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Delivery of livestock healthcare services and scope for its improvement: Evidence from Uttar Pradesh, India

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ABSTRACT

The study ascertained the use pattern of animal healthcare services (AHS) by the livestock farmers and to assess the impact of potential reforms in animal health delivery system (AHDS) in Uttar Pradesh, the largest state in India. A total of 1,037 households from all the 9 agro-climatic regions of the state were surveyed. Households were categorized in to poor (48%), medium (36.5%) and rich (15%) wealth categories to assess equity implications of potential reforms in AHDS. Analysis of use pattern of AHS revealed that quacks were the predominant AHS providers, followed by para-veterinarians and government veterinary officers (GVO's). Out of the total sample visits made by GVO's and para-vets, 58% and 66%, respectively, were attended at-home. The number of at-home visits by GVO's per household increased with increase in wealth status. Richer households paid significantly higher prices per visit to AHS providers as compared to poor households. Even then, the average price paid by the poor households were substantially high. Contingent valuation method used to elicit farmers' willingness to pay for animal healthcare services revealed that the amount they are willing to pay increased with increase in wealth status. Analysis of factors influencing farmers' WTP revealed that lower wealth status and distance to market negatively influences the farmers' likelihood of willing to pay a higher amount. On the other hand, household head education, easy credit availability and scale of milk production positively influenced the probability that a farmer will be willing to pay a higher amount.

Key words: Animal health delivery system, Livestock disease, Reforms in service delivery, Willingness to pay

The demand-driven growth in the livestock sector is bound to increase demand for services to this sector substantially. One of the crucial components of livestock services is animal healthcare services (AHS). AHS assumes critical importance in India in the context of significant economic losses due to various livestock diseases. As per recent estimates, value of annual economic losses in India due to Footh and Mouth Disease (FMD) is between US$ 1832–2137 million (Singh *et al.* 2013); between US$ 653 million and US$ 669 due to *Peste-des-petits* ruminants (PPR) the loss is (Bardhan *et al.* 2017) and US$ 3400 million due to brucellosis the (Singh *et al.* 2015). A vibrant animal healthcare delivery system (AHDS) is crucial as it plays a vital role in sustaining the productivity and viability of the livestock sector. At present, India has one of the largest animal health infrastructure in the world. This vast AHDS network however, cannot be equated with high quality of animal health supplies. It is now being advocated that new models of delivery of AHDS should be explored as a means of overcoming the inherent problems associated with the state AHDS and of improving the overall efficiency. However, any policy orientation towards AHS reforms needs to be supported by quantitative data from field level which evaluate and quantify the potential benefits of the proposed reforms. There is also a need of having a much deeper understanding of the behaviour and decision-making processes of the poor in animal healthcare management to guide policy decisions regarding the delivery of AHS. In this context, the present study was conducted to examine the nature and pattern of demand for preventive and curative AHS, and the factors that influence farmers' willingness to pay for AHS.

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MATERIALS AND METHODS

Study area: The study was carried out in Uttar Pradesh, which has the highest livestock population in the country, accounting for 13.42% of the total livestock population (GoI 2012). The state also accounts for highest share of total number of large ruminant owning rural households in the country (12.31% and 30.55%, respectively for cattle and buffalo), implying strong dependence on livestock in rural areas (GoI 2012). The state has robust infrastructure pertaining to animal healthcare delivery system with the

Table 1. Districts/Blocks/Villages surveyed

Agro-climatic region	District	Blocks	Villages	No. of HH's
Mid-western plains	Aligarh	Tappal	Budhka	30
			Atari	30
		Kher	Veroula	30
			Manpur	29
North-eastern plains	Gorakhpur	Brahampur	Lakshmanpur	30
			Amriha	30
		Sardar Nagar	Totouli	30
			Sareya	30
Bundelkhand	Jalaoun	Madhavgar	Mighni	25
			Bhagvanpur	26
		Konch	Tharpur	29
			Jakholi	25
Central Western Semi Arid plains	Bareilly	Bhojipura	Makrandapur	25
			Mirpur Baki	30
		Faridpur	Naugaon	30
			Gotiya	27
Tarai	Pilibhit	Bisalpur	Chausra	30
			Arjunpur	30
		Puranpur	Pipariya Dulai	30
			Muzzaffarnagar	30
Western plains	Bulandshahr	Syana	Chanpur Kutthi	30
			Bara Firozepur	30
		Khurja	Bigheypur	30
			Firozepur	30
Central plains	Hardoi	Malawa	Isharpur Sai	29
			Barhua	26
		Sahabad	Bilahari	22
			Udharpur	30
Vindhyan	Mirzapur	Sikhad	Tammanpati	30
			Khanpur	30
		Naraynpur	Belwari	29
			Dayalpu	30
Eastern plains	Azamgarh	Mehnagar	Gahni	30
			Rashulpur	25
		Lalgunj	Gogai	30
			Sofirpur	30

highest share (8.29%) of India's veterinary hospitals/ polyclinics/dispensaries/aid centres located in the state (GoI 2014).

Sampling: A combination of purposive and multi-stage random sampling design was adopted to select the sample households. Uttar Pradesh has 9 agro-climatic regions. All the 9 regions were covered in the study. One district each from every region was selected, randomly. Thus, a total of 9 districts were surveyed. Two blocks from each district and two villages from each block were then selected, randomly. A maximum of 30 livestock rearing households from each village were then selected, randomly. The sample comprised of 1,037 livestock rearing households as the ultimate sampling units. Table 1 presents the distribution of sample households across different blocks, districts and agro-climatic regions. Primary data were collected by personally interviewing the head of the household with the help of a well-structured and pre-tested schedule.

For the purpose of comparison across wealth categories, the sample households were classified into different categories based on the ranking by an index of assets as given by Ahuja *et al.* (2003) (Annexure 1). Table 2 elicits the distribution of sample households across different wealth categories, viz. poor, medium and rich.

Table 2. Distribution of sample households into different wealth categories

Wealth category	% of Households
Poor	48.25
Medium	36.50
Rich	15.24
Total	100

Estimation of willingness to pay (WTP)

To elicit farmers' WTP, a contingent valuation method (CVM) was adopted in this study (Kumar *et al.* 2011). The contingent valuation scenario that was presented to the farmers are as follows:

Scenario 1: Government is initiating a new scheme for

delivery of livestock healthcare services and is giving an offer for providing annual AHS at farmers' doorsteps. Those who accept the offer will be assured of guaranteed service at their home whenever they need it, for a year. How much would you pay for the offer?

Scenario 2: Government is initiating a new scheme for provision of livestock healthcare services at the government veterinary centres. Those who accept the offer will be assured of guaranteed service at these centres. This offer, once accepted, will be valid for a year. How much would you pay for the offer?

Before actually conducting the survey and presenting the CVM scenarios to sample respondents, focused group discussion was held at each region to ascertain the amount the farmers are WTP in that particular region. The final bid prices that were presented to individual respondents were based upon the results of the focused group discussions.

Identifying factors influencing farmers' WTP for quality AHS

Cumulative square root of frequency method was used to classify the respondents who elicited their WTP in to three categories, viz. low WTP, medium WTP and high WTP categories. Farmers who were not WTP constituted the fourth category. A multinomial logit model was adopted to focus on probability that a particular household will belong to one of the above four WTP categories. The non-WTP category was considered as the reference category.

Given the alternatives before a respondent, the probability that an individual i chooses alternative j can be expressed by

$$Pr[Yi=j] = \exp(\beta^1 jXi) / \Sigma \exp(\beta^1 jXj) \quad \ldots(1)$$

where, Pr[Yi=j] = Probability of not willing to pay, belonging to low WTP category, belonging to medium WTP category and belonging to high WTP category; j = 0, 1, 2, 3 i = 1, 2, 3, ….. , 1304; X_i = vector of the predictor variables; and β_j = vector of the estimated parameters.

The e^{β} were calculated, which gave the odds ratio (OR) associated with change in the independent variable.

RESULTS AND DISCUSSION

AHS providers accessed during last 12 months: The AHS providers in the study area, whose services were accessed by the respondent households, were private practitioners (Quacks), para-veterinarians, government veterinary officers (GVOs), community based animal health workers (CBAHW's), NGO veterinarian, private veterinary doctors and cooperative doctors (Table 3). Across all wealth categories, the highest proportion of respondents utilized the services of private practitioners, who practically have no formal training in veterinary healthcare. Private practitioner was followed next by para-veterinarians (who are Government employees attached to Government Veterinary hospitals with formal training on basic animal healthcare), in terms of proportion of households accessing their services. As compared to private practitioners and para-veterinarians, substantially lower proportion of respondents reported that they availed the services of GVOs, who are professionally qualified doctors with formal training in providing all kinds of animal health services. The proportion of households accessing the services of GVOs increased with increase in wealth status. State AHS are heavily subsidized based on the assumption that the poor are neither able nor willing to pay for AHS. However, the above findings clearly indicate that the subsidized nature of AHDS is not adequately serving its purpose as there are clear indications that these subsidies are benefitting the richer sections of the rural society than the poorer ones. These findings are in consonance with those of Bardhan *et al*. (2015).

Attribute-wise rating of different AHS providers: The respondents' ratings of different AHS providers on different attributes on a three-point continuum (1=low; 3=high) are presented in Table 4. No significant differences were observed in the mean ratings given to different attributes

Table 3. Percentage of respondents reporting accessing services of different LHS providers in last 12 months

LHS providers	At-home services				In-centre services				Pooled (At-home + In-centre)			
	Poor	Medium	Rich	Pooled	Poor	Medium	Rich	Pooled	Poor	Medium	Rich	Pooled
Govt. veterinary officer	5.74	10.24	16.66	9.76	3.44	3.61	1.11	3.02	9.18	13.85	17.77	12.78
Para-vet	14.94	12.04	10.00	12.79	4.59	4.81	14.44	6.74	19.53	16.85	24.44	19.53
Private veterinary doctor	0.57	0.00	1.11	0.46	–	–	–	–	0.57	–	1.11	0.46
CBAHWs	5.74	6.62	1.11	5.11	–	–	–	–	5.74	6.62	1.11	5.11
NGO veterinarian	10.91	12.04	13.33	11.85	–	–	–	–	10.91	12.04	13.33	11.85
Private practitioner (Quack)	51.22	47.64	37.80	47.03	–	–	–	–	51.22	47.64	37.80	47.03
Cooperative doctor	1.14	0.60	1.11	0.93	–	–	–	–	1.14	0.60	1.11	0.93
GVO + Para-vet	–	0.60	1.11	0.46	–	0.60	–	–	-	1.20	1.11	0.46
GVO + NGO Vet.	0.57	0.60	–	0.46	–	–	–	–	0.57	0.60	-	0.46
GVO + Quack	0.57	–	1.11	0.46	–	–	–	–	0.57	0.00	1.11	0.46
Para-vet + Quack	0.57	0.60	1.11	0.69	–	–	–	–	0.57	0.60	1.11	0.69
Total	91.97	90.98	84.45	90.01	8.03	9.02	15.55	9.98	100	100	100	100

Table 4. Respondents' ratings of different AHS providers on different attributes of LHS provision

LHS providers	Poor			Medium			Rich		
	Affordability	Quality	Proximity	Affordability	Quality	Proximity	Affordability	Quality	Proximity
Government veterinary officer	2.29	2.23	1.05	2.21	2.04	1.08	2.21	2.07	1.00
Para-vet	2.20	2.00	1.00	2.14	2.00	1.00	2.18	2.06	1.00
Private veterinary doctor	2.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Private practitioner (Quack)	2.29	2.04	1.02	2.20	2.03	1.06	2.50	2.08	1.05
CBAHWs	2.40	2.00	1.00	2.18	2.00	1.00	2.00	1.00	1.00
NGO	2.61	2.11	1.00	2.50	2.10	1.00	2.03	2.23	1.00

Respondents' ratings on a scale of 1-3, viz. 1, Low; 3, High.

Table 5. Average prices paid by users of LHS to different service providers per visit (US $)

LHS providers	At-home services				In-centre services			
	Poor	Medium	Rich	Pooled	Poor	Medium	Rich	Pooled
Govt. veterinary officer	5.62	5.75	6.35	5.94	3.28	3.82	–	3.55
Para-vet	5.67	5.61	7.22	5.95	3.09	2.87	1.74	3.21
Private veterinary doctor	6.11	–	–	6.11	–	–	–	–
CBAHWs	10.43	4.19	7.63	7.03	–	–	–	–
NGO veterinarian	3.25	1.93	1.95	1.91	–	–	–	–
Private practitioner (Quack)	5.52	4.79	7.28	5.64	–	–	–	–
Cooperative Doctor	5.34	1.53	1.98	3.55	–	–	–	–

across various AHS providers and also in the mean ratings for each attribute for a particular AHS provider across different wealth categories. The only pattern that is discernible from the table is that 'proximity' has consistently received a lower rating compared to 'affordability' and 'quality' across different wealth status categories and across various AHS providers. This finding, thus, provides some indication that the real issue in accessing AHS is proximity, i.e. easy access to AHS at the time of need.

Average prices paid by users of AHS to different service providers per visit: Richer households paid significantly higher prices per visit to AHS providers as compared to poor households (Table 5). Even then, the average price paid by the poor households are substantially high. Most of the instances of accessing AHS, as observed in this study, was that of at-home services. The prices paid by the livestock owners to Government AHS providers suggest that the Government service providers provide at-home services mostly in private capacity. Rich households paid significantly higher charges to private practitioner (quack) for their visit at home than their poor and medium counterparts. There were no significant differences in the amount paid to para-vets per at-home visit across different wealth categories. Bardhan *et al*. (2012) had reported from Uttarakhand that prices paid by the poor farmers to government AHS providers were not significantly different from that paid by their richer counterparts. On an average, the highest charges paid for each at-home visit across all wealth categories was in case of CBAHW's, followed by private veterinary doctor. In case of NGO veterinarians and cooperative doctors, the amount to be charged for at-home visit is a fixed amount as ordained by the respective mandates of these institutions, viz. the NGO's and the dairy cooperative societies. However, the average charges paid to a NGO veterinarian and a cooperative doctor, even though lower than the charges paid to other AHS providers, was higher than the fixed amount that can be charged for at-home visits. However, it should be noted that as compared to the major AHS providers in the study area, viz. GVO's, para-vets and private practitioners, the proportion of respondents who had accessed the services of other AHS providers, i.e. NGO and cooperative veterinarians, private veterinary doctors and CBAHW's were significantly lesser. Hence, some amount of bias in the estimates of the charges paid by the respondents for at-home visits by these AHS providers cannot be ruled out. The average charges paid to these AHS providers, thus, needs to be construed with some degree of caution.

Willingness to pay for AHS: Two contingent scenarios were presented before the respondents, viz. one being for provision of assured quality at-home services and another being that for quality in-centre services. No takers were observed for the in-centre scenario as proposed to the respondents. The results, henceforth regarding farmers WTP amount, pertains to the at-home service scenario. Both the proportion of respondents who are willing to pay and the amount they are willing to pay increased with increase in wealth status (Table 6). Thus, the amount richer farmers

Table 6. CVM results (Willingness to pay for LHS)

	Poor	Medium	Rich	Overall
% of respondents WTP	8.85	15.95	26.11	14.07
WTP Amount (US $)	3.37[a]	4.48[a]	6.55[b]	4.726107

Table 7. Factors influencing respondents' willingness to pay for AHS (Results of Multinomial Logit Analysis)

Particular	Low WTP		Medium WTP		High WTP	
	B	OR (exp^β)	β	OR (exp^β)	B	OR (exp^β)
Intercept	-1.903*** (0.614)		-2.265* (1.288)		-3.360*** (0.861)	
Low income category (Y=1/N=0)	0.042** (0.380)	1.043	-0.109 (0.833)	0.896	-1.348*** (0.465)	0.260
Medium income category (Y=1/N=0)	0.023** (0.174)	1.023	0.030*** (0.370)	1.030	-0.596*** (0.184)	0.551
HH head age (Yrs.)	-0.006 (0.009)	0.994	-0.027 (0.019)	0.973	-0.003 (0.012)	0.997
HH head education[#]	-0.152** (0.069)	1.165	0.050 (0.150)	0.951	0.299*** (0.092)	1.349
Easy credit availability (Y=1/N=0)	0.721 (0.276)	2.057	1.219** (0.547)	3.385	1.364*** (0.327)	3.910
Landholding (acres)	0.274 (0.054)	1.315	0.276*** (0.100)	1.318	0.318*** (0.055)	1.374
Distance to market (km)	-0.111*** (0.034)	0.896	-0.165** (0.081)	0.848	-0.098** (0.042)	0.907
Milk production (lts./day)	-0.065** (0.029)	0.937	-0.012** (0.055)	0.988	0.091*** (0.025)	1.095
- 2 Log likelihood	1064.351					

Reference category is non-willingness to pay for AHS. [#]0, Illiterate; 1, up to primary level; 2, up to class 9; 3, up to high school level; 4, up to higher secondary level; 5, graduate; 6, Post-graduate and above. Significant at ***1%, **5% and *10% level of significance, respectively.

are willing to pay was significantly higher than the same figures in case of poorer households. The average WTP amount is close to the amount farmers were willing to pay as reported by Bardhan (2010) in a study carried out in Uttarakhand. However, in that study, a higher proportion (75%) of farmers were willing to pay as against 14% who were observed to be willing to pay in this study. The percentage the farmers willing to pay, as estimated in this study, suggests that there is significant scope for raising revenues from AHS delivered by the government by cost recovery approach.

Factors influencing farmers' willingness to pay for quality AHS: The results of the multinomial logit analysis carried out to identify the factors significantly influencing respondents' willingness to pay for quality AHS at-home are presented in Table 7. The negative signs of the coefficients for the poor and medium income category variables associated with 'high WTP' and the positive signs of the coefficients for the same income category variables associated with 'low WTP' suggest that when the respondent belongs to poor or medium income wealth category, he is more likely to be willing to pay a lower amount, while the likelihood of a rich respondent to be willing to pay a higher amount increases. Education of age of the household head had positive effect on 'higher WTP' amount and a negative effect on 'low WTP' amount. This implies that with increase in education level, likelihood of farmers' willingness to pay a lower amount decreases while that of paying a higher amount increases. The positive coefficient of the variable 'easy credit availability' associated with 'medium WTP' and 'high WTP' indicates that when farmers have easy access to credit, their likelihood of willing to pay a higher amount for quality doorstep AHS increases. Landholding size also had positive effect on 'medium' and 'high' WTP category, implying that with increase in size of landholding, farmers' likelihood of willingness to pay a higher amount also increases. 'Distance to market' variable had a negative influence on all the three WTP categories, viz. low, medium and high. This indicates that with increasing distance to market, farmers' likelihood of belonging to any WTP category decreases and he becomes more likely to be not willing to pay. Distance to market often implies farmers are not remuneratively linked to the market. With increasing distance to market, farmers' produce do not fetch a premium price which in turn do not provide him enough incentives to be willing to pay for AHS. The variable 'milk production' exerted negative influence on the 'low' and 'medium' WTP category while its effect on 'high WTP' category was positive. This implies that with increase in scale of production, farmers shift away from 'lower WTP' categories to 'high' WTP category.

The findings of this study have provided crucial information to the stakeholders in policy making bodies related to AHDS regarding the present use patterns of AHS by different wealth categories of livestock farmers, gaps in present supply of AHS to the farming community and the potential scope for reforms in AHDS. The results will be useful in improving the AHDS by taking into consideration equity implications for such services. Overall, the study has provided deeper understanding of the behaviour and decision-making processes of the poor in animal healthcare management so as to guide policy decisions regarding the delivery of AHS.

The output of the study will also help in rationalization of AHDS in the state by better identifying the 'public' and 'private' components of AHS. Also the willingness to pay estimates will provide crucial insights to the policy makers in rational pricing of AHS. The equity implications of cost recovery/ privatization/ other reforms in animal healthcare delivery will help the stakeholders in identifying the groups who might be excluded from the proposed reforms and hence appropriate policies regarding subsidization of such services for the target groups can be designed. The overall benefits of the study are in terms of policy implications pertaining to easing budgetary constraints for the state department of animal husbandry and also providing quality and timely animal healthcare services to the rural community.

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Annexure 1

Construction of weighted wealth index

$A_i = \Sigma f_k (a_{ik} - a_k)/s_k$

where A_i, value of index of the i^{th} household; f_k, factor score coefficient for the k^{th} asset by the principal component method; a_{ik}, value of the k^{th} asset for the i^{th} household; a_k, mean of the k^{th} asset over all households; s_k, standard deviation of k^{th} asset over all houeholds.

Cumulative square root of frequency method was then used to categorize each household in to one of three wealth categories, viz. poor, medium and rich on the basis of its wealth index.

Asset variables used in the composite wealth index

Ownership of farm assets	Household assets	Farm specific characteristics	Household characteristics
Tractor	Fan	Size of landholding	Type of dwelling structure: kaccha/ semi-pucca/ pucca
Tresher	Television	Proportion of land irrigated	No. of rooms in house
Tiller	Refrigerator	No. of indigenous cows	
Chaff cutter	Computer	No. of crossbred cows	
Pucca animal shed	Washing machine	No. of buffaloes	
Manger	Mixer/grinder		
Milking machine	Radio		
	Camera		
	Scooter		
	Car		