Willingness to pay for contract health care services in dairy animals: a payment card study

Kathiravan, G.[*] and Thirunavukkarasu, M.

Department of Animal Husbandry Statistics and Computer Applications, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University 600 007, Chennai, India

[*]**Correspondence:** G. Kathiravan, Department of Animal Husbandry Statistics and Computer Applications, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University 600 007, Chennai, India. E-mail: drkathir@yahoo.com

Summary

A study was undertaken in southern peninsular state of India, the Tamil Nadu State, to assess the farmers' "Willingness to pay" (WTP) for receiving annual health care services to their dairy animals. The districts of the state were categorized as "Livestock developed" (LD) and "Livestock under developed" (LUD) based on initial base line developed. Contingent valuation (CV) approach was used to study the farmers' maximum WTP value for two types of health care services: (a) providing health care services at government veterinary centres (in-centre) and (b) extending health care services at farmers' doorsteps (farm gate). A payment card (PC) format was used to assess the farmers' maximum WTP for receiving health care services to cows and buffaloes. The Maximum Likelihood Interval technique was used on interval midpoints. Overall mean WTP value for annual health care services in cows was INR 202.34 for in-centre services, while it was INR 261.66 for home services. Similarly, overall mean WTP value for annual health care services in buffaloes was INR 135.78 for in-centre services and INR 186.20 for farm gate services. The mean stated WTP values for both in-centre and at home services in the LD districts were highest as compared to LUD districts, leaving a scope for increased cost recovery. These WTP estimates exhibited the scope of cost recovery measure that can be implemented in lieu of free services extended currently, besides presenting a clue for designing a "vet-claim" policy in line with "medi-claim" policy for humans.

Key words: WTP, Payment card, Interval regression, Dairy animals, India

Introduction

Meshed with the religious, social and cultural ethos of the people, the importance of livestock in India transcends the study of economics. Livestock plays a crucial role in Indian economy, especially for the rural vulnerable landless and women folk, employing over 11 million of them in principal and 8 million in subsidiary status which is about 5% of total working force in the country. The livestock sector contributes around 6.29% to GDP with the value of output from livestock to INR 1,64,509 crore at current prices during 2003-2004. However, the low input and low productivity of livestock production systems in India are by and large "extensive" in type. Majority of livestock owners are only marginal farmers with an average herd size of 3.7 cattle and buffaloes. There is also an inverse relationship between land and livestock holdings, excluding landless category (Ravishankar and Birthal, 1999), indicating better equity of farmers with respect to livestock holding. That is, the distribution of livestock is more equitable than that of land, with the economically weaker 60% of rural households owning 65% of total milch animals, leading to a much more equitable distribution of gains from livestock production (Ahuja *et al*., 2000).

Significant market led opportunities have recently been opened up for the livestock sector as a result of globalisation and economic liberalisation policies initiated by the government of India in 1991. Livestock production is growing faster than any other agricultural sub-sector and by 2020, this sub-sector is predicted to produce more than half

of the total agricultural output in value terms in the country. Growth in demand for livestock products is primarily expected to emanate due to human population growth, increasing urbanization and rising income, since the demand for livestock products is income elastic (Bhalla and Hazell, 1997). These developments present enormous opportunities to boost rural income and accelerate the pace of poverty reduction through promoting livestock sub-sector. However, this requires a policy regime that facilitates sustainable growth in livestock productivity at the farm level as well as in the processing sector.

Effective and efficient delivery of animal health and production services is considered vital for gainful livestock development and hence, efficient delivery of livestock services has become a subject of rising concern to many national and international organisations including FAO (Kleeman, 1999). In India, by recognising the importance of livestock to the rural poor and their inability to avail the fully paid livestock services, the governments in centre and the States have been extending these services at a huge subsidy. This has been achieved with their vast veterinary institutional network built-up in the past five decades through many livestock sector promotion schemes to augment livestock production and productivity. Although public sector is believed to be the appropriate means of delivering livestock services, but the government generally could not perform it efficiently (Leonard, 1993). The steering group constituted by the government of India, observed that free veterinary and artificial insemination (AI) services have resulted in an infrastructure that is vast and expensive, and the governments find it extremely difficult to sustain (GOI, 1996). Growing fiscal pressures exacerbated by the huge subsidy and less adequate cost recovery for the services had left the governments to bring down their priorities and budget allotments towards improving the quality of public provision of livestock services. Initiative policy aimed at increased cost recovery, which could alleviate these financial difficulties, are often deferred by the policy makers on the assumption that the farmers would not be willing to pay for these services.

In the light of above context, this study was undertaken in southern peninsular state of India, Tamil Nadu, to address two questions, viz. (1) how much the farmers are willing to pay for receiving total annual health care for their dairy animals? and (2) what factors determine their WTP levels. The estimated users' WTP for the total annual health care services would provide clues for designing a "vet-claim" policy in line with "medi-claim" policy for humans (where the total cost of treatment is borne by the insuring agency), besides presenting an idea on the cost recovery measures or deciding whether the government should provide these services or not.

Materials and Methods

The districts of Tamil Nadu State were categorized as "Livestock developed" (LD) and "Livestock under developed" (LUD) based on initial base line data gathered using the value of livestock output, rural human population and common property resources available for livestock farming. Four districts, two from livestock "Developed" (Coimbatore and Villupuram districts) and two from "Under developed" (Thanjavur and Sivagangai districts) areas were selected randomly. From the selected districts, a total number of 320 farmers (80 from each district) were chosen by adopting multistage random sampling technique. Information on socio-economic status of the selected farmers, livestock possession, accessibility of veterinary services, costs incurred, true maximum WTP for total annual health care services for sheep and goats, etc. were collected by personal interview through the structured and pilot-tested interview schedule.

Contingent valuation (CV) approach was used to study the farmers' maximum WTP for two types of health care services to dairy animals: (a) providing health care services at government veterinary centres (in-centre) and (b) extending health care services at farmers' doorsteps (at farm gate). The farmers were presented with two scenarios for eliciting their WTP as narrated below:

Scene 1: There is an offer to provide annual health care services for your dairy animals at the Government Veterinary Centre. This

offer will include all expenses on medicines, service fee, etc. What is the maximum amount of money you would be willing to pay for this offer? (in Indian Rupee: INR)

Scene 2: There is an offer to provide annual health care services for your dairy animals at your farm gate. This offer will include all expenses on medicines, service fee, etc. What is the maximum amount of money you would be willing to pay for this offer? (in INR)

A payment card depicting charges ranging from INR 25 to INR 1500, with an equal interval of INR 25 were shown to the farmers to choose the amount that they were willing to pay for the offers described above. The payment card WTP data, pertain to total annual health care to dairy animals, were analysed as interval data on the assumption that the respondent's true maximum WTP is at least as high as the amount chosen on the payment card, but less than the next highest amount listed on the card. As interpreted by Morey *et al.* (1997), this analysis presumed that a farmer would not choose any amount that exceeds his true maximum WTP, and therefore, selects the highest amount mentioned on the card which is less than or equal to his maximum WTP.

The WTP values estimated in this study were for hypothetically providing total annual health care for dairy animals, viz. cows and buffaloes, either at the veterinary centre or at farmer's doorstep. The WTP was assumed to be a function of a respondent's attributes and a random component that caused the WTP value to vary across respondents, even if they possessed the same attributes. Maximum Likelihood Interval technique could be unambiguously more reliable if used on interval midpoints, as Cameron and Huppert (1989) opined that there could be some bias and that its sign would be indeterminate in ordinary least square (OLS). Therefore, the interval model maximizes the likelihood of an individual's WTP that lies between the amount chosen on the payment card, WTP_M, and the next larger amount, WTP_L. The probability that WTP_i lies between WTP_{M_i} and WTP_{L_i} is given by Morey *et al.* (1997) as below:

$$= \Phi\left(\frac{WTP_{L_i} - E(WTP_i)}{\sigma_i}\right) - \Phi\left(\frac{WTP_{M_i} - E(WTP_i)}{\sigma_i}\right)$$

$$\text{Prob}\left(WTP_{M_i} \leq WTP_i \leq WTP_{L_i}\right) = \text{Prob}\left(WTP_i < WTP_{L_i}\right) - \text{Prob}\left(WTP_i > WTP_{M_i}\right)$$

where Φ is the standard normal cumulative density function. Then the expectation of the individual's WTP, $E(WTP_i)$, is:

$$
\begin{aligned}
WTP_i &= E(WTP_i) + \xi_i \\
&= \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 \\
&\quad + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \xi_i
\end{aligned}
$$

Where,

X_1 : Sex of respondent (1 – if male; 0 – otherwise)

X_2 : Age of respondent (Years in numbers)

X_3 : Mean household education (0 – illiterate; 1 – primary; 2 – secondary; 3 – collegiate)

X_4 : Annual household income (in INR'000)

X_5 : Livelihood share of livestock (proportion of income from livestock to total income)

X_6 : Possession of crossbred/graded buffaloes (1 – if possessing; 0 – otherwise)

X_7 : No. of cows and buffaloes owned

X_8 : Milk price (INR per Litre)

X_9 : Quantity of milk sold (Litre per day)

X_{10} : Distance from the government veterinary centre (in terms of travel time in minutes)

X_{11} : District versatility (1 – if LD; 0 – otherwise)

ξ_i: is distributed normally with mean zero and standard deviation σ_i

Estimation of interval model of WTP

STATA 9.0 SE was used to find the values of the parameters that maximized the log of the likelihood function:

$$\text{Log L} = \sum \log\left\{\Phi\left(\frac{WTP_{L_i} - E(WTP_i)}{\sigma_i}\right) - \Phi\left(\frac{WTP_{M_i} - E(WTP_i)}{\sigma_i}\right)\right\}$$

Results

Factors weighing the WTP values for annual health care services to dairy animals

Results of interval regressions that studied the relationship between the explanatory variables and the stated true maximum WTP values are detailed in the section that follows.

Modelling WTP values for annual health care services in cows

a) In-centre services

The model fitted to explain the WTP values elicited for rendering in-centre annual health care services was well fitted, with the log likelihood being estimated to be -488.1513

(Table 1). Of the factors included in the model, five explanatory variables, viz. household education, annual household income, possession of crossbred cow (dummy), quantity of daily milk sold and district category were found to be significantly predisposing the stated WTP values, for in-centre annual health care services in cows. However, other explanatory variables included in the model, sex of the respondent, age of the respondent, livelihood share of livestock, number of cows and buffaloes owned, milk price and distance from the nearest public veterinary centre did not significantly affect the stated WTP values.

b) Farm gate services

In addition to variables that significantly influenced WTP values for in-centre services, the explanatory variable, distance from the nearest public veterinary centre had also significantly predisposed the value of true maximum WTP for farm gate annual health care services in cows (Table 1).

Mean WTP values for annual health care services in cows

The mean WTP values calculated using the interval regression model fitted are presented in Table 2. Overall mean WTP value for annual health care services extended was INR 202.34 for in-centre services, while it was INR 261.66 for home services. The mean stated WTP values for both in-centre and at home services in the LD districts were more (INR 232.62 and INR

Table 1: Factors determining willingness to pay for annual health care services for cows and buffaloes (results of interval regression)

Explanatory variables	Services at centre		Services at home	
	Cows	Buffaloes	Cows	Buffaloes
Sex of the respondent	0.9229	13.9085[**]	6.7562	11.8500[*]
	(6.6932)	(6.1784)	(6.8516)	(6.1713)
Age of the respondent	-0.3094	0.0742	-0.1705	0.1205
	(0.2775)	(0.2547)	(0.2840)	(0.2534)
Mean household education	14.1634[**]	4.4694	14.0550[**]	3.5479
	(5.4162)	(6.1421)	(5.5443)	(6.1507)
Annual household income (INR'000)	0.2833[**]	-0.0059	0.2611[**]	-0.1251
	(0.0538)	(0.1436)	(0.0551)	(0.1438)
Livelihood share of livestock	3.1544	-31.4414	8.8367	-35.1504
	(9.9533)	(23.2609)	(10.1884)	(23.2501)
Possession of crossbred cow/graded buffalo (dummy)	33.3465[**]	19.2132[*]	37.0119[**]	11.9833
	(8.1324)	(7.6092)	(8.3238)	(7.6108)
No. of cows and buffaloes owned	1.0895	-1.5102	1.2467	-1.4788
	(2.7809)	(2.3608)	(2.8465)	(2.3534)
Milk price (INR/litre)	-0.3309	-0.0681	-0.4310	1.4436
	(3.7069)	(3.1049)	(3.7945)	(3.1042)
Quantity of milk sold (litre/day)	7.7375[**]	4.8809[**]	7.1239[**]	5.2323[**]
	(0.7055)	(0.8535)	(0.7221)	(0.8531)
Distance from nearest public veterinary centre (travel time in min)	0.1283	-0.5000[**]	1.2884[**]	0.3902[*]
	(0.1681)	(0.1893)	(0.1721)	(0.1896)
District versatility	23.3172[**]	22.4895[**]	24.6125[**]	26.9129[**]
	(5.0377)	(5.5165)	(5.1566)	(5.5114)
Constant	45.5401	55.7569	55.4255	66.3716
	(32.0376)	(34.2781)	(32.7939)	(34.3231)
/lnsigma	3.6026[**]	2.6455[**]	3.6268[**]	2.6439[**]
	(0.0448)	(0.1153)	(0.0448)	(0.1156)
Sigma	36.6929	14.0907	37.5913	14.0682
	(1.6445)	(1.6252)	(1.6822)	(1.6261)
Number of observations	268	59	268	59
LR χ^2 (11)	335.81	121.99	347.92	134.33
Prob > χ^2	0.0000	0.0000	0.0000	0.0000
Log likelihood	-488.1513	-56.8649	-494.4117	-56.7963

[*]Significant (P ≤ 0.05); [**]Highly significant (P ≤ 0.01). Figures in parentheses indicate standard errors

293.15, respectively) as compared to LUD districts (INR 172.50 and INR 230.65, respectively).

Modelling WTP values for annual health care services in buffaloes

a) In-centre services

The interval regression model fitted to explain the variation in the stated true maximum WTP values for health care services to buffaloes extended at the centres exhibited a good fit with the log likelihood of -56.86 (Table 1). Of the factors fitted to explain the WTP values for in-centre services, sex of the respondent, possession of graded buffalo (dummy), quantity of daily milk sold, distance from the nearest public veterinary centre and district versatility were found to be significant.

It was found that the explanatory variables included in the fitted model, age of the respondent, mean household education, annual household income, livelihood share of livestock, number of cows and buffaloes owned and milk price had not exerted any significant effect on the stated WTP values for annual health care services in buffaloes.

b) Farm gate services

The results of interval regression analysis indicated that the sex of the respondent, quantity of daily milk sold, distance from the nearest public veterinary centre and district versatility had significantly predisposed the stated true maximum WTP values for annual health care services in buffaloes proposed to be rendered at farm gate (home). However, the breed dummy factor which was significant in the model fitted for in-centre services turned out to be insignificant for home services (Table 1).

Mean WTP values for annual health care services in buffaloes

Table 2 presents the mean WTP values

predicted from the interval regression model fitted. Overall mean WTP value for annual health care services in buffaloes was INR 135.78 for in-centre services and INR 186.20 for farm gate services. The mean stated WTP values for both in-centre and at home services in the LD districts were higher (INR 165.99 and INR 221.12, respectively) as compared to LUD districts (INR 106.57 and INR 152.45, respectively).

Discussion

Factors weighing the WTP values for annual health care services to dairy animals

Results of interval regressions that studied the relationship between the explanatory variables and the stated true maximum WTP values are discussed in the section that follows.

Modelling WTP values for annual health care services in cows

a) In-centre services

The results of the interval regression model indicated that as mean household education increased by one level, the true maximum WTP also increased by INR 14.16, which could be attributed to the fact that the education of family members would increase the awareness of the animals health. Similarly, significant positive coefficient of annual household income exhibited that a thousand rupees increase in annual income would positively increase the WTP values by INR 0.28. Farmers possessing crossbred cows in their herd were willing to pay INR 33.35 more than those who had no crossbred cows, which could be due to the fact that the crossbred animals were more prone for ailments than desi animals. Likewise, every additional litre increase in the quantity of daily milk sold would increase the stated WTP value by INR

Table 2: Mean WTP values for annual health care for cows and buffaloes

District	In-centre services		At home services	
	Cows	Buffaloes	Cows	Buffaloes
LUD districts	172.50 (3.22)	106.57 (2.89)	230.65 (3.29)	152.45 (2.89)
LD districts	232.62 (3.24)	165.99 (2.93)	293.15 (3.32)	221.12 (2.93)
Overall	202.34 (2.28)	135.78 (2.06)	261.66 (2.34)	186.20 (2.06)

Figures in parentheses indicate standard errors

7.74. This could be due to the reason that the farmers who sold more quantum of milk had more cash to disperse. More importantly, farmers in the LD districts were willing to pay an additional amount of INR 23.32 as compared to the farmers in LUD districts.

b) Farm gate services

The results of the farm gate services interval regression analysis explained that an increase in the level of mean education of household adults' would enhance the stated true maximum WTP by INR 14.06 for farm gate annual health care services in cows. Similarly, for every thousand rupees increase in annual household income, there would be an increase of INR 0.26 in the stated true maximum WTP value. Farmers who owned crossbred cows were willing to pay INR 37.01 more than those who did not own, which shows that the farmers attached importance to the crossbred cows. As the average quantity of daily milk sold increased by a litre, the stated WTP value increased by INR 7.12, which could be due to the reasons stated earlier. Distance from the nearest public veterinary (measured in terms of travel time to reach the centre) had a highly significant ($P \leq 0.01$) and positive influence on the true WTP value. WTP value would increase by INR 1.29 for every additional minute travel, to avail annual health care services extended at farm gate. The regression results also exhibited that the farmers of the LD districts had a higher inclination than the farmers of the LUD districts towards contract annual health care services extended at home.

Mean WTP values for annual health care services in cows

The mean stated WTP values for both in-centre and at home services in the LD districts were more as compared to LUD districts. The higher amount in the LD districts could be attributed to the increased crossbred cattle wealth along with improved milk marketing facilities available in this area.

Modelling WTP values for annual health care services in buffaloes

a) In-centre services

The study revealed that the male respondent preferred to pay INR 13.91 more over the female counterpart for annual health care to buffaloes. The sex of the respondent played a part in case of buffaloes and not in cows. As the buffaloes are hardy, it is difficult to bring them to service centres and it takes a long time for the respondents to drive the animal forth and back. Hence, the male owners whose wage rate/earning is more vis-à-vis their counterparts preferred to pay additionally as a measure of comparative advantage. The farmers who possessed graded buffaloes had an inclination to pay INR 19.21 more as compared to those not possessing, which could be attributed to the reason that they are high yielders. Similarly, a litre increase in the quantity of daily milk sold would increase the stated WTP value by INR 4.88. The reason could be that the increased milk sales had left the farmer with more cash on-hand. Interestingly, the farmer whose locality was away from the public veterinary centre, was willing to pay less than those who were placed nearer to the centre. That is, an every additional minute travel time required to reach the centre would decrease the stated true WTP amount by INR 0.50. Obviously, as this offer was proposed for in-centre services, the distance would be an inhibiting factor to state a higher WTP value. Further, the farmers of the LD districts were willing to pay INR 22.49 more than that of the farmers in LUD districts, which could be attributed to the improved livestock related activities in the area.

b) Farm gate services

The interval regression analysis indicated that the sex of the respondent, with its significantly positive coefficient, represented that the males were willing to pay INR 11.85 more than females. As ascertained by Manivannan (1997), increased awareness of males on the cost of treatments could be attributed to the above result. The results of analysis also expressed that a litre increase in the quantity of daily milk sold would boost the stated WTP value by INR 5.23, which could be due to the fact that more quantity of milk sold would leave the farmers with sufficient liquid cash. In contrast to the in-centre services, the distance from the nearest public veterinary centre had a significant and positive influence on the stated WTP value

for farm gate services. That is, a minute increase in the travel time required to reach the public veterinary centres would add INR 0.39 in the stated WTP value. Compared to the farmers in the LUD districts, farmers of the LD districts were willing to pay INR 26.91 more for availing annual health care services at farm gate for their buffaloes.

Mean WTP values for annual health care services in buffaloes

Overall mean WTP value for annual health care services in buffaloes was more for farm gate services vis-à-vis for in-centre services. Parallel to cows, in buffaloes also the mean stated WTP values for both in-centre and at home services in the LD districts were higher as compared to LUD districts. The higher amount in the LD districts could be attributed to the improved milk marketing facilities available in this area, which left the farmers with more hard cash.

Currently, the public veterinary centres are providing animal health care services at free of cost, while levying a fixed INR 15.00 for every AI, irrespective of semen of breed. However, growing fiscal deficits have forced the governments to reorganize their policies and priorities, as initiatives aimed at increased cost recovery for AI and partial recovery for health care could alleviate these financial difficulties substantially. When the services are rendered privately, the costs of these services are on visit basis but not on case or annual basis as proposed in this study. Nevertheless, this study also leaves a scope for ascertaining the level of willingness to accept (WTA) on the part of private practitioners.

The results of the study indicated that the farmers in the LD districts were willing to pay more vis-à-vis their counterparts in the LUD districts, leaving a scope for increased cost recovery. These WTP estimates exhibited the scope of cost recovery measure that can be implemented in lieu of free services extended currently, besides presenting a clue for designing a "vet-claim" policy in line with "medi-claim" policy for humans. Similarly, the amount that the farmers were willingness to pay for availing

annual health care services for cows was more than buffaloes, which could be due to the reason that the buffaloes are hardy and face minimal threat from diseases, as compared to cows.

References

Ahuja, V; George, PS; Ray, S; McConnell, KE; Kurup, MPG; Gandhi, V; Umali, D and Haan, CDe (2000). *Agricultural services and the poor: case of livestock health and breeding services in India*. IIM Ahmedabad, The World Bank, Washington, DC and Swiss Agency for Development and Cooperation, Bern. PP: 1-148.

Bhalla, GS and Hazell, P (1997). Food grains demand in India to 2020: a preliminary exercise. Econ. Polit. Weekly. 32: A150-A154.

Cameron, TA and Huppert, DD (1989). OLS versus ML estimation of non-market resource values with payment card interval data. J. Environ. Econ. Manag., 17: 230-246.

GOI (1996). National livestock policy perspective: report of the steering group. Ministry of Agriculture, Government of India, New Delhi.

Kleeman, G (1999). Responses of the livestock services delivery and its management to the Asian economic crisis. *Proceedings of the workshop on the implications of the Asian economic crisis for the livestock industry*. Held in Bangkok on 6–9 July 1999. Organised by FAO, UN.

Leonard, DK (1993). Structural reform of the veterinary profession in Africa and the new institutional economics. Dev. Change. 24: 227-267.

Manivannan, C (1997). Communication behaviour of link workers of Pudukkottai Livestock Development project. Unpublished MVSc thesis submitted to the Tamil Nadu Veterinary and Animal Sciences University, Chennai, 600 051.

Morey, E; Rossmann, K; Chestnut, L and Ragland, S (1997). Valuing acid deposition injuries to cultural resources. On-line Discussion Papers, Prepared for: National Acid Precipitation Assessment Program, Washington DC. http://www.colorado.edu/Economics/morey/monument/index.html

Ravishankar, A and Birthal, SP (1999). The livestock sector in India: a country report with special emphasis on trade with southeast Asian economies. *Proceedings of the workshop on the implications of the Asian economic crisis for the livestock industry*. Held in Bangkok on 6-9 July 1999. PP: 213-232.