Marketing Research, 31:545-557.

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

Loppacher, L., Kerr, W. A. and Barichello, R. R. (2006). A Trade Regime for Sub-National Exports under the Agreement on the Application of Sanitary and Phytosanitary Measures. Trade Policy Brief No. 2, June, Canadian Agricultural Trade Policy Research Network (CATPRN), Saskatoon, http://www.catrade.org.

Louviere, J. J. (2001). Choice Experiments: an overview of concepts and issues, in: Bennett and Blamey (eds), The Choice Modelling Approach to Environmental Valuation: Edward Elgar.

Louviere, J. J. and Hensher, D. (1982). On the Design and Analysis of Simulated Choice or Allocation Experiments in Travel Choice Modelling. Transportation Research Record, 890:11-17.

Luce, R. D. (1959). Individual Choice Behaviour. A Theoretical Analysis, John Wiley & Sons Inc., New York.

MacDonald, J., Perry, J., Ahearn, M., Banker, D., Chambers, W., Dimitri, C., Key, N., Nelson, K. and Southard, L. (2004). Contracts, Markets and Prices: Organizing the Production and Use of Agricultural Commodities. Agricultural Economic Report No. 837, Economic Research Service, United States Department of Agriculture (USDA), www.ers.usda.gov

Manski, C. (1977). The structure of random utility models, Theory and Decisions, 8:229-254.

Mapitse, N. (2008). Botswana's foot-and-mouth disease and beef trade policy. Transboundary animal disease and market access: future options for the beef industry in Southern Africa. Working paper No. 3. Institute of Development Studies (IDS), Brighton.

McFadden, D. (1973). Conditional logit analysis of qualitative choice behavior. In: Zarembka, P. (ed.). Frontiers in Econometrics. Academic Press, New York, pp. 105-142.

McFadden, D. and Train, K. (2000). Mixed MNL Models for Discrete Response. Journal of Applied Econometrics, 15:447-470.

Morey, E. and Rossman, K. G. (2003). Using Stated-Preference Questions to Investigate Variations in Willingness to Pay for Preserving Marble Monuments: Classic Heterogeneity, Random Parameters, and Mixture Models. Journal of Cultural Economics, 27:215-229.

Obunde, P., Omiti, J. and Sirengo, A.N. (2005). Policy Dimensions in Human-Wildlife Conflicts in Kenya: Evidence from Laikipia and Nyandarua Districts. Discussion Paper No. 65, Institute of Policy Analysis and Research (IPAR), Nairobi.

OIE (2003). Terrestrial Animal Health Code 2003. World Organization for Animal Health (Office International des Epizooties), Paris, http://www.oie.int.

Omiti, J. and Irungu, P. (2002). Institutional and policy issues relevant to pastoral development in Kenya. IPAR Discussion Paper No. 031/2002, Nairobi: Institute of Policy Analysis and Research.

Otieno, D. (2008). Determinants of Kenya's Beef Export Supply. Discussion Paper No. 85, Kenya Institute for Public Policy Research and Analysis (KIPPRA), Nairobi, 46pp, ISBN: 9966777334. Available at: http://blds.ids.ac.uk/cf/opaccf/detailed.cfm?RN=281990

Republic of Kenya (2008). A Project Proposal on the Coast Disease Free Zone. Ministry of Livestock Development, Livestock Production Department, Nairobi.

Revelt, D. and Train, K. (1998). Mixed Logit with Repeated Choices: Household's Choices of Appliance Efficiency Level. The Review of Economics and Statistics, 80(4):647-657.

Roessler, R., Drucker, A., Scarpa, R., MarKemann, A., Lemke, U, Thuy, Le T. and Zarate, A. V. (2008). Using choice experiments to assess smallholder farmers' preferences for pig breeding traits in different production systems in North-West Vietnam. Ecological Economics, 66:184-192.

Rose, J. M. and Bliemer, M. C. J. (2009). Constructing Efficient Stated Choice Experimental Designs. Transport Reviews, 29(5):587-617.

Ruto, E. and Garrod, G. (2009). Investigating farmers' preferences for the design of agri-environment schemes: a choice experiment approach. Journal of Environmental Planning and Management, 52(5):631-647.

Ruto, E., Garrod, G. and Scarpa, R. (2008). Valuing animal genetic resources: a choice modeling application to indigenous cattle in Kenya. The Journal of the International Association of Agricultural Economists, AECNBC 38(1): 89-98.

Scarpa, R. and Rose, J. M. (2008). Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why. The Australian Journal of Agricultural and Resource Economics, 52:253-282.

Schulz, L. L. and Tonsor, G. T. (2010). Cow-Calf Producer Preferences for Voluntary Traceability Systems. Journal of Agricultural Economics, 61(1):138-162.

Swait, J. and Bernardino, A. (2000). Distinguishing taste variation from error structure in discrete choice data. Transportation Research Part B, 34:1-15.

Tonsor, G. T., Schroeder, T. C., Fox, J. A. and Biere, A. (2005). European preferences for beef steak attributes. Journal of Agricultural and Resource Economics, 30:367-380.

Train, K. E. (1998). Recreation Demand Models with Taste Differences Over People. Land Economics, 74(2):230-239.

Train, K. E. (2003). Discrete choice methods with simulation. Cambridge University Press, New York.

Wedel, M. and Kamakura, W. (2000). Market Segmentation: Conceptual and Methodological Foundations. Kluwer Academic Publishers, Boston, MA.

WTO (1995). Agreement on the Application of Sanitary and Phytosanitary Measures. World Trade Organization, http://www.wto.org.

Zepeda, C., Salman, M., Thiermann, A., Kellar, J., Rojas, H. and Willeberg, P. (2005). The role of veterinary epidemiology and veterinary services in complying with the World Trade Organization SPS agreement. Preventive Veterinary Medicine, 67:125-140.