Potential demand for a mixed public–private animal health input: evaluation of a pour-on insecticide for controlling tsetse-transmitted trypanosomiasis in Ethiopia

Brent M. Swallow a,*, Woudyalew Mulatu a,1, Stephen G.A. Leak b,2

aInternational Livestock Centre for Africa, Nairobi, Kenya
bInternational Laboratory for Research on Animal Diseases, Nairobi, Kenya

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Abstract

The new pour-on insecticides that can be used to control tsetse-transmitted trypanosomiasis confer benefits to the owners of the cattle given treatments and other people keeping cattle in areas affected by the control. A study was conducted in southwest Ethiopia to assess farmers' perceptions of the public and private benefits of the pour-on and identify the household-level factors affecting its demand. Ninety-seven percent of the 166 survey respondents had received pour-on treatments when they were free and 67% paid for treatments the month before the survey. Farmers noted public and private benefits from using the pour-on, the most important of which were less trypanosomiasis, fewer problems with biting flies (including tsetse), and fewer problems with ticks. The probit model estimated to quantify the effects of different variables indicates that proportions of cows and oxen, distance to the treatment centre, and seasonal factors were significant determinants of demand.

Keywords: Trypanosomiasis; Tsetse (Glossina spp.); Ethiopia; Economics; Policy

1. Introduction

Africa's livestock sub-sector is constrained by several animal health problems. Until the early-1980s, most of the inputs used to counter those problems were delivered by government agencies at highly subsidized rates. Tight government finances have since caused...
reductions in the quantity and quality of the supplies and services provided by those agencies (Leonard, 1993). Contemporaneously, the World Bank and other agencies have supported African governments to reform their animal health delivery systems as part of market liberalization programmes. The goal of those reforms is to strike the appropriate balance between private and public delivery of animal health inputs (De Haan and Bekure, 1991; Umali et al., 1994).

No particular public–private balance is appropriate for all animal health inputs. Umali et al. (1994) suggest that the most efficient method for delivering an input depends upon the way its benefits are distributed. An input whose benefits accrue to a livestock owner should be delivered by private firms, while an input whose benefits are diffused through a larger population should be delivered by public agencies. (The concepts of excludability and subtractability are used to characterize the public–private nature of animal health inputs. An input is subtractable if its use by one person reduces its value to others; it is excludable if its owner or provider can withhold its benefits without incurring any cost (Cornes and Sandler, 1986; Umali et al., 1994).) Umali et al. (1994) note that many animal health inputs are neither purely private nor purely public. For example, some inputs generate both public and private benefits. Such goods are called mixed public–private goods or impure public goods (Cornes and Sandler, 1986). The prospect for efficient private sector delivery of a mixed public–private good depends, everything else being equal, upon how the potential beneficiaries perceive the benefits and costs and how those perceptions compare with the benefits and costs to society. Umali et al. (1994) note that externalities and information asymmetries also affect the optimal balance between public and private involvement in input delivery systems. Private delivery systems can result in over-use of inputs that generate negative consumption externalities and under-use of inputs that generate positive consumption externalities. An input whose quality is known to the supplier but difficult to observe by potential customers can raise 'moral hazard' problems because the supplier (public or private) can be tempted to supply goods of inferior quality.

This paper focuses on a particular mixed private–public good: insecticide 'pour-ons' that can be used to control tsetse flies (Glossina spp.) that transmit African livestock trypanosomiasis. Trypanosomiasis is one of the most important livestock diseases in the tsetse-infested areas of Africa (Murray and Gray, 1984). Since January 1991 a study using a new formulation of pour-on insecticide has been undertaken in the Ghibe valley of southwest Ethiopia. The success of the pour-on in suppressing the population of tsetse and reducing the prevalence of trypanosomiasis is demonstrated elsewhere (Leak et al., 1995). In this paper we consider the potential demand for the pour-on and the prospects for its delivery through the private sector. The objectives of the study are to: (1) understand how cattle owners perceive the pour-on. What do they consider to be its main benefits? How public or private are those perceived benefits? (2) assess how the imposition of a 'cost-recovery' charge for the pour-on will affect its demand; (3) identify factors affecting demand for the pour-on.

Data were collected through a group interview and a formal survey of households. Hypotheses about factors affecting demand for the pour-on were derived from the economic theory of input demand and the innovation-diffusion model of technique adoption. A probit model was estimated to test those hypotheses.
2. Materials and methods

2.1. The public–private nature of the pour-on

Pour-ons are formulations of insecticide that can be applied to cattle kept in tsetse-affected areas. Cattle treated with pour-ons act as 'live targets': tsetse flies that land on treated animals contact the insecticide and die immediately or are immobilized by a knock-down effect. There is evidence that pour-ons can control tsetse, ticks (Thompson et al., 1991; Bauer et al., 1992b) and other biting flies (Leak et al., 1995). (Three different pour-on formulations based on synthetic pyrethroids have been proven to be effective in controlling tsetse. Deltamethrin (SPOTON®, Coopers Ltd., Zimbabwe) has been tested in Zimbabwe and on the island of Zanzibar (Thompson et al., 1991); flume&in (Bayticol®, Bayer AG, Germany) has been tested in Kenya and Burkina Faso (Bauer et al., 1992b; Löhr et al., 1991) and cypermethrin high-cis (ECTOPOR®, Ciba-Geigy, Switzerland) has been tested in Ethiopia (Leak et al., 1995).)

Some of the benefits of controlling tsetse and other biting flies accrue to anyone who keeps livestock in an area of effective control, whether or not their cattle are treated with pour-on. Because different species of tsetse and biting flies have different dispersal patterns, the areas in which they are effectively controlled also differ. The smaller the range of the fly, the more spatially concentrated are the benefits of its control. Some of the benefits of tsetse and biting fly control may be concentrated in relatively small areas (e.g. less than 1 km²), while other benefits are dispersed across much larger areas (e.g. 50 km²).

Other benefits accrue primarily to the owner of the animals receiving the pour-on treatments. In particular, most of the benefits of tick control accrue to the owners of the animals receiving the treatments. Young et al. (1985) have shown that cattle wearing ear tags impregnated with the synthetic pyrethroids used in pour-ons experience lower tick loads than unprotected cattle in the same area. Another possible private benefit is the 'hot-foot effect'. It is suspected that some of the flies that land on treated animals contact enough insecticide to be knocked down before they feed. If true, treated animals have lower risks of contracting trypanosomiasis than untreated animals in the same area (B. Bauer, personal communication, 1993).

2.2. Background to the study

Since January 1991 the International Livestock Centre for Africa (ILCA), with the International Laboratory for Research on Animal Diseases (ILRAD), has been conducting a tsetse control trial with a cypermethrin high-cis pour-on (ECTOPOR®, Ciba-Geigy, Switzerland) in the Ghibe Valley in southwest Ethiopia (Leak et al., 1995). The study site is located about 200 km southwest of Addis Ababa in the valley of the Ghibe river. Most households in the area practice integrated crop–livestock farming. In 1993 the average cattle-owning household had 5.6 adult cattle, including 2.9 oxen, and cultivated 4.2 ha (unpublished survey data). Every day the cattle owned by several households are brought into collective herds of between 30 and 80 cattle that are tended by one of the herd owners. The collective herds are grazed in areas of between 200 and 1000 ha. There is little overlap in the grazing areas used by different herds (unpublished herd monitoring data).
Data on tsetse density, trypanosome prevalence and cattle productivity have been collected in the area since 1986. Tsetse density was measured along a 4 km stretch of the Ghibe river; trypanosome prevalence and productivity were measured in two groups of about 100 adult cattle each. Data collected between 1986 and 1990 show high rates of trypanosome prevalence in cattle, exacerbated by a high level of trypanosome resistance to the available trypanocidal drugs (Codjia et al., 1993; Leak et al., 1993; Rowlands et al., 1993). Blood meal analyses showed that a high proportion of tsetse feeds are taken from cattle (Leak et al., 1995).

From January 1991 to November 1992 the pour-on treatments were freely provided to cattle kept in area of about 200 km² along the Ghibe river. One day each month cattle owners brought their animals to one of five crushes along the road between the villages of Gullele and Tolley. Between 2000 and 4000 cattle were treated each month with solutions containing 25 ml (animals over 1 year of age) or 10 ml (animals under 1 year of age) of the cypermethrin-based insecticide. Leak et al. (1995) record that the apparent density of tsetse (Glossina pallidipes and Glossina morsitans submorsitans) diminished by about 88% (P < 0.01) and the prevalence of trypanosomiasis in cattle diminished by 75% compared to the pre-intervention levels (P < 0.01).

Since December 1992 a charge of 3 Ethiopian Birr (US$0.60) has been levied for each animal treated each month. This charge covers the costs of purchasing and administering the treatments. Two new crushes were built and anyone who chooses may bring animals to receive treatments. Tsetse density, trypanosome prevalence in cattle and cattle productivity continue to be monitored. In addition, farmers' use of the pour-on is being monitored each month and their perceptions are being assessed through group and household interviews.

2.3. Demand for the pour-on

The short-term demand for a variable input such as a pour-on is a function of its price, the prices of other variable inputs, the price(s) of the output(s), and the quantities of the fixed inputs (Chambers, 1988, pp. 145–147). In this case, the monetary price of the pour-on was the same for all farmers, while the distance they walked to the crush, and the transaction costs they therefore incurred, varied from farmer to farmer. Distance to the crush was measured by the number of minutes it took to walk from the person's homestead to the crush (Distance). Prices of the other inputs and outputs (e.g. meat, milk, traction) did not vary between households and thus were not included. The main fixed inputs were cattle and labour. Cattle were measured by three variables: total number of cattle (Cattle), proportion of herd comprised of oxen (Oxen), and proportion of herd comprised of cows (Cows). Labour was measured by the number of adults employed outside of the household (Labour).

Hypotheses about other factors that might affect demand for the pour-on derive from the innovation-diffusion model of technique adoption. The maintained hypothesis supporting the innovation-diffusion model is that the main constraint to the adoption of new techniques is access to information and ability to process that information (Adesina and Zinnah, 1993). Variables measuring age (Age), formal education (Education) and previous involvement in the health–productivity survey (Monitor) were thus included. Additional variables were included to indicate the month that the household was interviewed (April is used as the
Table 1  
Definition of variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Range</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>26</td>
<td>21</td>
<td>2-75</td>
<td>Number of minutes of walk from corral to crush</td>
</tr>
<tr>
<td>Cattle</td>
<td>5.6</td>
<td>6.4</td>
<td>1-38</td>
<td>Number cattle held by household</td>
</tr>
<tr>
<td>Oxen</td>
<td>0.69</td>
<td>0.29</td>
<td>0-1</td>
<td>Proportion of herd comprised of oxen</td>
</tr>
<tr>
<td>Cows</td>
<td>0.15</td>
<td>0.17</td>
<td>0-1</td>
<td>Proportion of herd comprised of cows</td>
</tr>
<tr>
<td>Labour</td>
<td>3.1</td>
<td>1.5</td>
<td>1-8</td>
<td>Number of adult household members less adult males employed outside of the household</td>
</tr>
<tr>
<td>Age</td>
<td>0.44</td>
<td>0.50</td>
<td>0-1</td>
<td>1 if household head is between 30 and 50 years of age, 0 otherwise</td>
</tr>
<tr>
<td>Education</td>
<td>0.34</td>
<td>0.47</td>
<td>0-1</td>
<td>1 if household head has any formal education, 0 otherwise</td>
</tr>
<tr>
<td>Monitor</td>
<td>0.16</td>
<td>0.37</td>
<td>0-1</td>
<td>1 if animals were involved in health-productivity monitoring, 0 otherwise</td>
</tr>
<tr>
<td>DM1</td>
<td>0.12</td>
<td>0.32</td>
<td>0-1</td>
<td>1 if interview conducted in January, 0 otherwise</td>
</tr>
<tr>
<td>DM3</td>
<td>0.57</td>
<td>0.50</td>
<td>0-1</td>
<td>1 if interview conducted in March, 0 otherwise</td>
</tr>
<tr>
<td>DM6</td>
<td>0.14</td>
<td>0.35</td>
<td>0-1</td>
<td>1 if interview conducted in June, 0 otherwise</td>
</tr>
<tr>
<td>DM7</td>
<td>0.14</td>
<td>0.35</td>
<td>0-1</td>
<td>1 if interview conducted in July, 0 otherwise (April is used as the base month)</td>
</tr>
</tbody>
</table>

Base month). These variables account for possible seasonal fluctuations in pour-on use. The variables are defined in Table 1.

2.4. Group and household interviews

In July 1992 the authors conducted a semi-structured interview with a group of about 50 of the cattle owners who had received free treatments of the pour-on. The group was assembled by cattle owners in one of the villages. Questions were posed to elicit farmers’ perceptions of the benefits and costs of the pour-on. Farmers were told that from December of that year a charge of 3 Birr per treatment would be levied to cover the purchase and application costs. Questions were also posed to assess, ex ante, how the imposition of the charge might affect their use of the pour-on.

A household survey was implemented to pursue some of the issues raised during the group interview. The population for the survey was all cattle owning households who resided in the pour-on control area at the time the charge was first levied (December 1992). It was not possible to develop a sampling frame of all cattle-owning households in the entire area, so the survey was administered to households in one of the local government areas within the control area (Gullele kebele). The Gullele kebele was purposively chosen because of its close proximity to the tsetse monitoring site and because it includes one of the herds involved in the health and productivity survey. Leaders and elders in the Gullele kebele assisted in developing a sampling frame of all livestock-owning households in the four villages. A total of 380 household heads were listed. Interviews were conducted with all livestock-keeping households in the three small villages and a random sample in the single large village (using a random number table). A total of 166 households were interviewed between January and July of 1993.
The survey was timed to give the respondents at least 2 years of experience with the pour-on and some months of experience with cost recovery. The questionnaire was written and pre-tested in English, translated to Amharic and pre-tested again, administered in Amharic, and translated back to English for data entry and analysis. The questionnaire included questions about the household head, characteristics of the household, structure of the livestock herd, use of livestock products, livestock diseases, their use of the pour-on, and the advantages of using the pour-on. They were read a list of the advantages that had been elicited during the group interview, asked to add other important advantages and rank the most important, second most important and third most important advantages.

2.5. Probit analysis

A probit non-linear regression model was estimated to test several hypotheses about factors affecting demand for the pour-on. Demand was measured by a binary variable: did the household take animals for treatment the month before they were interviewed (yes/no)? The coefficients measure the effects of changes in independent variables on an unobservable index variable. The index variable (\(i_i\)) is assumed to be a linear function of the explanatory variables (\(X = X_1, ..., X_n\)) as indicated in Eq. (1). The relationship between the index variable and the probability of a yes response (Prob-yes) is defined by the cumulative normal distribution function (Eq. (2)). (The probit and logit models are similar except for the assumed relationship between \(Z_i\) and Prob-yes. In the logit model, the relationship is defined by the logistical cumulative distribution function (CDF). The following logic favours the normal CDF as in the probit model: each individual chooses yes or no by comparing the value of \(Z_i\) to a threshold value (\(I\)). If \(Z_i > I\), they choose yes. \(I\) is determined by many independent factors, and thus by the central limit theorem, can be assumed to be normally distributed (Judge et al., 1982, p. 519). In practice the standard normal and the logistical CDFs are similar except in the tails. The logit model generates higher probabilities at low levels of \(X \beta\) and lower probabilities at high levels of \(X \beta\).) Maximum likelihood techniques were used to estimate the coefficients of the probit function and thus the standard errors are asymptotic. The SHAZAM econometrics software was used to estimate the parameters (White, 1993).

\[
Z_i = X_i \beta + e_i \\
Prob\text{-yes}_i = F(X_i \beta)
\]

where \(F\) is the normal cumulative distribution function.

3. Results

Only four of the 166 households that were interviewed were headed by women. Almost all of the household heads were available for the interview: five households were represented by the wife of the head, four by a brother of the head, and four by other household members. Only respondents who reported that they had used the pour-on the previous month were asked questions about the advantages and disadvantages of the pour-on. Data on all 166 respondents were included in the estimation of the probit model.
Table 2
Use of pour-on* by farmers in the Gullele area of the Ghibe Valley, southwest Ethiopia

<table>
<thead>
<tr>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>67</td>
</tr>
<tr>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Total cattle held by respondents 967
Cattle given pour-on month before 418 43

* Ectopor, CIBA-Geigy, Switzerland.

3.1. The prevalence of pour-on use

Ninety-seven percent of the households had received pour-on treatments since the beginning of the trial, 66% of the households received treatments the month prior to the survey, and 43% of adult cattle held by respondents were treated the previous month (Table 2). Those who did not take animals for treatment the previous month gave a variety of reasons including: too expensive, fewer problems with tsetse and ticks, and no labour or cash available on the date the treatments were given.

3.2. Advantages and disadvantages of the pour-on

The rankings given in Table 3 indicate that the most important advantage was less trypanosomiasis, the second most important was fewer problems with flies (including tsetse) and the third most important was fewer problems with ticks. Other advantages...
including quieter grazing, quieter milking, faster healing of wounds, fewer problems with ox-peckers (*Buphagus* spp., birds that feed on insects attached to the cattle), and faster healing of wounds were mentioned by between 20 and 35% of the households. The most important disadvantage was the high cost.

### 3.3. Factors affecting demand for the pour-on

Table 4 presents results of the analysis of factors affecting demand for the pour-on. The coefficients estimated for three of the variables derived from the input demand model—Oxen, Cows, Distance—were statistically significant. The higher the proportions of cows and oxen in a farmer’s herd, the more likely he was to purchase treatments. The further he lived from the crush where the treatments were given, the less likely he was to take animals for treatment. Two of the binary month variables were positive and significant. Farmers who were interviewed in June and July were significantly more likely to have taken animals for treatment than farmers interviewed in April. None of the variables derived from the innovation-diffusion model—Age, Education, Monitor—were statistically significant.

Table 4 also indicates the marginal effects of changes in the five statistically significant variables. Holding all other variables constant at their mean levels: (1) a household located twice as far from the crush as the mean household was 36.2% less likely to treat some of their animals (*P* < 0.05); (2) a household with 10% more oxen than the mean household was 2.8% more likely to treat some of their animals (*P* < 0.05); (3) a household with 10% more cows than the mean household was 4.4% more likely to treat some of their animals.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated coefficient</th>
<th>Asymptotic SE</th>
<th>Change</th>
<th>% change in probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>-0.014 *</td>
<td>0.007</td>
<td>Double</td>
<td>-36.2</td>
</tr>
<tr>
<td>Cattle</td>
<td>0.003</td>
<td>0.023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxen</td>
<td>1.12 *</td>
<td>0.53</td>
<td>Mean +0.1</td>
<td>+2.8</td>
</tr>
<tr>
<td>Cows</td>
<td>1.90 *</td>
<td>0.82</td>
<td>Mean +0.1</td>
<td>+4.4</td>
</tr>
<tr>
<td>Labour</td>
<td>0.063</td>
<td>0.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.082</td>
<td>0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>0.283</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor</td>
<td>0.59</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM1</td>
<td>0.12</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM3</td>
<td>0.02</td>
<td>0.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM6</td>
<td>1.44 *</td>
<td>0.69</td>
<td>0/1</td>
<td>+15.4</td>
</tr>
<tr>
<td>DM7</td>
<td>2.03 *</td>
<td>0.79</td>
<td>0/1</td>
<td>+17.9</td>
</tr>
</tbody>
</table>

* Significant at the 5% level of confidence.

n = 166.

Log-likelihood function = -87.46.

Maddala R-square = 0.227.

Percentage of correct predictions = 77.

* Ectopor, CIBA-Geigy, Switzerland.

b Variables are defined in Table 1.
(P < 0.05); (4) households interviewed in June or July were 15.4% or 17.9% more likely to treat some of their animals than a household interviewed in April (P < 0.05).

4. Discussion and conclusions

The imposition of the charge of 3 Birr per treatment (0.60 US$) coincided with a reduction in the demand for the pour-on treatments. Part of the reduction was likely due to the increase in price from 0 to 3 Birr, while part of it was due to a normal seasonal fluctuation in demand. Results from the regression model indicate that the households who were interviewed in June and July were more likely to have purchased treatments the previous month than households interviewed in January, March or April. This seasonal pattern is borne out by inspection of the aggregate data on the total number of pour-on treatments given per month. Only 750 treatments were given in January 1993, while 4000 and 3260 treatments were given in June and July of 1993, respectively. Data from the second year of the trial further substantiate a seasonal pattern of high demand in the most rainy months (June, July, August) and low demand in the driest months (December, January, February).

Leak et al. (1995) show that the reduction in demand that resulted from the imposition of the price did not reduce the effectiveness of the pour-on in lowering tsetse density and trypanosome prevalence. A cooperative or government agency that could adopt a similar cost-recovery policy of pricing could achieve similar results. The higher prices that would be charged by a private firm might or might not choke demand enough to reduce the efficacy of the pour-on. Private delivery of the pour-on would further depend upon their ability to solve the problem of information asymmetry. Government agencies could protect farmers from inferior products by enacting appropriate regulatory procedures.

The theory of public–private goods summarized by Umali et al. (1994) implies that the high level of demand that has been observed since the price has been imposed would not have been possible if cattle owners had perceived that the benefits were diffused throughout the 200 km² of the control area. Because the tsetse species found in the area are relatively mobile, we hypothesize that some of the benefits of tsetse suppression and trypanosomiasis control were in fact distributed through relatively large areas. The farmers also perceived that the animals that received pour-on treatments were at less risk of contracting trypanosomiasis. Such a private benefit is possible if the pour-on actually had a repellent or 'hot-foot' effect. The existence of such an effect, however, has not been proven for tsetse. (Dagnogo and Gouteux (1983) reported that there was a repellent effect from deltamethrin used on targets at least for short periods, whilst Bauer et al. (1992a) found that flies landed repeatedly on cattle treated with deltamethrin.)

We hypothesize that some of the biting flies affected by the pour-on were relatively restricted in their range and thus the benefits of their control were concentrated in relatively small areas (perhaps equivalent to the areas grazed by collective herds). For example, significant reductions in numbers of *Stomoxys calcitrans* and Tabanidae disturbing horses were obtained by treating as few as 50 horses on a 52 000 ha airbase in the Philippines (Lang et al., 1981). Permethrin impregnated ear-tags have successfully been used to control nuisance flies on horses in India (Parashar et al., 1986). We also hypothesized, as discussed above, that most of the benefits of tick control accrue to the owners of the animals treated
with the pour-on. Despite the potential private benefits, however, the pour-on is not a technique for tsetse and trypanosomiasis control that is suitable for private use.

The probit model indicates that the most significant determinants of a household’s use of the pour-on are related to their expected benefits and costs (derived from the model of demand for a variable input). Everything else being equal, the households that were most likely to have their animals treated were those with high proportions of oxen and cows in their herds. Aggregate data on the density of cattle and proportions of oxen and cows would therefore provide information on the potential demand for the pour-on in another area. Unfortunately, it was not possible to relate the demand for the pour-on to farmers’ perceptions of its advantages and disadvantages because the only respondents who were asked about their perceptions of the advantages and disadvantages were those who had used the pour-on the previous month. The study by Adesina and Zinnah (1993) suggests that farmers’ perceptions may have important influences on their adoption decisions.

The negative effect of distance to the crush where pour-on treatments were given indicates that the geographical dispersion of livestock owners is important for planning the locations of delivery points for pour-on treatments. The lack of all-weather roads in rural Ethiopia could result in high distribution costs in other areas of the country. While most of the distribution points in this study were located along an all-weather road, almost 90% of the people who live in rural Ethiopia live more than 48 h walk away from a primary road (Webb et al., 1992). More conclusive results would have been obtained if the survey had been administered to some people located at greater distances away from the crush.

In sum, therefore, we conclude that people perceive that most of the benefits of pour-on use accrue to the owners of animals receiving treatments. Private supply of pour-ons will be feasible if enough people are willing to pay a price high enough to cover costs and generate normal profits. High distribution costs will hamper private supply in less-accessible areas of Ethiopia. The possibility that suppliers will sell inferior or diluted products will require common control, government regulation or the involvement of producer cooperatives.

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