Delivery of the Contagious Bovine Pleuropneumonia (CBPP) vaccine in northeastern Kenya
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# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tables</td>
<td>iv</td>
</tr>
<tr>
<td>Figures</td>
<td>v</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>vi</td>
</tr>
<tr>
<td>Summary</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Literature review</td>
<td>4</td>
</tr>
<tr>
<td>Contagious bovine pleuropneumonia (CBPP)</td>
<td>4</td>
</tr>
<tr>
<td>Vaccine delivery</td>
<td>4</td>
</tr>
<tr>
<td>Vaccine adoption by end consumer</td>
<td>6</td>
</tr>
<tr>
<td>Methodology</td>
<td>8</td>
</tr>
<tr>
<td>Study area</td>
<td>8</td>
</tr>
<tr>
<td>Sampling frame and strategy</td>
<td>8</td>
</tr>
<tr>
<td>Data collection and analysis</td>
<td>9</td>
</tr>
<tr>
<td>Results and discussion</td>
<td>11</td>
</tr>
<tr>
<td>Vaccine delivery system</td>
<td>14</td>
</tr>
<tr>
<td>Vaccine adoption and gendered WTP for hypothetical CBPP vaccine</td>
<td>16</td>
</tr>
<tr>
<td>Conclusions and recommendations</td>
<td>20</td>
</tr>
<tr>
<td>Policy recommendations</td>
<td>21</td>
</tr>
<tr>
<td>References</td>
<td>22</td>
</tr>
<tr>
<td>Annexes: Data collection tools</td>
<td>25</td>
</tr>
</tbody>
</table>
Tables

Table 1. Sub-locations from which Focus Group Discussion participants were conducted 9
Table 2. Field veterinary professionals and paraprofessionals interviewed 9
Table 3. Focus Group Discussion (FGD) composition 11
Table 4. Cattle ownership by household headship 11
Table 5. Population characteristics and vaccination tendencies according to key informants 15
Table 6. Sample socio-demographic characteristics 17
Table 7. Cattle owners’ WTP for CBPP vaccine (KSh/vaccine per animal per year) 18
Table 8. Linear regression analysis coefficients’ estimates 19
Figures

Figure 1. Components of vaccine delivery 5
Figure 2. Map of study area showing the study sites 8
Figure 3. Distribution of cattle ownership within male and female headed households 12
Figure 4. Cattle related roles by time spent on various activities on a 24hr day by gender 13
Figure 5. Nvivo word clouds showing men and women’s accounts of the clinical signs of CBPP 14
Figure 6. Constraints of delivery of CBPP vaccine given by livestock personnel, key informants from the field and from KEVEVAPI 15
Figure 7. Photographs of a) vaccine and diluent in a bed of ice packs containing ice in a vaccine carrier and b) the un-constituted vaccine from the carrier in a vial with a worn out label 16
Figure 8. Gendered cattle producers’ WTP for CBPP vaccine 18
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Summary

To answer questions on the delivery of the Contagious Bovine Pleuropneumonia (CBPP) vaccine in northeastern Kenya, a gendered socioeconomic analysis of vaccine delivery was conducted. Qualitative and quantitative data were collected from men and women cattle owners, chiefs, veterinarians and veterinary paraprofessionals in Ijara sub-county, and a vaccine manufacturer representative in Nairobi. Results indicate that a private public vaccine delivery hybrid model exists. Most cattle owning households purchase vaccine and veterinary paraprofessionals vaccinate their cattle because there is a shortage of veterinarians in the region. Vaccine purchase from manufacturer is restricted by the government enforced requirement that only a government veterinarian or their representative can purchase. The road infrastructure in northeastern Kenya is very poor and the vaccine, which requires refrigeration, is transported to the field in vaccine carriers containing ice packs and by public means of transport. Often, the duration of vaccine in transit necessitates the changing of ice packs, which may compromise the already low efficacy of the vaccine.

The study also tested the adoption rates of vaccine by men and women cattle owners by determining their willingness to pay for a hypothetical (safe, efficacious, thermostable and commercially available) vaccine using the bidding game contingent valuation method. Men are willing to pay significantly more money, because they owned higher cattle wealth, than women. The variables gender, number of adults in the household and owning cattle jointly, have significant influence on the willingness to pay, and hence vaccine adoption.
Introduction

It is now well established that vaccination services for humans and livestock often fail to achieve sufficient coverage in Africa’s remote rural settings because of financial, logistical, and service delivery challenges (Schelling et al., 2005, 2007). While the term delivery in vaccine language mainly means the [safest] form and route that a vaccine is administered (Khan, 2012), in this study, the term vaccine delivery represents the multiple processes that take place between the release of the vaccine by the manufacturer to when it gets to the end user. Heffernan and Misturelli (2000) conducted a study on client-focused veterinary delivery services for the poor in Kenya using three main analytical variables, access, affordability and acceptability. Vaccine delivery in the current study included client-focused and other variables that affected it. Studies on delivery of vaccines have mainly concentrated on client-focused adoption of livestock vaccine technologies. For instance, Kairu-Wanyoike et al. (2014) identified economic drivers of CBPP vaccine adoption by demonstrating farmers’ willingness to pay, whereas Bhattacharyya et al. (1997) and Rezvanfar (2007) demonstrated that perceptions and attitudes towards vaccination determine adoption. These studies were gender-blind and considered “client” and “farmer” as a homogenous group of actors who adopted and perceived vaccines in similar ways.

That technology delivery and adoption is gendered, with women accessing and adopting fewer technologies and at a lower rate than men, for almost all agricultural (Doss, 2001; Meinzen-Dick et al., 2011; Behera and Behera, 2013) and livestock (Mburu et al., 2013; Johnson et al., 2015; Quisumbing et al., 2013; Waithanji et al., 2015) technologies remains an undisputed fact of concern to many advocates of gender equality. A popular explanation for the lower adoption of agricultural technologies by women is the fact that gender based norms in most cultures are unfavourable for women, situating them in disadvantageous positions to access technologies in relation to men.

This paper builds on these past studies and seeks to answer two main questions, namely: What delivery mechanisms exist for the CBPP vaccine in Ijara sub-county in Garissa county, Kenya and what opportunities and challenges for vaccine delivery exist? Second, how does CBPP vaccine adoption by men and women compare, and if different, what is the difference and what causes it? More specifically, CBPP vaccine adoption by women and men will be compared by measuring the difference between their willingness-to-pay (WTP) for the vaccine.

The findings from this study are intended to inform stakeholders in the CBPP vaccine delivery about the status of delivery of the product currently in use and the potential of adoption by end users of the vaccine they are developing (currently hypothetical) based on its accessibility, affordability and acceptability accounts given by women and men cattle owners. Findings from this study will, therefore, enable stakeholders in CBPP vaccine delivery to plan and implement the following a priori. First, with the knowledge of the current status of vaccine delivery, they can put in place more efficient and effective delivery mechanisms for the vaccine under development. Second, the vaccine developers can factor-in many characteristics while prioritizing the most desirable ones specified by women and men as key attributes of the new vaccine. Third, using the findings from the willingness-to-pay study, the vaccine developers will develop a product that will retail at a price not exceeding the average lower price stated by those willing to pay for it by e.g. packaging in bulk and using cheaper carriers. The results from this study will also provide information and direction on the potential for commercialization of this vaccine for sustainable delivery and use.
This paper is organized into four main sections. After this introduction, the second section constitutes a literature review, followed by the methodology, then a section on results and discussions. The paper ends with a conclusion that includes statements of recommendations for policy makers.
Literature review

Contagious bovine pleuropneumonia (CBPP)

Contagious bovine pleuropneumonia (CBPP), also called cattle lung disease, is a highly contagious disease of cattle and water buffaloes caused by a bacterium, Mycoplasma mycoides mycoides small colony biotype (MmmSC) (Masiga et al., 1996). Clinically, the disease presents as hyper-acute, acute, sub-acute, or chronic. The disease is mainly spread through direct contact with cough droplets and is exacerbated by crowding of animals (Provost et al., 1987). CBPP also occasionally affects the joints of calves. CBPP is listed as a notifiable disease (OIE, 2008) and may cause high mortalities in naïve cattle population (Newton and Norris, 2000).

The main methods of control of CBPP include movement control, stamping out by slaughter, vaccination, and treatment. Movement control is considered to be logistically difficult to apply due to socio-cultural and trade practices, whereas stamping out with or without compensation is too costly (Tambi et al., 2006; Mariner et al., 2006). This leaves vaccination and treatment as the main possibilities for CBPP control. Treatment of affected cattle with antimicrobials has, however, been officially discouraged (Mariner and Catley, 2004) as it alleviates the clinical signs, but does not prevent the spread of infection, and may favour the creation of chronic carriers (Provost et al., 1987). Other evidence from research on antimicrobial treatment of CBPP seems to suggest that antibiotic treatment may be beneficial (FAO, 2004; Mariner et al., 2006).

Vaccine delivery

Generally, livestock vaccine delivery is less well established than human vaccine delivery, but in marginal areas occupied by nomadic pastoral and transhumanant populations whose livelihood depends entirely on livestock, especially cattle (e.g. some areas of Chad), human vaccine delivery has been reported to depend on livestock vaccine delivery infrastructure. In other areas, e.g. Southern Sudan before secession, livestock vaccine delivery depended upon human vaccine delivery infrastructure (Schelling et al., 2005). This symbiosis between human and livestock vaccine delivery systems has been exploited in many instances, but often in an ad hoc manner. In most cases, however, these two delivery systems operate fairly exclusively. As a result, livestock disease control practices have differed remarkably from those of human disease control. Schelling et al. (2005) recommend a combination of the one health and ecosystems approach to disease control, whereby human and livestock diseases are addressed simultaneously while conducting practices that will ensure a sustainable ecosystem.

As stated in the introduction, vaccine delivery has multiple meanings for different people with the most common meaning being how a vaccine is presented and administered (Khan, 2012). In this study, however, we operationalize the term vaccine delivery to represent the processes that take place between the release of the vaccine for use by the manufacturer at a private or public market (Angelmar and Morgan, 2012) and reaching the end consumer who adopts it according to his/her capacity to access, afford and accept the vaccine (Bhattacharyya et al., 1997; Heffernan and Misturelli, 2000; Rezvanfar, 2007). The term delivery is all encompassing whereas the term adoption will infer uptake by the end user. Using these operational meanings, we adapt work by Waithanji et al. (2015) and describe drivers of
vaccine delivery to be non-consumer-centred – the market and political, and consumer-centred (Figure 1). As a proxy index of the consumer centred drivers of vaccine delivery/ adoption, we conduct a gendered analysis of willingness to pay using the bidding game contingent valuation method (CVM). The concept of vaccine delivery is complex because some overlap exists between market, political and consumer centred aspects of delivery, which makes this characterization more conceptual than actual.

In the market place, human or livestock vaccines are classified as public or private goods. As public goods, governments buy and regulate their distribution, whereas as private goods, they are bought by customers, who include the end users; prescribers – the physicians/ veterinarians; organizations issuing vaccine recommendations such as the World Health Organization (WHO), the International Office of Epizootics (OIE) and National Immunization Technical Advisory Groups (NITAGs) (Angelmar and Morgan, 2012). The market-centred component of vaccine delivery is driven by factors such as vaccine types; their efficacy and the ability of commercial producers to forecast sales (Angelmar and Morgan, 2012). Often in developing countries, vaccine delivery in the market is supply (push) rather than demand (pull) driven (Brooks et al., 1999) and most human and livestock vaccines are given free or sold at subsidized prices by government and non-governmental organizations (Schelling et al., 2005).

Figure 1. Components of vaccine delivery.

The political component of vaccine delivery constitutes political processes that are characterized by policies and priorities. Policies on vaccines are often supply-driven, demand-insensitive and most vaccines constitute low priority commodities (Brooks et al., 1999). In developing countries, vaccines are in low demand because they are often too expensive to sustain sales, which causes governments to buy them and distribute them as needed. Depending on the budgetary allocation by the treasury, a government may choose to buy a vaccine or not, making it difficult for profit driven vaccine manufacturer firms to predict demand. For this and other reasons, most for profit vaccine manufactures do not invest in production of vaccines for tropical diseases even when public funded laboratories have identified candidate vaccines that could be tried, which has resulted in a group of important, but neglected diseases (Phillips, 2014).

Efforts by developing countries to develop vaccines against these diseases have been fraught with challenges such as lack of the technical and financial infrastructure, which policy makers tend to underplay (Brooks et al., 1999). Low prioritization of some vaccines more than others is an outcome of a historical drop in donor/ scientific interest in some diseases (Brooks et al., 1999). Furthermore, there is prevalence of elasticity whereby with vaccination, the disease appears to disappear and once out of sight, gets out of mind, people stop vaccinating until the disease

### Table: Components of Vaccine Delivery

<table>
<thead>
<tr>
<th>Market Centred</th>
<th>Politically Centred</th>
<th>Consumer Centred</th>
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</thead>
<tbody>
<tr>
<td>Vaccine Type</td>
<td>Political Processes</td>
<td>Access</td>
</tr>
<tr>
<td>Vaccine Industry</td>
<td>Vaccine Priority and Policies</td>
<td>Affordability</td>
</tr>
<tr>
<td>Market Decisions</td>
<td>Supply vs Demand Driven</td>
<td>Acceptability</td>
</tr>
<tr>
<td>Sales Forecasting</td>
<td>Perceptions of Affordability</td>
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<td></td>
<td>Unanswered Technical Questions</td>
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<tr>
<td></td>
<td>Advocacy</td>
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Adapted from Waithanji et al., 2015

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Efforts by developing countries to develop vaccines against these diseases have been fraught with challenges such as lack of the technical and financial infrastructure, which policy makers tend to underplay (Brooks et al., 1999). Low prioritization of some vaccines more than others is an outcome of a historical drop in donor/ scientific interest in some diseases (Brooks et al., 1999). Furthermore, there is prevalence of elasticity whereby with vaccination, the disease appears to disappear and once out of sight, gets out of mind, people stop vaccinating until the disease
appears again (Angelmar and Morgan, 2012; Cox, 2012). There also exist some unanswered technical questions on vaccines such as on safety – e.g. the human papilloma vaccine in Canada recommended for girls aged 9 – 13 (Renee and MacAdam, 2007) and the controversial tetanus vaccine targeting women aged 14 – 49 in Kenya (Nzwili, 2014). Questions on vaccination strategies and a large number of highly visible problems such as epidemics that take priority over the more endemic diseases (Brooks et al., 1999) present additional challenges in vaccine development. Policy makers may also have varying perceptions of ‘affordability’ that may lead to inconsistent policy positions (Figure 1).

On vaccine adoption, advocacy is considered to be more influential than any other factor in facilitating change; however, conventional methods of advocacy such as providing evidence based communication and making bottom line factual statements (Reyna, 2012) have been found to be less effective than stressing the obligation to act as moral members of society (Caplan, 2011) and providing emotionally compelling content (Bean, 2011) of actual people’s testimonies of reprieve or losses associated with vaccinating or not (Parikh, 2008).

The emergence of the Global Alliance for Livestock Veterinary Medicines (GALVmed) since 2005 represents evidence of recent efforts to improve delivery of livestock vaccines for neglected animal diseases in Africa by harmonization and coordination. GALVmed facilitates provision of animal health tools such as livestock vaccines, medicines and diagnostics, by making them accessible and affordable to the millions of poor people in developing countries for whom livestock is a lifeline (GALVmed, nd). GALVmed’s project on Vaccines for the Control of Neglected Animal Diseases in Africa (VACNADA) supports sustainable improvements to the quality and quantity of vaccines produced by laboratories in eight African countries – Botswana, Cameroon, Democratic Republic of Congo (DRC), Ethiopia, Ghana, Kenya, Mali and Senegal. Inputs include capacity development through staff development, market intelligence and upgrading of laboratory equipment, facilities and processes. VACNADA focuses on four vaccines: Newcastle disease, contagious bovine pleuropneumonia (CBPP), contagious caprine pleuropneumonia (CCPP) and peste des petits ruminants (PPR) (GALVmed, 2010). Some industrialized countries, such as Canada, Britain, Italy, Norway (Ginsberg, 2007) and recently the United States (Salam-Blyther, 2014) have decided to invest on human vaccines for neglected tropical diseases, and unpublished evidence exists of donor commitment to neglected livestock diseases by Germany, Canada, China, Britain and the United States. With these initiatives, there is need to ensure that the vaccines being developed will reach the intended end users through effective and efficient delivery mechanisms.

Vaccine adoption by end consumer

Including women and providing them equal resources as men in agriculture could reduce the 925 million undernourished people in the world by 12 – 17% (FAO, 2011). Adoption of improved agricultural technologies would increase agricultural productivity of men and women farmers, increase the availability and affordability of food by consumers, especially poor women, and promote economic growth – thereby diversifying livelihood sources by expanding non-agricultural business opportunities for women. Gender affects farmers’ access to labour, land and other inputs and it may affect farmers’ preferences concerning outputs, gender, therefore, matters in technology adoption (Doss, 2001).

Three main consumer related drivers of vaccine adoption exist, namely; accessibility, affordability, and acceptability (Figure 1) (Bhattacharyya et al., 1997; Heffernan and Misturelli, 2000; Rezvanfar 2007). Work on assessment of the delivery of veterinary services to the poor in Kenya by Heffernan and Misturelli (2000) revealed that access to veterinary services, rather than affordability, appears to be the primary constraint to veterinary technology adoption. The same study also revealed that majority of animal health expenditure was on curative rather than preventative treatments and although farmers were willing to pay for services, their ability to pay was low and contributing to the limited adoption of services. The gender gap in access to resources and knowledge, whereby women have less access than men is well recognized. This stems from women’s historical and cultural subordination, and is maintained through gender roles, practices, beliefs, attitudes and discourses (Deere and Doss 2006; Doss and Deere 2008; Deere et al., 2012; Quisumbing et al., 2013; Johnson et al., 2015). From the foregoing, women are, therefore, likely to adopt technologies like the CBPP vaccine at a lower rate than men because they are likely to have a lower access to resources and knowledge.
Affordability represents the sustainable ability of an individual, group or entity to pay for a goods or service. Heffernan and Misturelli (2000) measured the affordability by poor households to pay for veterinary goods and services by evaluating how close households were to meeting the minimum necessary level of preventative and curative animal healthcare. A person’s gender is likely to affect affordability of the CBPP vaccine because men and women often do not have equal amounts of money or resources that can be converted to money due to the gendered differences in access and control of resources. In the case of CBPP, Muindi et al. (forthcoming) demonstrated that women preferred a safe and affordable vaccine, whereas men preferred a more efficacious and safe vaccine. The issue of cost of vaccine did not arise from men. How a vaccine is accepted is also enhanced by how much people know about the severity of the disease being vaccinated against (Angelmar and Morgan 2012) and how safe or efficacious a vaccine is (Muindi et al., forthcoming).

Perceptions on the effect of a vaccine in its totality can determine the acceptability of a vaccine. For example, if one perceives more positive outcomes from vaccination, they are likely to accept it more than if they perceive more negative outcomes. The belief that a product may cause the very harm it is supposed to prevent, e.g. reactors following East Coast Fever (ECF) vaccination, violates consumer trust and represents a safety product betrayal. This betrayal causes negative emotions such as anger, sadness, anxiety, fear and disgust and may cause the rejection of a product in a manner that is disproportionately larger than the harm caused (Angelmar and Morgan 2012). For the CBPP vaccine, safety in terms of post vaccination abortion and loss of the tail were an issue of concern, but men and women accepted the vaccine anyway, because these effects occurred very rarely – 1.02% overall attack rate and 0.17% mortality (Sori, 2005). In a study on perceptions by women and men on how a CBPP outbreak affects the household, Muindi et al. (forthcoming) demonstrated that for women, reduction in the productivity of cattle was mentioned 36% of the times, which is double the number of times the second most perceived effects – poor living standards, reduction in market participation and cattle mortality – mentioned 18% of the times each. Men perceived the greatest effects to be a reduction in the productivity of cattle and reduction in market participation, mentioned 33% of the times each. Thus, for women and men, the top two most perceived effects of the disease were mentioned 72 and 66% of the times respectively, meaning that the current vaccine is most probably well accepted.

This study also compared men and women’s ability to adopt the CBPP vaccine in terms of access, affordability and acceptability of the vaccine. It identified what the gender gaps are and where possible demonstrated how wide the gaps were while proposing ways of narrowing them.
Methodology

Study area

The study was conducted in Ijara sub-county and Garissa county of northern Kenya (Figure 2). Ijara is located in the Southern part of Garissa county and borders the Lamu county to the south. The predominant ethnic community in Ijara are the Somali of the Abdalla clan followed by the Rer-Mohammed clan. Islam is the predominant religion and their main livelihood source is cattle raised in a transhumant production system.

Figure 2. Map of study area showing the study sites.

Sampling frame and strategy

The sampling frame used in this study was a map of Ijara sub-county (Figure 2). The sampling strategy consisted of four steps. First, with a key informant and using a pre-existing map of Ijara sub-county, the authors identified and documented the names of all its locations. A total of six locations – Masalani, Ijara, Sangailu, Kotile, Ruqha and Hulugo were identified. Second, Masalani location was removed from the sample because it is urban and had few cattle. The authors also excluded sub-locations from which overt conflict had recently been reported – Jalish and
Bula sub-locations in Ijara location, and Mawe and Ege sub-locations in Sangailu location. Third, the authors selected locations of study using a simple stratified random sampling technique – by placing the names of sub-locations without conflict from each location in a box and asking someone not associated with the project to pick a name from each of the groups of names for the different locations. The sub-location picked became the study site. At the field, covert conflict in Ruqha location caused us to conduct interviews on two communities across the road from each other. We named one Rugha and the other Ruqha Bullaqalanqala. This was the fourth step in our sampling strategy. In the field, chiefs/assistant chiefs from these sub-locations were asked to identify about 12 women and 12 men from different households owning cattle. Table 1 lists the names of the selected sub-locations and the name of the location they belong to.

Table 1. Sub-locations from which Focus Group Discussion participants were conducted

<table>
<thead>
<tr>
<th>Sub-location</th>
<th>Location</th>
<th>Main clan (&gt;50%)</th>
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<tbody>
<tr>
<td>Alijarare</td>
<td>Kotile</td>
<td>Abdallah</td>
</tr>
<tr>
<td>Sangole</td>
<td>Ijara</td>
<td>Abdallah</td>
</tr>
<tr>
<td>Ruqha</td>
<td>Ruqha</td>
<td>Rer-Mohammed</td>
</tr>
<tr>
<td>Falama</td>
<td>Hulugo</td>
<td>Abdallah</td>
</tr>
<tr>
<td>Gedilun</td>
<td>Sangailo</td>
<td>Abdallah</td>
</tr>
<tr>
<td>Ruqha Bullaqalanqala</td>
<td>Ruqha</td>
<td>Rer-Mohammed</td>
</tr>
</tbody>
</table>

Data collection and analysis

Vaccine delivery study

Data on vaccine delivery was collected through key informant interviews with animal health professionals and paraprofessionals involved in the vaccine delivery chain and sex disaggregated focus group discussions with men and women hailing from cattle owning households. The data was analysed inductively by identifying trends, categorizing them and building statements of conclusions from these categories. In some cases, responses by focus group discussants were translated into words or statements representing their meanings. The words/ statements were then filtered, counted and presented in the form of word clouds using the NVivo 10® software.

One field veterinarian and seven paraprofessionals were interviewed as key informants on vaccine delivery (Table 2). Only one paraprofessional was a woman. A manager from the Kenya Veterinary Vaccine Production Institute (KEVEVAP) was also interviewed and two GALVmed employees informally interviewed to validate information on GALVmed obtained from the internet.

Table 2. Field veterinary professionals and paraprofessionals interviewed

<table>
<thead>
<tr>
<th>Number</th>
<th>Qualification</th>
<th>Duty County/ Sub-county</th>
<th>Sex</th>
<th>Age (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAHW</td>
<td>Sangailu</td>
<td>M</td>
<td>32</td>
</tr>
<tr>
<td>1</td>
<td>CAHW</td>
<td>Sangailu</td>
<td>F</td>
<td>46</td>
</tr>
<tr>
<td>1</td>
<td>CAHW</td>
<td>Sangole</td>
<td>M</td>
<td>52</td>
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<td>38</td>
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<td>Masalani</td>
<td>M</td>
<td>45</td>
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<tr>
<td>1</td>
<td>CAHW</td>
<td>Masalani</td>
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<td>45</td>
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<tr>
<td>1</td>
<td>CAHW</td>
<td>Masalani</td>
<td>M</td>
<td>54</td>
</tr>
<tr>
<td>1</td>
<td>Veterinarian</td>
<td>Former DVO Ijara</td>
<td>M</td>
<td>45</td>
</tr>
</tbody>
</table>

*With the new county government, a community animal health worker (CAHW) is called a community animal disease reporter and these reporters were vaccinating the animals against CBPP

**At time of the study, there was no veterinarian working in Ijara, but we interviewed a former veterinarian who had been transferred from Ijara

In addition to the responses by veterinarians and veterinary paraprofessionals, chiefs available were also interviewed in order to give information about their locations. Two chiefs from Kotile and Gedilun aged 35 and 39 years respectively and one senior chief, from Sangole and aged 55 years were interviewed. The chiefs were all men. The chiefs gave an overview of their communities and helped identify the distinct characteristics unique to their locations. Chiefs from the other locations were not available for interviewing.
Vaccine adoption study

The proxy index used for vaccine adoption in this study was the willingness-to-pay. Data on willingness-to-pay were obtained through individual questionnaire interviews with men and women from cattle owning households and analysed using the contingent valuation method (CVM). The objective of the CVM study was to assess cattle owners’ WTP for the new (hypothetical) CBPP vaccine with all the characteristics they desire, and to compare the results obtained from men and women. When introducing a new product or a nonmarket product, the use of stated preference data (based on respondents’ declaration) is a common method to assess buyers’ preferences and WTP for the new product attributes. Two types of techniques could be used: contingent valuation or choice experiment methods.

Owing to its simplicity and rapidity with which data can be collected, the authors opted for the contingent valuation method, which is a nonmarket valuation method widely used in the areas of environmental cost-benefit analysis and environmental impact assessment (Venkatachalam, 2004). Carson and Hanemann (2005) provide a detailed description of the method from its initial development and theoretical background to its results’ consistence with theoretical prediction.

CVM includes four major types of elicitation techniques: namely, bidding game, payment card, open-ended question and dichotomous choice approach (Bateman et al., 1999; Venkatachalam, 2004). In this study we opted for the bidding game method.

The bidding game method consists of asking respondents a series of questions on their willingness-to-pay for a specific item/product. In the current study each individual respondent was asked if s/he was willing to pay KSh 200 for the hypothetical CBPP vaccine/dose per year. If a respondent answered “yes”, then s/he was asked for her/his willingness-to-pay KSh 220, and so on. An increment of KSh20 was made each time the participant responded “yes” until they responded with a “no”. The last value before the respondent said “no” was documented as the individual WTP. If the respondent answered “no” to the first question on paying KSh 200, then the value was successively reduced by KSh 20 till the respondents said “yes”. The value at which the respondent said “yes” was then considered to be the individual WTP value.

The KSh 200 selling price of the new CBPP vaccine was calculated by adding 30% to the estimated USD 1.5 cost given by one of the scientists involved in the laboratory development of the vaccine. When implementing a bidding game elicitation format the researchers are faced with two alternatives: using the same starting bid for all respondents or choosing one starting bid randomly from among a list of 4 possible values. Literature review has revealed that some researchers found that the starting point to have sizeable influence on the final estimate of WTP (Rowe et al., 1980), whereas other researchers found no such effects (Thayer, 1981). In this study, the authors opted to use a unique value (KSh 200) for two reasons: first, a reasonable estimate of the production costs of the vaccine as well as reference prices for other cattle vaccines were available; and second, the sample of individuals available for the interview was relatively small (108 respondents). Further, the authors intended to compare the results between both groups of men and women, which lead to higher level of sample disaggregation.

The results were first analysed using descriptive statistics whereby the mean, mode, maximum and minimum WTP for the vaccine from both men and women were obtained. Using a student test, statistical significance in the differences between both groups was sought. Next, a linear regression analysis was undertaken to assess the influence of respondents’ socio-demographic characteristics and the number of cattle owned on their WTP for the vaccine.

The individuals interviewed for the WTP study constituted the population of 12 sex disaggregated focus group discussants of six men only and six women groups only (Table 3). Responses and explanations given during focus group discussions were deemed to be potentially complementary to the data obtained through individual interviews.
Table 3. Focus Group Discussion (FGD) composition

<table>
<thead>
<tr>
<th>Name of location</th>
<th>Number of women</th>
<th>Number of men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gedilun</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Sangole</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Alijarere</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Falama</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Ruqha</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Ruqha (Bullaqlaqala)</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61</strong></td>
<td><strong>66</strong></td>
</tr>
</tbody>
</table>

Results and discussion

General gender differences within the community

Results from this section provide background information on the community while highlighting gender issues and differences that may aid in explaining some of the results as well as informing some recommendations.

Gender ratio in the community

The ratio of men and women, obtained through proportion piling, was 41:59, which deviates remarkably from the national ratio of 50:50 (Index Mundi, 2014). Focus group discussants associated the deviation with more girls being born in the community, more women being brought in the community as brides because polygamy is commonly practiced, outmigration of boys and men to seek waged employment and the fact that more men than women die in conflict. Of the responses, the most logical explanation was that of outmigration and suggests that feminization of pastoralism might be happening in this community. Feminization of agriculture associated with rural to urban migration of men in search of waged labor is a well-established concept in smallholder agricultural communities (Deer 2005; Behera and Behera, 2013) and pastoral communities (FAO, 2012; Jothilakshmi et al., 2013). Feminization of pastoral communities, therefore, makes it crucial to involve women in livestock interventions because rural women will soon become the main cattle managers on the ground.

Cattle wealth distribution by gender between and within households

Men and women FGD discussants agreed, during a proportion piling exercise, that households headed by men had more cattle wealth than those headed by women (Table 4). The key informants, the community animal disease reporters and the chiefs gave a range of 3 – 100 heads of cattle per household and about 40 head on average.

Table 4. Cattle ownership by household headship

<table>
<thead>
<tr>
<th></th>
<th>Average number of cattle owned by male headed households (MHH) in the community</th>
<th>Average number of cattle owned by female headed households (FHH) in the community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men FGD (n=5)</td>
<td>39</td>
<td>5</td>
</tr>
<tr>
<td>Women FGD (n=6)</td>
<td>82</td>
<td>36</td>
</tr>
</tbody>
</table>

Within the households, and according to men and women FGD discussants (Figure 3), cattle wealth distribution among men, women and children is uneven with women having the lowest proportion of cattle wealth in men headed households. Women FGDs also indicated that 28% of the cattle belonging to female headed households were owned by men. The men were not their children and the women were not asked who these men were. Men discussants also indicated that children owned most cattle (79%) belonging to female headed households (FHH). According to men and women discussants, women in FHH own between 21 and 32% of the cattle in these HH, and between 11 and 17% of the cattle in male headed households (MHH).
Irrespective of the household headship, therefore, women own less than a third of the cattle wealth in the community. This finding was corroborated by results from a questionnaire survey conducted, as a part of this study, on all individual women and men who participated in the FGD. The survey results indicated that men owed an average of 20.8 animals and women an average 4.4 heads of cattle ($P<0.01$). The finding that women own less cattle wealth than men has been reported before (Behera and Behera, 2013; Njuki and Mburu 2013) and has been associated with the lower ability of women than men to adopt livestock technologies (Behera and Behera, 2013; Mburu et al., 2013).

In addition to female headed households owning much fewer cattle than male headed households, women own fewer cattle than other household members in both male and female headed households. They own up to a third of the cattle in FHH and less than a fifth of the cattle in MHH. The issue of joint cattle ownership in this community was investigated during group discussions in order to establish if men and women from the same households owned cattle jointly. Four out of six women groups and three out of six men’s group agreed that there was no joint ownership and whatever they termed jointly owned was tentative as demonstrated in the verbatim responses below endorsed by FGD members.

“Even when you are told that they (cattle) belong to both of you, you soon realize that it is a situation of *nishikilie tu*, which means “hold onto this one for me” … “Men are wealthier than women, so they own cattle because they bought them” … “Men own cattle, women access them but do not make decisions – men make the final decisions on the cattle” … “Man is the household head so he owns and decides on cattle.” Four women focus group participants, Ijara

“Joint ownership *ni ya mdamo tu*, meaning that “this is lip service rendered to the women” … “Women own everything at night, but in the day they own nothing – we try to avoid being shown the back at night.” Two male focus group participants, Ijara
Joint ownership of cattle between spouses is a rare occurrence and was reported to occur when, for example, a child died and his/her cattle were jointly held pending decisions on redistribution or disposal and if a woman and man contributed money to buy cattle together. The data on cattle ownership are, therefore, unlikely to change because of joint ownership of cattle.

Results from the questionnaire interview with 137 respondents in this study indicated that, 109 respondents (80%) owned cattle individually (57%), jointly (2%) or both individual and jointly (21%). Of those who owned cattle jointly (2% and 21%), most owned them with their children (9%), then siblings (5%) and then with spouses (4%).

### Cattle related gender roles and responsibilities and time spent doing them

Boys and men have specialized roles distinct from those for girls and women, but they share certain roles such as caring for sick animals (Figure 4). Men spend 49% (11.76 hrs) of their time (24hrs) doing cattle activities, whereas women spend 28% (6.72 hrs) of their time doing cattle activities (Figure 4). Herding cattle in Ijara constitutes a large proportion of the time spent by boys and men whereas milking constitutes a large proportion of time spent by women. Different gender roles in livestock (Saghir et al., 2012) and cattle (Johnson et al., 2013) activities have been documented with some roles being carried out exclusively by men, others by women and still others by women and men jointly.

![Figure 4. Cattle related roles by time spent on various activities on a 24hr day by gender](image-url)

<table>
<thead>
<tr>
<th>Boys and men only</th>
<th>Girls and women only</th>
<th>Roles by men, women, boys and girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herding</td>
<td>Milking, selling milk</td>
<td>Removing thorns</td>
</tr>
<tr>
<td>Vaccination</td>
<td>Feeding calves</td>
<td>Taking care of sick cattle</td>
</tr>
<tr>
<td>Branding, castration</td>
<td>Fencing calf enclosure (boma)</td>
<td>Treatment</td>
</tr>
<tr>
<td>Hoof trimming</td>
<td>Fetching water for cattle</td>
<td>Dipping/spraying</td>
</tr>
<tr>
<td>Pasture investigation</td>
<td>Cleaning the main animal enclosure (boma)</td>
<td>Building the boma</td>
</tr>
<tr>
<td>Counting cattle</td>
<td></td>
<td>Separating calves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proportion (%) of time spent on activity by gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>men</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>0%</td>
</tr>
<tr>
<td>10%</td>
</tr>
<tr>
<td>20%</td>
</tr>
<tr>
<td>30%</td>
</tr>
<tr>
<td>40%</td>
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<td>50%</td>
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<tr>
<td>60%</td>
</tr>
<tr>
<td>70%</td>
</tr>
<tr>
<td>80%</td>
</tr>
<tr>
<td>90%</td>
</tr>
<tr>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proportion of time spent doing cattle and non-cattle related activities by gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>men</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Unaccounted time</td>
</tr>
<tr>
<td>Non-livestock activities</td>
</tr>
<tr>
<td>Livestock activities</td>
</tr>
<tr>
<td>Rest</td>
</tr>
<tr>
<td>Sleep</td>
</tr>
</tbody>
</table>
Owing to the exposure of men and women and boys and girls to cattle through different activities, men and women had different knowledge of cattle diseases. For example, because women interacted closely with individual cattle during milking, they were able to give more detailed clinical signs of CBPP than men (Figure 5).

Figure 5. Nvivo word clouds showing men and women’s accounts of the clinical signs of CBPP.

<table>
<thead>
<tr>
<th>Men only FGD</th>
<th>Women only FGD</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Word Cloud Men Only FGD" /></td>
<td><img src="image2" alt="Word Cloud Women Only FGD" /></td>
</tr>
</tbody>
</table>

Women touch cows when they milk them and are able to detect fever and can tell if there is a reduction in milk production immediately. Men detect emaciation and then cough, which suggests that men detect the disease from a distance and after it has established (Figure 5).

The different perspectives of CBPP by women and men demonstrate the complementarity of their gender roles and the importance of recognizing that women and men contribute to knowledge of disease in different, but important ways. Overall, women knew of fewer diseases than men, but for diseases known to them like CBPP, women knew more clinical signs, more post mortem lesions and were able to tell early signs of the disease than men. Women therefore knew depth and men breadth, making their sets of knowledge complimentary. Reports of early CBPP by women can be used to notify neighbors of the possibility of its occurrence so that communities can practice quarantine and notify others further away in order to ring-vaccinate around the affected herds in an effort to contain the disease.

Vaccine delivery system

Findings from this section will enable stakeholders in the vaccine delivery process to put in place the most effective vaccine delivery mechanisms for the vaccine under development.

Opportunities for CBPP vaccine delivery

Livestock personnel and chiefs accounts of proportion of population dependent on cattle, 76 and 72.5% respectively, and minimum number of cattle required for a household to trade in cattle, a mean of 175 cattle for both groups, were really close (Table 5). The livestock personnel also indicated that 96% of the population vaccinates their cattle and 83% of the cattle are vaccinated against CBPP (the majority of animals not vaccinated were away in distant pastures or missed the last vaccination because they were less than six months old). These proportions indicate that the cattle owners have accepted the vaccine currently in use very well, are committed to control this disease and if delivery of the vaccine were to be made highly efficient, it might be possible to eradicate CBPP through vaccination.
Table 5. Population characteristics and vaccination tendencies according to key informants

<table>
<thead>
<tr>
<th></th>
<th>Proportion (%) of population dependent on cattle</th>
<th>Minimum number of cattle required for a HH to trade in livestock</th>
<th>Average number of cattle per HH</th>
<th>Proportion (%) of human population that vaccinate against CBPP</th>
<th>Proportion (%) of cattle vaccinated against CBPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock personnel average</td>
<td>76</td>
<td>175</td>
<td>48</td>
<td>96</td>
<td>83</td>
</tr>
<tr>
<td>Livestock personnel range</td>
<td>40–100</td>
<td>20–500</td>
<td>15–100</td>
<td>80–100</td>
<td>75–100</td>
</tr>
<tr>
<td>Chiefs’ averages</td>
<td>72.5</td>
<td>175</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chiefs’ range</td>
<td>70–80</td>
<td>150–200</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Using information obtained from community animal disease reporters and local leaders (chiefs), three main opportunities, in no order of importance, for excellent vaccine delivery exist. First, over 70% of the population depends on cattle as a livelihood source; second 96% of the cattle owning population vaccinate their animals and finally 83% of the cattle are already vaccinated. The current vaccine was retailing at KSh 15 – 20 (USD 0.17 – 0.23) per dose at the consumer end and KSh 6 at KEVEVAPI (USD 0.07) the difference being the cost of transportation and the vaccinator’s professional fee. The high proportion of the population that vaccinates animals and the high proportion of vaccinated animals are an indication that the vaccine is well accepted by the community. Focus group discussants also indicated that the benefits of the vaccine outweighed its setbacks, which were mainly safety and cost for women and safety and efficacy for men (Muindi et al., forthcoming).

Constraints of CBPP vaccine delivery

Livestock personnel were asked what they considered to be the constraints to CBPP vaccine delivery. Of the most frequently mentioned constraints given by community disease reporter key informants and depicted in NVIVO word cloud, poor roads that were impassable during the rainy season were mentioned most frequently followed by the need for refrigeration (Figure 6). The key informant from the national veterinary vaccine producer organization, KEVEVAPI, associated poor vaccine delivery with two main challenges, namely: the turning away of needy customers wanting to buy vaccine at KEVEVAPI in compliance with the government controlled delivery of vaccine; and challenges of the vaccine reaching buyers with the shortage of livestock personnel on the ground in CBPP endemic areas (Figure 6).

1. The USD was retailing at around KSh 87 at the time of the study (March 2014).
Government control of CBPP vaccine delivery and shortage of veterinary personnel in areas where CBPP vaccination is allowed were identified by livestock personnel in the field as well as from the manufacturer. These two constraints, in addition to the poor roads and the need for refrigeration of the vaccine might be considered the greatest constraints to vaccine delivery.

In terms of delivery to the market, physical access to cattle because of poor and impassable roads was the most frequently mentioned constraint by the veterinarian and paraveterinarians on the ground. This challenge is further compounded by the fact that vaccine requires refrigeration. The vaccine is transported in vaccine carriers (small cool boxes packed with ice), which often melts on the way and is replenished in hospitals along the way. The vaccine being administered in the field during the time of data collection was still packed in ice, but the information on the label was not visible because it had become erased probably because of frequent transfers to replenish ice packs (Figure 7). One men discussion group had mentioned that the vaccine label often falls off by the time the vaccine gets to them.

Figure 7. Photographs of a) vaccine and diluent in a bed of ice packs containing ice in a vaccine carrier and b) the un-constituted vaccine from the carrier in a vial with a worn out label.

Policy related challenges include the requirement that the vaccine be sold only to qualified veterinarians and there is shortage of qualified veterinarians on the ground. Some men group discussants, key informants and KEVEVAPI respondent stated these two issues as major challenges to the vaccine delivery chain. At the time of the study, March 2014, there was no veterinarian at the study area.

Vaccine adoption and gendered WTP for hypothetical CBPP vaccine

A short face-to-face individual questionnaire was administered to the population of FGD discussants. A total of 137 respondents participated in the study. Results indicate that the sample was almost equally divided between men and women (Table 6). The majority of respondents are married and few are divorced with more women than men being divorced (more than three-quarters of divorced persons). Polygamy prevails in this community and men are allowed to marry more than one woman making the number of divorced women more than men.
Table 6. Sample socio-demographic characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>49</td>
</tr>
<tr>
<td>Female</td>
<td>51</td>
</tr>
<tr>
<td>Marital status (%)</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>3</td>
</tr>
<tr>
<td>Married</td>
<td>87</td>
</tr>
<tr>
<td>Widowed</td>
<td>1</td>
</tr>
<tr>
<td>Divorced</td>
<td>9</td>
</tr>
<tr>
<td>Number of persons in the household</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>7.8</td>
</tr>
<tr>
<td>Min./Median/Max./Std.*</td>
<td>2/8/15/2.7</td>
</tr>
<tr>
<td>Number of children in the Household</td>
<td>5.4</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Min./Median/Max./Std.*</td>
<td>0/5/13/2.6</td>
</tr>
<tr>
<td>Household income (KSh/year)</td>
<td>Mean</td>
</tr>
<tr>
<td>Mean</td>
<td>46,500</td>
</tr>
<tr>
<td>Min./Median/Max./Std.*</td>
<td>1,000/20,000/2,500,000/214,749</td>
</tr>
<tr>
<td>Individual cows ownership (%)</td>
<td>Yes</td>
</tr>
<tr>
<td>Mean</td>
<td>78</td>
</tr>
<tr>
<td>No</td>
<td>22</td>
</tr>
<tr>
<td>Joint cows’ ownership (%)</td>
<td>Yes</td>
</tr>
<tr>
<td>Mean</td>
<td>22</td>
</tr>
<tr>
<td>No</td>
<td>78</td>
</tr>
</tbody>
</table>

*Min=Minimum; Max=Maximum; Std=Standard deviation

The average number of persons per household is eight persons. The standard deviation value indicates a low dispersion among the household sample. The average number of children per household is 5.4 with extreme values ranging between 0 and 13, but the standard deviation indicates a relatively low dispersion among the observations. The disparity in household income is huge among respondents and ranges between KSh 1,000 to KSh 2.5 million, with an average annual income around KSh 47,000 and a median of KSh 20,000. From the field observations during the interviews, the enumerators noticed that some livestock producers were underestimating their income because of the fear of tax payment.

Respondents were also asked if they owned cattle individually. Results indicate that the majority of them (78%) have their own cattle. When disaggregating the results by respondents’ gender, the proportion of men owning cattle (90%) is significantly higher (P<0.01) than the proportion of women owning cattle (67%). The same applies to the number of cattle owned, where a man possess on average 20.8 animals while a woman possess on average 4.4 heads of cattle which is significantly different (P<0.01). This result confirms the disparity between gender groups in terms of cattle ownership, and also confirms the results from the previous section on cattle wealth distribution by gender that indicated a higher cattle ownership by men than women.

Respondents were also asked if they jointly owned cattle with another family member. Around one fifth of the participants responded positively. Surprisingly this group is almost entirely composed of cattle owners who also own cattle individually, except the case of one woman who jointly own 10 cattle with her brother, but did not own any animal individually. The rest of the respondents owned cattle jointly mainly with their children.

Finally and before moving forward to the contingent valuation question and WTP assessment, we opted to only interview the persons who stated that they owned cattle individually or jointly with another family member. This decision was based on the assumption that persons who do not own cattle can’t provide a reliable response since the exercise will be hypothetical for them. The final sample was composed of 109 respondents.

In total we dropped from the initial group of 137 persons 28 persons who did not individually or collectively own cattle (but they belonged to households that owned cattle). Results from the 109 cattle owners’ WTP are reported in Table 7. An analysis of the entire group of respondents (men and women groups together) indicates that cattle owners
are willing to pay on average KSh 204/vaccine-dose per animal per year, which is slightly above the assessed production and marketing costs of the vaccine (KSH 200). The observations are moderately dispersed (coefficient of variation around 0.48), but there are few outliers that should be corrected/taken into account in further analysis. In fact, two male persons stated that they won’t pay any money for the vaccine, and one person declared willing to pay up to KSh 660. There are many research studies that tried to “correct” for the zero payment value, known as protest response. In this research study, respondents after declaring their WTP were asked why they were willing to pay the specified amount. In the case of zero value respondents, one declared that he will never pay anything at any given time (which is a typical protest response), and the other declared that he did not have the necessary funds and that the amount is expensive, which could also be assumed to be as a protest response.

Table 7. Cattle owners’ WTP for CBPP vaccine (KSh/vaccine per animal per year)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men (n1=60)</td>
<td>227.8a*</td>
<td>0</td>
<td>660</td>
<td>101.3</td>
</tr>
<tr>
<td>Women (n2=49)</td>
<td>174.5*</td>
<td>40</td>
<td>440</td>
<td>86.0</td>
</tr>
<tr>
<td>All Group</td>
<td>203.8a</td>
<td>0</td>
<td>660</td>
<td>98.0</td>
</tr>
</tbody>
</table>

*When not taking into account the 0 KSh values of WTP (2 observations), men group WTP and All respondents' group WTP were respectively KSh 235.7 and KSh 207.7.

When segmenting the sample by sex, the results differ between groups. Men were on average willing to pay KSh 228/dose per year, whereas women were willing to pay significantly less (KSh 174). The Student mean comparison test reported statistically significant difference between both groups. Women are willing to pay 30% less than men. This difference could be explained by the fact that, as observed previously, men own more cattle, which implies more intense market participation and also better market linkages and higher incomes from cattle trade. The distribution of men and women WTP for CBPP vaccine are reported in Figure 8.

Figure 8. Gendered cattle producers’ WTP for CBPP vaccine.

![Figure 8](image)

Men’s WTP distribution is closer to a normal distribution, whereas for the women the distribution is closer to a bi-modal one with peaks on KSh 100 and KSh 220, which indicates the existence of two subgroups of women with different behaviour/decision making or from different income brackets.

The final process was to estimate a linear regression model using respondents’ WTP as dependent variable and including other socio-demographic characteristics of the cattle owners as well as the herd size as explanatory variables. Results from the regression analysis are shown in Table 8. Results confirm that respondent’s gender affects his/her WTP. In fact the coefficient of the dummy variable “Gender” is positive and statistically significant at 1% level. It also indicates that men are on average willing to pay 53 KSh more than women which is almost the same amount (53.3) observed when comparing average gendered WTP results from Table 7.
Table 8. Linear regression analysis coefficients’ estimates

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>113.31***</td>
<td>38.94</td>
</tr>
<tr>
<td>Gender</td>
<td>52.77***</td>
<td>17.39</td>
</tr>
<tr>
<td>Number of children in HH</td>
<td>3.84</td>
<td>3.39</td>
</tr>
<tr>
<td>Number of adults in HH</td>
<td>12.01*</td>
<td>7.14</td>
</tr>
<tr>
<td>Income</td>
<td>-4.2 10-6</td>
<td>3.62 10-5</td>
</tr>
<tr>
<td>Joint ownership</td>
<td>46.01***</td>
<td>19.37</td>
</tr>
<tr>
<td>Alijarere</td>
<td>37.74</td>
<td>28.46</td>
</tr>
<tr>
<td>Bullagalankala</td>
<td>19.75</td>
<td>29.31</td>
</tr>
<tr>
<td>Falama</td>
<td>15.30</td>
<td>31.02</td>
</tr>
<tr>
<td>Gedilun</td>
<td>-103.38***</td>
<td>29.60</td>
</tr>
<tr>
<td>Sangole</td>
<td>10.55</td>
<td>27.42</td>
</tr>
</tbody>
</table>

R2 = 0.30
Adj. R2 = 0.23
F(10,98) = 4.16***

* a Dummy variable takes 1 when man and 0 when woman
b Dummy variable takes 1 when the respondent jointly own cows with other person and 0 otherwise
c Dummy variable takes 1 when the respondents is from Alijarere and 0 otherwise
d Dummy variable takes 1 when the respondents is from Bullagalankala and 0 otherwise
e Dummy variable takes 1 when the respondents is from Falama and 0 otherwise
f Dummy variable takes 1 when the respondents is from Gedilun and 0 otherwise
g Dummy variable takes 1 when the respondents is from Sangole and 0 otherwise

***, **, * Respectively significant at 1%, 5% and 10% levels.

The coefficient corresponding to the number of adults in the household is positive and statistically significant at 10%. This result was expected since we can assume that adults are more involved in herding and milking practices and could also generate additional income to the household which increases its purchasing power. The coefficients that correspond to the number of children in the household as well as to the household annual income were not statistically significant. Their respective signs were positive and negative which was not expected. In fact, we assume that households with children are faced with higher fees (educational, health, food, etc.) compared to households that do not have children. For the income, we expected that higher income households are willing to pay more for the CBBP vaccine compared to lower income ones, but as stated earlier, we believe that responses to the household income question were not accurate and precise.

Respondents who owned cattle jointly with another person (generally from the same family) were willing to pay more (KSh46) than those not owning cattle jointly (the coefficient is statistically significant at 5% level). This might be explained by the fact that costs of vaccination could be shared by both holders while simultaneously decreasing the risk of illness or death of animals incurred by either owner. Joint ownership may represent a person’s inclination to risk prevention and may suggest that joint cattle owners are more likely to see the benefit of disease prevention by vaccination than those who own them individually.

Finally, dummy variables were introduced to capture the possible effect of respondent’s location on its WTP for the improved vaccine. As previously reported in Table 3, the questionnaire was implemented in 6 locations. For the regression analysis, Ruqha location was selected as the base level. Results indicated that there is no statistically significant difference between respondents’ WTP on the basis to their location. Exception is for the Gedilun located respondents (coefficient statistically significant at 1% level) who are willing to pay much less (around KSh 103) compared to those located in Ruqha. Key informants and FGD discussants from Gedilun talked about two events of Rift Valley Fever occurring in this area in 2006 – 08 that left them economically devastated as the disease depleted their cattle numbers. They are, therefore, still not able to afford the vaccine like the rest of the community.
Conclusions and recommendations

Currently, CBPP vaccine delivery in Kenya is controlled by the government and allowed only in CBPP endemic areas. In the past, the government used to provide the vaccine free of charge through government funded vaccination campaigns. But currently, in Ijara, cattle owners organize themselves in groups, raise the required money and request the government veterinarian to purchase the vaccine for them from the manufacturer, KEVEVAPI. KEVEVAPI sells the vaccine only to district veterinary officers or their representatives authorized, in writing, to purchase the vaccine at KEVEVAPI. The CBPP vaccine retails at KSh 6 (USD 0.07) a dose and is only sold to authorized persons. At the field in Ijara, cattle owners pay between KSh 15 – 20 (USD 0.17 – 0.23) a dose depending on how logistically difficult it is to access the cattle. Most cattle owners vaccinate most cattle above six months and in good body condition. Mainly community disease reporters vaccinate the cattle by administering it at the tip of the tail.

The greatest opportunity that exists for the current CBPP vaccine delivery is that it is well accepted, according to data on the proportion of people using it (96%) and the proportion of cattle already vaccinated (83%), and also because the vaccine is affordable. Both women and men are aware of, and concerned about, the low vaccine efficacy requiring that cattle are vaccinated twice a year and the few cases of adverse post vaccination reactions that may occur. In spite of these shortcomings, men and women cattle owners appreciate the benefits of vaccinating their cattle regularly against CBPP. Women were also concerned about the cost of the current vaccine. Data suggests that if a more efficacious and safer vaccine is developed it will be well received, but it has to be affordable even by the women. Results on WTP for a more efficacious and safer vaccine indicate that women are willing to pay KSh 174.5 (USD 2), which is significantly less than the KSh 227.8 (USD 2.62) that men are willing to pay. This is a plausible finding considering that women own significantly less cattle wealth than men. In addition regression results indicated that WTP was enhanced when men owned cattle, when there were more adults in the household and when cattle were jointly owned.

Challenges to delivery of the current CBPP vaccine were mutually reinforcing and consisted of the following in no specific order of importance. It is difficult to access cattle in disease prone areas due to poor and impassable and sometimes lack of roads. These cattle may constitute disease reservoirs. The fact that the vaccine requires refrigeration and has to be transported in vaccine carriers containing ice, which has to be replenished during transit, makes the transportation process extremely cumbersome. The fact that Ijara is far from Nairobi, where the vaccine originates, and very hot makes it necessary to change the ice packs frequently, which might compromise the already low efficacy of the vaccine further. Melting ice wets labels on the vaccine bottles resulting in labels that are worn or have fallen off by the time they arrive at the point of use. This results in loss of crucial vaccine information such as dosage rate, storage requirements, expiry date etc. Although KEVEVAPI encourages veterinarians to buy vaccines and stock them in the field so that they can be dispatched to the cattle quickly, there is a shortage of veterinarians in the field and there might not be enough government money allocated for vaccines. If the government allowed paravets to buy these vaccines from KEVEVAPI and if the paravets could be allowed access to the veterinarian office refrigerators for medium term (up to 3 months) vaccine storage, the vaccine delivery might improve. Moreover, these cattle are vaccinated twice yearly as CBPP is endemic to the area and cattle owners may even pay for vaccine prior to its administration, as they still have to pay and wait for it to be ordered and then delivered from Nairobi.
The poor road infrastructure has worked against the development of the study area and other similar areas. Unless the county government invests heavily on the road infrastructure, access will remain the greatest challenge to vaccine delivery and other development efforts. Hopefully, the new county governments will be more sensitive to the community needs and make infrastructure development high priority in their development agenda. County governments should also consider employing more veterinarians, especially those and from the county, who may have commitment to stay and serve their communities.

Gendered division of cattle associated roles and responsibilities, has produced different and complementary types of knowledge on CBPP by women and men. Women appeared to know more about the clinical signs of the early disease manifested by individual animals, whereas men appeared to know more about signs associated with the latter stages of the disease and manifest in the herd. Recognition of this difference in knowledge and its utilization – by requesting women to alert the community when they see early signs of CBPP – can contribute to prevention of spread of disease. A strategy whereby women alert the community when they see early signs of disease leading to quarantine of suspect animals and herds, followed by ring vaccination of animals in neighboring herds would contain the disease and prevent its spread. Such action would prevent socioeconomic consequences of herd and trade losses associated with widespread CBPP outbreaks.

Feminization of pastoralism is ongoing in this community rendering women more relevant in cattle production than before because young men are migrating to urban areas in search of higher education and, or alternative livelihood sources. In spite of this, ownership of cattle by women remains low even for women from female headed households. There is need for recognition of this reality, by, for example, being conscious of the fact that the cattle managers will soon be women more than men and including women in matters concerning livestock at the community levels. Women should constitute a reasonable proportion (up to 60% in Ijara, which is commensurate with the current gender ratio) of beneficiaries of government and non-governmental interventions such as seminars and trainings on cattle production, health and trade.

Policy recommendations

1. The CBPP vaccine under development has great potential for commercialization especially if it is thermostable and more efficacious and safer than the current one. The current vaccine in its less safe and cold chain dependent state is well accepted and widely used. Men and women are willing to pay a much higher price for a better vaccine if it is made available.

2. Success of delivery of the CBPP vaccine can be accelerated by removing the current government control, which will be rendered unnecessary once a safe and thermostable vaccine with a competitive price that cattle owners can pay is made available for the market.

3. More delivery success can be achieved if the county government improved road infrastructure and employed local veterinarians who will be committed to stay in the area.

4. It is crucial to include women as relevant stakeholders in the cattle industry in northeastern Kenya because they are gradually becoming cattle managers with feminization of pastoralism.

5. Recognition and consideration of communities affected by unusual circumstances, like the effect of RVF on the vulnerability the Gedilun community calls for consideration for interventions that will address this vulnerability, such as subsidizing the cost of the vaccine to what the community can afford.

6. Extant CBPP surveillance system can be strengthened and/or new ones established and by including women’s reports on detection of early symptoms of the disease as part of disease early warning system. Once detected early, ring vaccination and quarantine can be implemented to contain, and prevent spread of the disease.
References


Khan, F. A. 2012. Biotechnology Fundamentals. CRC Press. p. 270. Available at: http://books.google.co.uk/books?id=-s5oRDUtMSIC&pg=PA270&dq=oral+vaccines+are+likely+to+be+solid+which+have+proven+to+be+more+stable+and+less+likely+to+freeze&hl=en&sa=X&ei=UQ3LUfGQOsud0xXuz4GgCQ&ved=0CC4Q6AEwAA#v=onepage&q=oral%20vaccines%20are%20likely%20to%20be%20solid%20which%20have%20proven%20to%20be%20more%20stable%20and%20less%20likely%20to%20freeze&f=false (accessed 16 December 2014).


Annexes: Data collection tools

Focus Group Discussion (FDG) checklist

FDG checklist: Social and economic factors that influence acceptability and adoption of CBPP vaccine by livestock owners/keepers

Gender of the group:
Name of location:
Number at beginning:
Number at end:
Number lasting throughout the FGD:
Date of FGD
Start Time:
Finish Time:

1. Background information

Proportion of women, men and children in the community (proportion piling)
Characterization of community members by wealth:
List the wealth categories
By proportion piling demonstrate the distribution of the population according to main wealth categories used by the community (categories should not exceed five, but must be at least two)

For each category mentioned, list the identifying characteristics

Proportion of people of different marital status in the community (proportion piling for each status)

<table>
<thead>
<tr>
<th>Marital status</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single never married</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (explain)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Explain the proportions
On average, how many times does a man re-marry in his lifetime? (Group may also give a range and explain the variation)
Explain.
On average, how many times does a woman re-marry in her lifetime? (Group may also give a range and explain the variation)

Explain.
What is the average family size? (Family consists of a man, his wives and children or a woman and her children)

Male headed household
[Dejure] Female headed household (divorced, widowed, or single never married)

Do your daily routines change in the year, or do you do the same things all year round? If they change, when do they change?

Roles and responsibilities
On an average day what do you do from when you wake up to when you go to sleep? (Activity clock – make two clocks if there is a distinct variation in seasons)

Clan/sub-clan composition of community (List clans and sub-clans available)
What proportions of the population constitute 5 of the largest clans/sub-clans? (Proportion piling)
Clan/sub-clan composition of FGD (Head-count by show of hands)

2. Livestock distribution in the community
What are the main livestock species in this community (list)?

How is each species distributed among the five dominant communities (proportion piling)? – decide on number of species to consider depending on proportion

Preference of livestock owned by men/women in the community (pairwise ranking)

CATTLE

3. Ownership of cattle by women and men
What is the average number of cattle in an average wealth MHH and FHH?
MHH
FHH

In the MHH what proportion of cattle are owned by:
Men
Approximately how many cattle do men own
Women
Approximately how many cattle do women own
Others

Who are the others

In the FHH, what proportion of cattle are owned by:
Men
Approximately how many cattle do men own
Women
Approximately how many cattle do men own

Others
Who are the others

What do you mean when you say that a man owns cattle? What does/can he do with the cattle he owns that makes/can make you confirm that he is the owner (wait for spontaneous responses and if having difficulty ask (probe) if they can give them away or sell them without consulting, who to consult, if there is a disagreement whose decision carries the day, etc.)

What do you mean when you say that a woman owns cattle, what does/can she do with the cattle she owns that makes/can make you confirm that she is the owner (wait for spontaneous responses and if having difficulty ask (probe) if they can give them away or sell them without consulting, who to consult, if there is a disagreement whose decision carries the day, etc.)

[If joint ownership was not mentioned, ask if cows can be jointly owned] When you say cattle are jointly owned by women and men, what do you mean?

In this community, what proportion of the cattle population is owned by the following (proportion piling):

- Men only
- Women only
- Jointly by women and men

In this community, what proportion of men and women own cattle as individuals?

- Men
- Women

In this community, what proportion of men and women own cattle jointly? (proportion piling):

- Men
- Women

What are the benefits for women who own cattle?
Who else benefits when women own cattle?
In what ways (for each response)?
What are the benefits for men who own cattle?
Who else benefits when women own cattle?
In what ways (for each response)?

4. Cattle related roles and responsibilities

What cattle related activities are conducted in a household (List)

Of these, which are done by
- Men only
- Women only
- Children only and a combination of two or more of the above categories
5. Cattle diseases

What are the common cattle diseases in this community?
Which are more important (pairwise ranking)
For the five most important, how are they controlled – vaccination, treatment or both?

6. Contagious Bovine Pleuropneumonia (CBPP)

[Prior to the interview, obtain the different names of this disease in local dialect from KII – give a few names and ask the FGD participants to provide the rest. Agree on what name to use to refer to the disease and use it to discuss the following]

Knowledge of disease, its control and sources of information
What are the signs of the disease (CBPP)?
How are you able to tell that it is CBPP and not another disease?
Is it possible to confuse it with other diseases? Which ones, and why?
When did the last CBPP outbreak occur?
How did you learn about the outbreak?
Is this how you normally obtain information on disease outbreaks?
How else are you able to obtain information on disease outbreaks?
How [else] would you like to be informed about disease outbreaks in general?
How do you control CBPP?

Vaccination

Of the cattle owning households, what proportion vaccinate their cattle if an outbreak is reported (proportion piling)
Discuss the proportions – why they are high and/or low
Why don’t the non-vaccinating households want to vaccinate

For vaccinating households:
Who decides whether to vaccinate or not?
Why?
If joint decision-making and there is conflict of interest between decision-makers, whose decision is taken? Why?
For households with men-only, women-only cattle, and jointly owned cattle what proportions of these cattle are vaccinated (proportion piling)?
Men only
Women only
Jointly owned by men and women

Explain the variations [Try to establish if variations can be associated with ownership status]

What are the benefits of vaccinating against CBPP?
What are the challenges of vaccinating against CBPP?
What are the alternatives to vaccinating against CBPP? (List)
What alternative is most popular?
What are the benefits of the most popular alternative to vaccinating against CBPP?
What are the challenges of the most popular alternative to vaccinating against CBPP?

If you were to recommend a most appropriate vaccine against CBPP, what would be its most desirable characteristics? (List and rank - pairwise)

CBPP key informant checklist

CBPP Key Informant Interview (KII) checklist

Date:
Place where resides:
Occupation:
Age:
Place of interview:
Person interviewing:

General information on Ijara (An elderly resident – man and woman)

What are the main seasons in Ijara?
What clans constitute the communities and what are the distinguishing characteristics of the different clans?
What are the main livelihood strategies of the people of Ijara?
Are there differences in livelihood strategies for women and men – what are they and how do they differ?
What proportion of community depend on cattle for their livelihoods?
In order to participate meaningfully in cattle trade, what is the minimum number of cattle that a household should own?
On average, how many cattle does a household own?
What is the approximate range?
What is the one or two things that you feel every visitor should know about this community once they visit?

CBPP questions (Veterinarian or livestock personnel)

What proportion of community depend on cattle for their livelihoods?
In order to participate meaningfully in cattle trade, what is the minimum number of cattle that a household should own?
On average, how many cattle does a household own?
What is the approximate range?
Is CBPP a common disease in this area? (define according to position of interviewee – county vet officer, division vet officer)
What is (are) the common local name(s) for CBPP?
How often do CBPP outbreaks take place in a 10 year period?
Do people normally vaccinate cattle against CBPP?
When?
About what proportion of the population vaccinates cattle against CBPP?
About what proportion of cattle are vaccinated against CBPP?
What are the constraints of CBPP vaccine delivery in Ijara/ this location?
How does response to CBPP vaccination compare to other vaccinations? e.g. HS
How does delivery of CBPP vaccine differ with that of other cattle vaccines? e.g. HS
Interview for KEVEVAPI marketing team

Key informant interview KEVEVAPI marketing manager (May 2014)

Introduction
The purpose of this interview is to build on data that we have on the CBPP vaccine delivery system. Data from Ijara field work indicated that cattle owners are able to access the vaccine from KEVEVAPI if they make a request through the vet officer or the district veterinary officer. Community members reported that because of this access, they have been able to vaccinate their cattle annually/biannually and have, therefore, not experienced a widespread outbreak of CBPP for a long time although there are few cases reported in the herds sporadically. The research team found some cattle being vaccinated and the vaccine was kept in a closed cool box with much ice.

Date of interview: ...........
Location of interview: .....................
Name of the respondent..............................; Occupation: .........................
Person interviewing: .....................
When was KEVEVAPI institution formed and what was its mandate?
Is it still following the same mandate?
If not, what is the new mandate?
Is this only time its mandate has changed since inception or had it changed before?
If mandate had changed before, list the changes and explain why the changes happened?
What vaccines does KEVEVAPI manufacture? – List the vaccines and against each indicate quantities (million doses) manufactured last year.
Are last year’s quantities representative of what you normally vaccinate or do they vary?
If they vary, how do they and why do they?
Are all the vaccines manufactured at KEVEVAPI used only locally?
If you export, which ones do you export and to what countries? What proportion of vaccines that you export is exported and what proportion is used locally?
Does KEVEVAPI import vaccines?
If KEVEVAPI imports vaccines, which ones are they?, why? and from what countries?
Among the vaccines imported, do you manufacture some?
If yes, what proportion of the vaccine is manufactured here and what proportion is imported?
Do you re-export the vaccines that you import?
To which country(ies)
What proportion of imported vaccine is re-exported?
Do you manufacture vaccine(s) against CBPP?
Name the types and state the differences in the types named and proportions manufactured last year
How many doses did you manufacture in:
2010
2011
2012
2013
Of these doses how many did you sell?
How many doses did you sell in Kenya and how many did you export?
For the vaccine used locally, where did you sell it – districts or sub-districts and what quantities did you sell to each districts or sub-districts since 2010. Why?
For how much did you sell a dose locally?
For how much did you sell a dose for export?
How do you pack vaccines when presenting them to the buyer?
Do you label the packages? (please give me a sample label)
Why do you label the packages?
Do you put instructions in the package? (please give me a copy of the instructions)
Why do you put instructions in the package?
For how long (hours) is a package viable at a room temperature of about 35°C?
Are there times when you turn away buyers from purchasing the CBPP vaccine?
When and why?
Do you experience challenges in terms of reaching buyers?
What challenges?
For each challenge how do you deal with it?

Willingness to pay questionnaire

Date and Time of interview: ___________________ 2014 at (time): ___________________
Enumerator name: ____________________________

Willingness to pay questionnaire: To be administered to individuals participating in FGD discussions

Individuals constituting FGD will be asked the following questions individually:

1. Gender of respondent (Tick one): Male Female

2. Number of the persons in the Household: ............

3. Number of children in the household: .............

4. Marital status (Code): [............]

5. If woman, wife no (circle one)? 1 2 3 4 Other (specify) ______

6. On average what was your household income in KSh in the last 12 months? [Enumerator, please note the exact amount where given]

[ ] ≤5,000
[ ] 5,001–10,000
[ ] 10,001–20,000
[ ] 20,001–30,000
[ ] 30,001–50,000 Exact amount: KSh ______________________
[ ] 50,001–70,000
[ ] > 70,000

[ ] I prefer not to answer

7. Do you own cows as an individual? (circle one) 1 – Yes 2 – No

7.1. If yes, how many? ___________

8. Do you own cows jointly with someone? (circle one) 1 – Yes 2 – No

8.1. With who? (code)

Owns cow with who(m)

<table>
<thead>
<tr>
<th>Spouse</th>
<th>Father</th>
<th>Mother</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

8.2. If yes, how many? ___________
(If does not own any cows, ask how come they do not and document their response. Then excuse them)
If s/he owns cow(s) ask the following questions?

9. Are you willing to pay KSh 200 for a CBPP annual vaccination (circle one)? 1 – Yes 2 – No

9.1. If answer is yes, ask if they are willing to pay KSh 220, then KSh240, continue making increments by KSh 20 and note what value they say no at. Document the value to which they say no: __________________

9.1.1. Why are you willing to pay up to the specified value?

Reason:

____________________________________

9.2. If answer is no, ask if they are willing to pay KSh180, then KSh160, continue decreasing amount by KSh20 and note what value at which they say yes. Document the value to which they say yes:____________________

9.2.1. Why are you willing to pay up to the specified value?

Reason:

____________________________________
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