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Willingness To Pay for Bovine Breeding Services: The Case of Rural India

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Abstract: A study was undertaken in Tamil Nadu State of India to assess the farmers' 'Willingness To Pay' (WTP) for bovine breeding services. 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 breeding services: (a) providing animal breeding services at government veterinary centres, (b) extending animal breeding services at farmers' door steps. A Payment Card (PC) format was used to assess the farmers' maximum WTP for making a cow or buffalo pregnant through Artificial Insemination. The Maximum Likelihood Interval technique was used on interval midpoints. The farmers were willing to pay a maximum of INR.116.39 and INR 139.29 for effecting pregnancy in their cows and buffaloes, respectively, by availing in-centre services, while they were ready to offer INR 190.83 and INR 214.29 for the breeding services delivered at doorsteps. The mean maximum WTP value was found to be more for buffaloes than cows, postulated both in-centre and home services. A significant difference in the WTP values was also noted between LD and LUD districts. Of the factors incorporated in the in-centre service model for cow, district versatility, annual income of farmers, average household education, breed dummy and daily milk production were found to significantly influence the WTP values. Unlike cows, herd size and distance to the centre had a significant role in determining WTP values in buffaloes. WTP values in cows were found to significantly predispose by district versatility, breed dummy, daily milk production and the distance to government veterinary centre for home service. However, in case of buffaloes, these values had a significant influence from district versatility, household income, herd size and daily milk production. The results indicated that the people were willing to pay more for getting their animals conceived at the earliest and this amount was more than what the government charges currently as insemination charges.

Key words: WTP, payment card, bovine breeding services, livestock services, contingent valuation

INTRODUCTION

Livestock play an important role in the economies of the most of the developing countries and especially in India, it forms significant source of supplementary income for over 65 per cent of rural households. Small farmers and landless households, including women rear most of the livestock in Asia, especially in India[1,2]. However, productivity levels of livestock tend to be lower than the production potential which could be achieved.

The relatively higher livestock wealth in this region provides greater opportunities to boost rural income and accelerate the pace of poverty alleviation process. Yet, successful capitalization of these opportunities requires a policy regime that could facilitate growth in productivity at the farm level[3].

Availability of and accessibility to better quality livestock services could play a pivotal role in increasing the productivity of livestock sector. Recognising the importance of livestock to the rural poor and inability to avail the fully paid livestock services, the Government of India and the Governments in the States have been extending these services at a huge subsidy with their vast veterinary institutional network built-up in the past five decades through many special livestock sector promotion schemes to augment livestock production and productivity.

Although the public sector is believed to be the appropriate means of supplying livestock services, the governments could not perform with the efficiency it should have in practice. Some now even argue that it could be better to privatise these 'public services'[4]. The advocacy for privatization has, however, been tempered by the recognition that in many situations livestock services require some form of public management. The availability and quality of these livestock services are therefore unlikely to improve, unless public sector performance is strengthened[5]. Growing fiscal pressures exacerbated by huge subsidy and less than 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. Policy initiatives aimed at increased cost recovery, which could alleviate these financial difficulties, however, are often deferred by the policy makers due to political reasons on the assumption that the farmers would not be willing to pay for these services. It is in the light of this background, a study was undertaken in southern peninsular State of India, Tamil Nadu, to assess the farmers' 'Willingness To Pay' (WTP) for bovine breeding services, an integral component of livestock services. This study basically addresses two questions, viz., 1) How much the farmers are WTP for getting an animal (cow/buffalo) pregnant and 2) What factors determine their WTP level.

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. Two districts, one each from livestock 'Developed' (Coimbatore district) and 'Under Developed' (Thanjavur district) areas were selected randomly. From the districts so selected, a total number of 160 farmers (80 from each district) was chosen by adopting multistage random sampling technique. Information on socio-economic status of the selected farmers, livestock possession, accessibility and use of animal breeding services, costs incurred, maximum WTP for bovine breeding, 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 breeding services: (a) providing animal breeding services at government veterinary centres (in-centre), (b) extending animal breeding services at farmers' door steps (at farm gate). The farmers were posed with two scenerios for eliciting their WTP as narrated below:

- There is an offer to make your animal conceived by providing services at the government veterinary centre. The good will bear all expenses on semen straw, medicine, pregnancy diagnosis, service fee, etc. What is the maximum amount of money that you would be willing to pay to get your animal pregnant through this offer?
- There is an offer to make your animal conceived by providing the services at your farm gate. The offer will bear all expenses on semen straw, medicine, pregnancy diagnosis, service fee, etc. What is the maximum amount of money that you would be willing to pay to get your animal pregnant?

A Payment Card (PC) format was used to assess the farmers' maximum WTP by showing them a card with several Rupees amounts starting from INR 25 (with INR 25 as interval) on it and asking him/her to encircle the highest amount on the card that he/she could be willing to pay for making a cow or buffalo pregnant through Artificial Insemination[6,7].

Modelling WTP values: Encircled amount in the payment card was used to construct the WTP interval for each respondent. The payment card WTP data were analysed as interval data on the assumption that the respondent's true maximum WTP is atleast 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.*[8], this analysis presumed that a farmer would not chose any amount that exceeds his true maximum WTP and therefore circles the highest amount mentioned on the card that is less than or equal to his maximum WTP. This means, for example, an individual's response is in the X to Z interval if he circled X, where Z is the next larger amount on the PC, his WTP is taken as Y. So, if a farmer circled INR 50, then his WTP is assumed to be between INR 50 and INR 75.

The WTP values estimated in this study are only for making a cow/buffalo pregnant by extending the breeding services either at the veterinary centre or at farmer's doorstep. The WTP is assumed to be a function of a respondent's attributes and a random component that causes the WTP value to vary across respondents, even if they possess same attributes. Hence Cameron and Huppert[9] suggested that there could be some bias and that its sign will be indeterminate in Ordinary Least Squares (OLS), while the Maximum Likelihood Interval technique could be unambiguously more reliable if used on interval midpoints. Kolmogorov-Smirnov test also confirmed the PC estimation model used in this study that assumed the normal distribution in its random component. Therefore, the interval model maximizes the likelihood such an individual's WTP_i lies between the amount chosen on the PC, WTP_{Mi} and the next larger amount, WTP_{Li}. The probability that WTP_i lies between WTP_{Mi} and WTP_{Li} is given by Morey *et al.*[8] as below:

$$Prob(WTP_{Mi} = WTP_i = WTP_{Li}) = Prob(WTP_i < WTP_{Li}) - Prob(WTP_i < WTP_{Mi})$$

$$= \Phi \frac{[WTP_L = (WTP_i)]}{\sigma} - \Phi \frac{[WTP_{Mi} - E(WTP_i)]}{\sigma_i}$$

where Φ is the standard normal Cumulative Density Function. Then the expectation of the individual's WTP, $E(WTP_i)$, is:

$$(WTP_i) = E(WTP_i) + \xi_i$$

$$= \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_{9+} \beta_{10} X_{10} + e_i$$

Where,

X_1: District versatility (1 - if LD district; 0 - LUD district)
X_2: Annual income (in INR '000)
X_3: Livelihood importance of livestock (as share of income from livestock)
X_4: Average household education level
X_5: Age of respondent (in years)
X_6: Total number of cows/buffaloes reared by the respondent
X_7: Breed dummy (1 - if crossbred cow/graded buffalo; 0 - otherwise)
X_8: Total daily household milk production (litres)
X_9: Milk price (INR per litre)
X_{10}: Distance from the government veterinary centre (in terms of travel time in minutes)

e_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:

$$LogL = \Sigma \log \{\Phi \frac{[WTP_{Li} - E(WTP_i)]}{\sigma} - \Phi \frac{[WTP_{Mi} - E(WTP_i)]}{\sigma_i}\}$$

RESULTS AND DISCUSSION

In all, 135 farmers owning cows and 28 owning buffaloes were studied. Surprisingly, all of them were willing to enter into such an agreement to get their animal conceived.

Table 1 summarises the average maximum WTP (in INR) elicited by the farmers in both LD and LUD districts for achieving conception in their bovines. The sample farmers in the study area were willing to pay a maximum of INR.116.39 and INR 139.29 for effecting pregnancy in their cows and buffaloes, respectively, by availing in-centre services, while they were ready to offer INR 190.83 and INR 214.29 for the breeding services delivered at doorsteps. In this context, it is appropriate to note the findings of Thirunavukkarasu[11] where he assessed the average number of Artificial Insemination (AI) services required for making a cow and buffalo conceived as 2.90 and 3.92, respectively in Tamil Nadu. This leads to indicate that the government is charging INR 43.50 and INR 58.80 for achieving conception in a cow and buffalo, respectively, after extending a huge subsidy at current rates (i.e. INR 15 per AI) for the in-centre services.

The mean maximum WTP value was found to be more for buffaloes than cows, postulated both in-centre and home services (Table 1). The WTP for making a buffalo pregnant by extending services at farm gate was as high as INR.247.50 in LD district. These high values for buffaloes could be attributed to the difficulties the farmers face in driving this species to the veterinary centres and the obvious poor breeding efficiency of buffaloes, which inturn warrants more number of AIs per conception as compared to cows[10].

There was a highly significant difference in the WTP values elicited per conception of farm animals between LD and LUD districts (as indicated by 't' values). This could probably due to the well developed milk marketing infrastructure that encouraged the farmers to rear good quality stock available in developed districts. A marked difference of around INR 84 and INR 65 in the WTP per conception of a cow between the in-centre and farm gate services could be observed at LD and LUD districts, respectively, with the differences in case of buffalo breeding being around INR 90 and INR 58. The higher WTP values for home services could be due to labour scarcity for farm works and relatively higher wage rates. Determinants of WTP values for the government veterinary centre services

Factors influencing the WTP values per conception through the services proposed at government veterinary centres and those at farm gate were analysed using maximum likelihood method. Table-2 presents the influence of the factors included in the model on the maximum WTP values of farmers for getting their cow/buffalo conceived through in-centre services. Of the factors incorporated in the model for cow, district versatility, annual income of farmers, average household education, breed dummy and total daily household milk production were found to significantly influence the WTP values. The farmers in LD district had inclined to pay INR 8.48 unlike the farmers in LUD district, for every conception of their cow, which could be due to their prosperity in terms of breedable stock and other material wealth. Besides, the higher charges levied for private

Table 1: Mean WTP values per conception of an animal (in INR)

	Cow		Buffalo	
District	Service at veterinary centre	Service at home	Service at veterinary centre	Service at home
Developed	131.16	215.11	157.50	247.50
	(3.85)	(7.71)	(10.97)	(12.86)
Under developed	101.84	166.91	118.27	175.96
	(3.75)	(5.54)	(7.57)	(10.44)
Overall	116.39	190.83	139.29	214.29
	(2.96)	(5.16)	(7.71)	(10.75)
't' value	5.457**	5.089**	2.855**	4.231**

Figures in Parentheses indicate Standard Errors
** Significant ($p \leq 0.01$)

Table 2: Factors affecting WTP values per conception (by serving in-centre)

	Cow		Buffalo	
Factors	Coefficients	'z' value	Coefficients	'z' value
Log likelihood	-590.1034	-114.4883		
District versatility	8.48 (4.22)	2.01*	33.88 (11.12)	3.05**
Annual income	0.11 (0.03)	3.53**	0.64 (0.27)	2.40*
Livelihood importance of livestock	-5.66 (5.79)	-0.98	51.07 (42.22)	1.21
Average household education	7.97 (3.67)	2.17*	4.74 (12.31)	0.38
Age of respondent	-0.05 (0.18)	-0.26	-0.56 (0.55)	-1.01
No. of cows/buffaloes	0.37 (2.28)	0.16	-17.12 (7.80)	-2.19*
Breed dummy	19.47 (6.17)	3.15**	-2.40 (25.08)	-0.10
Daily household milk production	4.09 (0.60)	6.84**	4.91 (2.08)	2.36*
Milk price per litre	-0.88 (2.78)	-0.32	-1.70 (12.44)	-0.14
Distance from the govt. vet. centre	0.10 (0.13)	0.75	-1.30 (0.39)	-3.33**
Constant	39.71 (23.84)	1.67	138.65 (122.01)	1.14

Figures in Parentheses indicate Standard Errors
** Significant ($p \leq 0.01$) and * Significant ($p \leq 0.05$)

Table 3: Factors affecting WTP values per conception (by serving at farm gate)

Factors	Cow		Buffalo	
	Coefficients	'z' value	Coefficients	'z' value
Log likelihood	-672.8368		-116.8209	
District versatility	18.04 (7.79)	2.31*	54.11 (12.09)	4.48**
Annual income	0.06 (0.06)	0.98	0.60 (0.29)	2.06*
Livelihood importance of livestock	-1.54 (10.69)	-0.14	60.08 (45.90)	1.31
Average household education	6.19 (6.77)	0.92	4.67 (13.38)	0.35
Age of respondent	-0.22 (0.34)	-0.66	-1.16 (0.60)	-1.93
No. of cows/buffaloes	-1.86 (4.20)	-0.44	-17.98 (8.48)	-2.12*
Breed dummy	29.57 (11.40)	2.59**	-8.98 (27.26)	-0.33
Daily household milk production	4.90 (1.10)	4.44**	6.72 (2.26)	2.97**
Milk price per litre	5.71 (5.13)	1.11	7.93 (13.52)	0.59
Distance from the govt. vet. centre	2.11 (0.24)	8.70**	-0.09 (0.42)	-0.22
Constant	-13.96 (44.00)	-0.32	83.51 (132.62)	0.63

Figures in Parentheses indicate Standard Errors
** Significant ($p \leq 0.01$) and * Significant ($p \leq 0.05$)

veterinary services in LD district could have made them to opt for high WTP values. Similarly, as household education level shifted upwards, the WTP value was found to increase at the rate of INR 7.97. This result implies the fact that education makes the people to understand current market trends and importance of livestock. Crossbred cows added INR 19.47 over desi or non-descript cows to the WTP. It is imperative to note that the total daily household milk production had a significant positive influence on the WTP and it enhanced INR 4.09 per litre increase. The higher WTP value in case of crossbred cows might due to the economic importance attached towards these animals, as losses arising due to conception failures are nothing less than huge and the possible increased daily milk production ensuring them to pay more for animal breeding services.

Willingness to pay values for breeding buffaloes, at government veterinary centre were too significantly determined by district versatility, annual family income, number buffaloes reared, daily milk production and geographical proximity to government veterinary centre. Unlike cows, herd size and distance to the centre had a

significant role in determining WTP values in buffaloes. The farmers declined to pay INR 17.12 for every buffalo added to the herd. Similarly, every minute increase in travel time to the veterinary centre was found to bring down the WTP to INR 3.33, a sequel to the strenuous efforts required to take the animals to the centres.

Determinants of WTP values for the farm gate services: The results of the maximum likelihood analysis for the model fitted to evaluate the factors determining the WTP values per conception of cow/buffalo by the services provided at farm gate are furnished in Table 3. The willingness to pay values in cow were found to significantly predispose by district versatility, breed dummy, daily household milk production and the distance to government veterinary centre. However, in case of buffaloes, these values had a significant influence from district versatility, household income, herd size and daily milk production.

The farmers in the LD district would prefer to pay more to the tune of INR 18.04 for cow and INR 54.11 for buffalo per every successful conception, than LUD district. Well established milk marketing network and upgraded breedable stock in the LD district favoured them to pay more than the farmers in LUD district could do. A unit increase in the daily milk production of households could boost the WTP values in cow and buffalo to the tune of INR 4.90 and INR 6.72, respectively as a result of affluent and regular flow of cash in hand. The economic significance of the crossbreds in terms of production and the huge loss that might arise due to conception failures in these high productive stocks led the respondents owning crossbred cows to pay INR 29.57 more in relation to those possessing only desi or non-descript cows. However, possession of graded buffaloes had no significant effect on the WTP values. Yet, the buffalo herd size had a significant negative influence on the willingness to pay values, while no such influence was observed in case of cows. Addition of a buffalo to the herd could decrease the WTP values to INR 17.98. The WTP for home services in case of cows attracted INR 2.11 as the travel time to reach the government veterinary centre increased by a minute. However, factors such as livelihood importance of livestock, age of respondent and milk price had significantly influenced WTP values neither for in-centre services nor for farm gate services.

CONCLUSION

The results of the study indicate that the people were willing to pay more for getting their animals conceived at the earliest and this amount was more than what the government charges now as insemination charges. The WTP values of the farmers in LD district were high compared to LUD district. Similarly, buffaloes attracted a high WTP value over cows and among cows, crossbreds increased WTP values than non-descript or desi cows did.

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