An economic assessment of farmer demand in Kenya for a vaccine against East Coast fever.

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Summary
Conjoint analysis and contingent valuation were used as complementary methods to assess potential demand for two vaccine products against East Coast fever, one an existing live vaccine and the other a sub-unit vaccine under development. Both approaches were administered to sample farmers in areas in Kenya where the vaccine has not yet been introduced. Conjoint analysis evaluated farmer preferences for key vaccine attributes, while contingent valuation assessed farmer willingness to pay to the two products. Both approaches confirm high potential demand for either vaccine.

Introduction
East Coast fever (ECF) is a tick-borne disease responsible for approximately half of cattle mortality in Kenya. Improved breeds of cattle, especially the higher-value animals kept by smallholder farmers for dairy production, are particularly susceptible to the disease. Farmers currently depend on tick control measures to reduce the risk of exposing their cattle to the disease, or treating the disease with curative drugs if the symptoms are diagnosed in time. Vaccines have not been available to cattle keepers, but this is expected to change in the near to medium future. A live vaccine, referred to as the Infection and Treatment Method (ITM), was developed in the 1970s, but its use has been limited to the Kenya Coast. It is now slated for wider distribution to other areas of the country where the great majority of dairy farmers are located. Though proven effective, ITM is relatively expensive (US$8-$20/dose) and requires a strict cold chain to ensure its viability. A potentially cheaper and easier-to-deliver sub-unit vaccine is also under development at ILRI, but is not expected to be available as a commercial product before 2009. In this paper, we describe economic analyses to evaluate the potential farmer demand for these two vaccine products, using two different approaches.

Methods
Conjoint analysis: The first analysis examines farmers' preferences for vaccine attributes. Given that ECF vaccines will be distributed as commercial products, their eventual success and uptake will depend on how their attributes are perceived and judged by cattle keepers. To gain insight into the relative importance of such vaccine attributes, a conjoint analysis experiment was designed to evaluate the role that a few key attributes play in decision-making by smallholder dairy farmers when purchasing an ECF vaccine. The selected attributes included: (1) level of expected protection (high-95% *versus* moderate-75%); (2) required frequency of administration (one time only *versus* repeated boosters); (3) risk of reactors (none *versus* some); and (4) price (three different price levels). Farmers were then presented with a series of 8 cards,

each representing a unique combination of one level per attribute, and were asked to rank the cards in order of preference. A fractional factorial design was used to identify an orthogonal subset of 8 combinations out of the 24 possible combinations. One card, for example, might offer a vaccine at a moderate price providing moderate protection, but administered only once and have no risk of reactors. The attributes were represented by picture illustrations as well as text, and the enumerators provided a standardized explanation.

Contingent valuation: The second analysis evaluates farmer willingness to pay for the two vaccine products. A contingent valuation experiment was designed for each type of vaccine and one of the two experiments was randomly assigned to each sample household. After a carefully prepared, standardized explanation of the vaccine product, the respondent was presented with one of five possible price bids randomly assigned to her, and asked if she would be willing to buy the product. If "yes", then a second higher price would be proposed, and if "no", a second lower price would be proposed. The design permitted econometric estimation of a double-bounded contingent valuation model, using both restricted and unrestricted parametric and non-parametric configurations (i.e., with and without covariates).

Data collection: Data for the analyses were collected from a sample of 1000 dairy farm households in four sites (Makuyu, Kiambu, Uasin Gishu, Kakamega), areas of relatively high ECF challenge in the Central and Western Highlands of Kenya, in November 2000 to June 2001. A stratified sampling strategy was applied, with 5 of the 10-15 administrative sub-locations in each site first being selected using a standard random sampling procedure. A sampling frame of all cattle-keeping households was established for the 5 sub-locations, and 50 households were then randomly selected from each sub-location. Enumerators administered a questionnaire and the conjoint analysis experiment during a single visit to each household.

Results and Discussion

Conjoint analysis: The conjoint analysis experiment was successfully completed with 971 farm households. The results are summarized in Table 1. Part-worth Scores represent an internally consistent utility value of the individual attribute levels. The estimated Part-worth Scores all perform to expectations, with price, for example, offering increasingly negative utility as the price increases. Although scores for individual attributes varied significantly across the four study sites ($p=0.000$), the general pattern and order of importance were the same.

Summing the Part-worth Scores for attribute levels associated with a given product provides a measure of its perceived utility to farmers. The current live vaccine offers utility of +0.59 (high effectiveness, one-time administration, high price, risk of reactors). The proposed sub-unit vaccine is expected to offer utility of +0.90 (high effectiveness, boosters, low price, no reactors), and so should be a more attractive product to farmers. If, however, the sub-unit vaccine is not able to achieve as high protection, the utility drops to –2.08; if not sufficiently effective, the sub-unit vaccine may be unable to compete successfully with the existing live vaccine, ITM, even though ITM is more expensive.

Table 1: Conjoint analysis results for farmer preferences for ECF vaccine attributes (n=971)

Attribute	Average Importance	Attribute Levels	Average Part-worth
Effectiveness (protection)	38.8 %	Moderate (75%) High (95%)	-1.41 1.41
Frequency of administration	27.5 %	Once only Annual boosters	0.95 -0.95
Price ($US 1=78 KSh)	12.3 %	KSh 600 KSh 1200 KSh 1800	-0.33 -0.66 -1.00
Safety (risk of reactors)	21.4 %	No reactors 5% risk of reactors	0.77 -0.77

This result is also reflected in the average Relative Importance Scores, representing the relative importance of the attribute in percentage terms in the farmer's overall decision-making (with the importance scores for the four attributes summing to 100%). The estimated Relative Importance Scores indicate that farmers give highest priority to a vaccine that ensures a high level of protection (39% of the overall decision), and secondly to one that does not require boosters (28%). Price is the least important factor (12%).

Contingent valuation: Data for the contingent valuation experiment have been analysed for the Makuyu site only, representing 234 respondents--119 for ITM and 115 for the proposed sub-unit vaccine product. The mean willingness to pay estimates for ITM ranged between $16.83-$18.33 (US$1=78 KSh) across the various models, and for the sub-unit vaccine, between $17.37-$18.83. Although the willingness to pay for the sub-unit vaccine was slightly higher than that for ITM, the difference was not statistically significant. Both sets of estimates exceeded the expected farm-gate price of $10-$15 for the more expensive product (ITM).

Conclusion

Two approaches were applied to assessing farmer demand for two ECF vaccine products in areas where a vaccine product has not been available. In the first approach, an indirect method is used in which farmer preferences for specific attributes of the vaccine products are evaluated using conjoint analysis. In the second approach, a more direct method of soliciting willingness to pay using contingent valuation was attempted. With respect to price, the two approaches generated consistent results, suggesting that even relatively high prices are unlikely to discourage farmer uptake of a vaccine. The analysis of preferences also sends a clear signal to developers of the sub-unit vaccine highlighting the critical importance of achieving a product that guarantees a sufficiently high level of protection from ECF if it is to offer a viable alternative to the existing live vaccine.