Beyond Economic Motives: Value of Indigenous Dairy Cattle Breed for the Livestock Keeper in India

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Abstract

Indigenous cattle not only provide milk, dung and draught power but are also a crucial part of India's ecological and cultural heritage. Despite this, they are facing threat of extinction. Absence of information regarding their multiple roles and monetary estimates of the benefits obstructs the investment for their conservation. Current study attempts to document and assess the "total economic value" of Sahiwal, one of the best indigenous cattle breeds of India. Choice experiment was used for collecting primary data from 168 dairy farmers which was then analyzed using random parameter logit model. "Cultural value" of Sahiwal occupied the major share (29.93%) of total economic value followed by "indirect use value (21.25%)" and "existence value (18.40%)". Interestingly, share of "direct consumptive use value" was comparatively lower. This indicates that any decision on conservation taken solely on the basis of direct consumptive use value is unlikely to maximize the societal welfare.

Key-words: Indigenous Cattle, Cultural Value, Existence Value, Total Economic Value, Conservation, Choice Experiment, Societal welfare.

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Introduction

India is home to 16.5 per cent of the world's cattle population with forty-three well defined breeds. These breeds evolved over centuries in their breeding tract and are thus, well adapted to the local conditions. They are sturdy, endowed with ability of heat tolerance, resistant to diseases and thrive under extreme nutritional stress. They have been traditionally serving many roles in farming households of India. Besides milk production, cattle in India have been used as a source of draught power and dung which is used as manure and fuel. Milk of Indian cow is high in fat content and also acts as main source of protein for majority of the population. It is often preferred by native people for consumption who consider it as more healthy, easily digestible and nutritious. India is also home to some of the best breeds of draught cattle. Their number has reduced drastically with increase in mechanization but still more than 55% of the total cultivated area is being managed by using draught animals as against about 20% by tractors (Phaniraja *et al.*, 2009) due to small size of land holdings and hilly terrain. Use of bulls for transportation remains prevalent in most of the Indian villages. Besides, cow dung and urine are conventionally being utilized in agriculture. Cow dung in the form of cakes or biogas serve as an important source of energy for rural households.

Along with these direct consumptive use value, Indian cow have been a crucial part of the country's ecological and cultural heritage too due to their long association with the native people. People share an emotional connection with the indigenous cattle. Many traditional sports and ceremonies revolve around them. Festivals like Govardhan Pooja and Gopashtami which are celebrated in India are centered on the cow (Agoramurthy *et al.*, 2012). They occupy prominent position in most of the religions of India and are considered sacred (Lodrick, 2005). Any ritual in Hinduism is considered incomplete without panchgavya- prepared by mixing five products of cow-milk, curd, ghee, dung and urine. Home warming ceremony in many parts of India is done by boiling milk of cow. Thus, in India, indigenous cow is important not only for the products it provides but also assumes significance for the non-consumptive purpose.

However, cattle biodiversity in the country is now under severe threats due to sole emphasis of policy makers on raising the milk production and failure of markets in accounting other benefits of indigenous breeds. Random crossing, breed substitution and inadequate program for improvement of local breeds have led to the genetic dilution of native breeds. As a result number of some of the most popular Indian cattle breeds like Red Sindhi, Sahiwal, Tharparkar, Vechur,

Punganur, Mewati, Kenkatha, Kheriagarh, Bargur, Panwar, Siri, and Krishna valley have severely declined and needs attention.

While certain species of wild animals have hogged the attention of conservationist, India is losing its wealth of genetic resources in domesticated animals (Khurana, 2015). There is no doubt that the erosion of farm animal genetic resources will eventually result in irreversible damage for both present and future generations, accompanied by the loss of potential market values and environmental functions (FAO, 2000; Hammond, 1999). Thus, for long term sustainability of our system, it is important to widen our approach and see beyond explicit economic benefits. A systematic study of the total economic value of the breeds involving both explicit and implicit value of the cattle for the society becomes essential to justify investment on conservation. Successful conservation strategies can be designed only by understanding the importance and relevance of a native breed for the local ecosystem and community.

With this background, the present study was undertaken with the following objectives: a) To document the role and importance of the Sahiwal breed for the local community, and, b) To assess relative importance of different components of the total economic value of the breed.

Methodology

Study breed

This study was conducted on the Sahiwal breed that is one of the best indigenous cattle breed of India but is still facing threat of extinction in their own homeland. Sahiwal has the highest milk yield among the indigenous cattle of India with average lactation milk yield of 3,500 - 4,500 kg and fat content varying from 4 to 4.5 per cent. Moreover, they possess several other important characteristics like tick and parasite resistance, tolerance to heat, ease of calving, drought resistance, bloat tolerance and good temperament (Glass *et al*., 2002; Sreedhar *et al*., 2011; Sailo *et al*., 2015; Verma *et al*., 2016 and Raina *et al*., 2016).

Due to their characteristics, they have been used to develop new breeds like Karan Swiss and Frieswal. The contribution of the Sahiwal breed to adaptability is also well documented in other countries. Despite this, they form only 2.5 per cent of total cattle population in India and out of that also only 22 per cent are pure and rests are graded. The fast changing socio-economic levels of farmers and cattle breeders, ecological profile and agricultural scenario and various factors

such as shrinking pasture lands, over-emphasis on cross-breeding with exotic cattle inheritance as well as the increased emergence of buffalo as commercial dairy animals, have resulted in the further decline in the population of Sahiwal cattle who were already sparsely distributed. Keeping in view their multipurpose utility, it is of utmost importance to multiply, improve and conserve this dairy breed (Joshi *et al*., 2001).

Study area

The study was carried out in the breeding tract of Sahiwal in India comprising of Sri Ganganagar district of Rajasthan, Fazilka district of Punjab and Sirsa district of Haryana. This region was purposively selected as due to prolonged association with the native community, Sahiwal breed is well known and forms a part of local landscape, tradition and customs. Despite this, the area has observed a major decline in the number of indigenous cattle and a subsequent rise in the population of crossbred which makes it an ideal choice for studying the importance of Sahiwal and its dynamics.

Sampling design and data collection

Multi-stage sampling procedure was adopted for the collection of primary data (Figure 1).

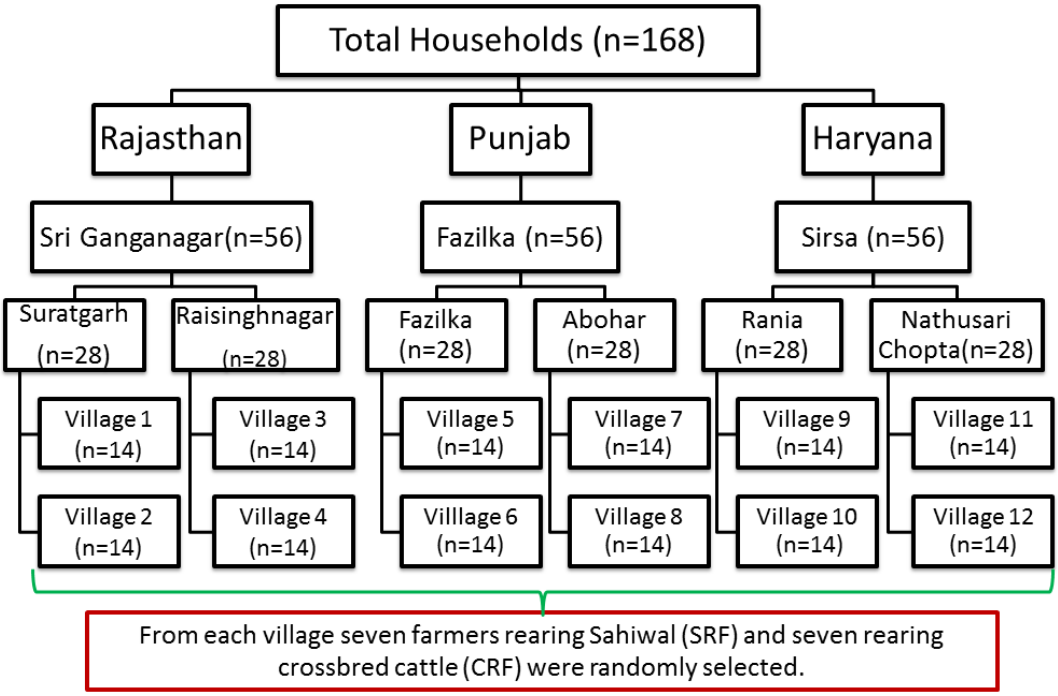

Fig. 1: Sampling framework

In the first stage, entire breeding tract of Sahiwal in India comprising of Fazilka district of Punjab, Sri Ganganagar district of Rajasthan and Sirsa district of Haryana was purposively selected. After that, based on field information two blocks having higher number of Sahiwal cattle were purposively selected from each district and from each block again two villages were selected. From each village, 7 Sahiwal rearing and 7 non- Sahiwal rearing dairy farmers were randomly selected. Thus, a total of 168 dairy farmers comprising 84 Sahiwal rearing and 84 non-Sahiwal rearing were selected from twelve villages. Primary data was collected by personally interviewing the respondents using a pretested structured schedule developed for the purpose. In addition to this, data was also collected from experts, scientists and field functionaries for opinion survey.

Analytical Tools

Other than milk yield, severable non-marketable features of the indigenous breeds are also important for the farmers. Due to prolonged association with the native community, indigenous breeds are an important part of local landscape, tradition and customs. Market price often fails to capture these non-marketable benefits. Following paragraphs discuss steps for valuation of non-market benefits using choice experiment, a stated preference technique.

Step I. Identification and classification of attributes

Prior to the generation of choice sets, information was collected from the locals about various uses of the Sahiwal breed and their cultural and religious importance with the help of group discussions. These benefits were compiled and then broadly categorized into- direct consumptive use value, direct non-consumptive use value and indirect use value. For livestock, direct consumptive use values include production outputs. Direct non-consumptive use values relate to the role of livestock in supporting the maintenance of rural culture and landscapes. Indirect use value refers to their role in maintenance of local ecology. Attributes were included from each of the three categories in the choice set. The choice set also included attributes of option value and existence value. Option value denotes the potential future use of the animal and existence values relate to the utility derived by people from knowing that a specific resource simply exists. Farmers were asked about their perception regarding the right of breed to exist. Importance of the breed for future generation in the wake of climate change and for maintaining biodiversity was also discussed beforehand with the livestock keepers.

Step II. Selection of attributes

One or two benefits from each category were then selected with the help of experts and local people based on their relevance with respect to the Sahiwal breed and the study region. Availability of Sahiwal milk and milk products for consumption accounted for the direct use value. Maintenance of Sahiwal related religious beliefs and cultural knowledge was used as an indicator of the direct non-consumptive use value whereas maintenance of soil health indicated indirect use value. Option value was represented by the ability of Sahiwal cattle to be used for establishing the cattle breeds adaptable to local climate in the future whereas existence value relates to the mere presence of Sahiwal breed devoid of any use or non-use value for humans.

Step III. Inclusion of monetary attribute

Other than the above attributes, a monetary attribute was also included which allows Willingness to Pay (WTP) estimates to be assigned to each of the attributes. WTP estimates represent the utility that respondents derive from the attributes of a given scenario. Donation (₹ per annum) for a hypothetical Sahiwal conservation plan was used as the monetary attribute. Donation amount was decided based on the preliminary interaction with the farmers.

Table 1: Attributes and their levels used in the choice set

Attributes	Total economic value components	Levels
Availability of Sahiwal milk and milk products for consumption (PRODUCTS)	Direct consumptive use value	Yes, No
Maintenance of Sahiwal related religious and cultural beliefs and knowledge (CULTURAL)	Direct non- consumptive use value	Improving, Declining, Stable
Maintenance of soil health (SOIL)	Indirect use value	Improving, Declining Stable
Risk due to climate change in future (RISK)	Option value	Low, High
Certainty of continued existence of live animals (EXISTENCE)	Existence value	90%, 50%, 10%
Donation amount in ₹ per annum (DONATION)	Monetary attribute	0, 500,1000,1500,2000

Step IV. Deciding the levels of attributes

Different levels of all the selected benefits were decided with the help of experts. The levels were decided in such a way that they represent different hypothetical scenarios. Different options

for the donation amount were fixed. Care was taken to keep donation amount within reasonable limits. Table 1 shows various attributes and their levels used in the study.

Step V. Designing the choice sets

After final selection of attributes and their levels, JMP software of SAS was used for generating orthogonal choice sets having two scenarios. Each scenario presented a hypothetical conservation plan. A total of twelve choice sets were generated. Status quo scenario was later added to each choice set. Status quo scenario acted as opt out scenario since the donation amount was zero in this case. Thus, each 'choice set', presents to respondents the outcome of two different alternatives along with a status quo option. The alternatives were described in terms of common set of attributes but with different levels.

Step VI. Designing the schedule

After obtaining twelve choice sets with three alternatives each, they were divided into two blocks- A and B. Each block consisted of six choice sets. Only one randomly selected block was included in each schedule. Thus, a single respondent had to express his preference only for six choice sets instead of twelve which helps in avoiding the respondent's fatigue. Pictorial representation was used for representing the choice sets in the schedule.

Step VII. Implementation of survey

Survey was done for data collection after preparation of the schedule. The respondents were presented the choice sets and were asked to select their most preferred scenario out of the three scenarios in each choice set, noting that they incurred no financial cost if selecting the status quo, while the other two scenarios would involve a donation amount to Sahiwal breed conservation programme. Along with the pictorial representation, choice sets in the schedule were explained verbally also to the respondents in order to avoid any ambiguity. In this way, a total of six choices were obtained from each respondent. Respondents' choices of their preferred alternatives demonstrated their willingness to trade-off one attribute against another.

Step VIII. Data analysis

Data obtained from choice experiment was analyzed using random parameter logit model/ mixed logit model with 1000 Halton draws. This model takes the heterogeneity of the population into account and can approximate any random utility model.

In the regression model, utility was taken as a function of a vector of the attributes (availability of breed specific milk products, maintenance of breed related religious and cultural beliefs and knowledge, maintenance of soil health, risk due to climate change in future, certainty of continued existence of live animals and donation amount) and random residual term.

$$U_{nj} = \beta'_n X_{nj} + \varepsilon njt$$

where,

U_{nj} = utility perceived by the n^{th} decision maker of j^{th} alternative,

β_n = vector of random parameters defining the weight of each co-variable on the value of the utility,

X_{nj} = vector containing the known values for the level of co-variables (attributes and monetary value) associated with alternative j and

ε_{nj} = random residual term.

Following formula was then used to estimate willingness to pay (WTP) after obtaining the coefficients for each attribute:

WTP/ Welfare estimates = - (Attribute coefficient/ Monetary coefficient)

Step IX. Value of the non-market benefits of the breed

The total economic value of a breed was then calculated by summing the highest levels of the attributes which represents willingness to pay.

Results and Discussion

Information related to perception of respondents about role and importance of the Sahiwal breed was compiled to get a comprehensive idea of the utility of breed. The data collected during the field survey was further analyzed to obtain the estimates of various types of economic value. The empirical results are presented and discussed in the following paragraphs under the different heads as per the objectives of the study:

a) Socio-economic profile of the respondents

Prior knowledge of socio-economic characteristics of the sample respondents helps in meaningful interpretation of the results. Table 2 presents the details on various socio-economic

characteristics of sample households like age, education, family size, occupation, income, land holding and livestock details.

The average age of household head was 45.13 years and there was no major difference between the two groups. Percentage of farmers having education higher than secondary level was more in the case of crossbred rearing farmers. Education provides exposure to the literature, thus, more educated ones are likely to have better access to new breeds and package of practices for rearing them. The average family size in the study area was 5.65. Major difference can be observed among the two groups with respect to size of the landholding and ownership of livestock. Sahiwal rearing farmers in Fazilka region were traditionally nomads and did not own any land, which explains the difference in the land holding size. They practice low input livestock farming and maintain a large herd (50-200 animals) due to which average number of livestock is also very high for Sahiwal rearing farmers. Average household income in the study area was ₹ 6.85 lakh/ year and it was marginally higher in the case of Sahiwal rearing households in comparison to their counterparts.

Table 2: Socio-economic characteristics of sample households

Particulars		Units	Sahiwal Rearing Farmers	Crossbred Rearing Farmers	Overall
Age		Years	45.43	44.83	45.13
Education		Percentage of farmers having higher than secondary level of education	16.67	32.14	24.41
Family Size		Number	5.85	5.46	5.65
Land holding		Acres/household	12.00	17.00	14.50
Livestock*		Number/household	31.00	7.63	19.32
Household income		₹/ year	6,98,179.00	6,722,26.00	6,85,203.00
Religion	Hinduism	Percentage of total farmers	44.04	60.71	52.38
	Islam		36.91	0.00	18.45
	Sikhism		19.05	39.29	29.17

With respect to religion, most of the Sahiwal rearing farmers (44%) were Hindus followed by Muslims and Sikhs. Interestingly, none of the crossbred rearing farmer in the study area was from the Muslim community. Sahiwal breed besides being a symbol of cultural heritage is also

suitable for their low input and pastoral system, which is why they are strongly preferred over crossbreds.

b) Perception of respondents on direct and indirect uses of Sahiwal breed

Group discussions were done with the farmers to know their perception about role and importance of Sahiwal cattle. Their perception about the benefits was recorded, compiled and then broadly categorized into- direct consumptive use value, direct non-consumptive use value and indirect use value. These benefits are listed below:

Direct consumptive use value

i. Sahiwal milk was preferred by the locals for domestic consumption over other cattle for its taste and health benefits. Sahiwal milk was specifically preferred for babies as it was considered to be easily digestible. Taste and texture of Sahiwal ghee was also preferred by the locals. Special preference towards indigenous animal products (indigenous chicken eggs, meat, cow's milk curd, cow's milk and ghee in particular) over the exotic equivalent was also reported by Weerahewa (2004) in her study in Srilanka.
ii. Farmers stated that colostrum which has high nutritional value can be prepared from Sahiwal milk for comparatively more number of days after parturition than crossbred.
iii. Villagers were using a drink called lapsi made from Sahiwal ghee and gau ark prepared with Sahiwal milk as home remedies.

Direct non-consumptive use value

i. Ghee of Sahiwal was considered to be pure by the locals and was specifically used for religious purpose particularly by the Hindu community.
ii. Aesthetically, Sahiwal was more preferred than crossbred. Locals believed as Sahiwal stays clean, eats only clean things and thus, their milk is also clean. They also reported that there is no pungent smell of cow dung and urine in the case of Sahiwal.
iii. Sahiwal was found to form an important part of rich indigenous technical knowledge. Local people were having know-how of using Sahiwal milk and urine for home-remedies for around 10-15 different diseases like joint pain, common cold, mouth ulcer, thyroid etc. Along with this they were using cow dung and urine of Sahiwal cattle mixed with Neem for organic seed treatment and as pesticide in case of diseases in wheat. Apart from

this, they were also aware of remedies for various problems faced by the Sahiwal breed and thus, have to rely less on treatment from outside.

iv. There were also various cultural beliefs associated with Sahiwal breed. People firmly believed on "what we eat is what we become". According to them, if the calf of Sahiwal cow dies then she stops giving milk whereas it is not so in the case of exotic and crossbred cattle. Thus, the locals consider that Sahiwal milk increases empathy among humans. Similarly, HF cross are more furious and aggressive whereas Sahiwal are calm and quiet. They believe that these qualities also pass on with the consumption of their milk.

v. Locals also believed that being in close association with the indigenous breed like Sahiwal and feeding them daily radiates positive vibes.

vi. Sahiwal was being reared in the study area for past many years. They were passed from one generation to the next and as such are a part of cultural heritage. The original native of Sahiwal breed is Montgomery district of present day Pakistan and from there it spread in the surrounding areas. During partition of India and Pakistan many relatives of people residing in the border areas of India migrated to Pakistan. Local people consider Sahiwal as a common cultural link between the two nations.

vii. Along with this in earlier times during off-season when green fodder used to be scarcely available, farmers from present day Ganganagar used to migrate towards Punjab along with their cattle (mostly Sahiwal). There the cattle used to graze the left over stubble in the field and the farmers used to milk them and sell their milk in the local market. Some of these farmers are now permanently settled in Fazilka area of Punjab. The trend of seasonal migration still continues though at a very small scale now.

Indirect use value

i. Traditionally, cow was not reared only for milk in India. Cow dung and urine of indigenous cattle like Sahiwal were used as organic fertilizer and pesticide. With the advent of agrochemicals, farmers replaced the organic sources with inorganic ones. Unbalanced application of agrochemicals led to soil pollution and land degradation. Farmers in the area agree that revival of organic ways is necessary for restoring the fertility of land and necessary inputs required for it like dung and urine can be provided by the indigenous cattle.

ii. Crossbreds in the study area were prone to diseases due to poor adaptability to tropical conditions and thus, heavy dosages of antibiotics were given to them. Locals were aware about the problem of antibiotic residues in the milk and surrounding environment. They believed that rearing of Sahiwal also helps in coping with the problem of environmental degradation and contamination as antibiotics are rarely used in their case.

iii. Sahiwal cattle were well adapted to digest the local vegetation. They were not specific in their food requirement and were able to convert locally available grasses into milk. Thus, they were contributing in the nutrient recycling within the local ecology.

It can be observed that there is a specific preference for the milk and milk products from Sahiwal cow among the locals. However, the role and importance of Sahiwal extend much beyond their direct economic advantage. The farmers listed a number of their beliefs and tradition which reveals their connection with the breed. The dairy farmers were also using dung and urine of Sahiwal cow as organic fertilizer and pesticide, were aware about the side-effects of antibiotic use in crossbred and appreciated the ability of breed to thrive on local vegetation.

c) Economic valuation of non-market benefits of Sahiwal breed by sample households

Welfare estimates were calculated for all the components of total economic value of the Sahiwal breed in order to know their relative importance for the local people (Table 3). All the coefficients were found to be significant except coefficient for stable level of soil health. Sign of the coefficient for donation was negative as per expectation. This implies that for same options the respondents were more likely to choose the one with lower donation amount. For all the other attributes, coefficients were positive which means that respondents were willing to pay for an improvement over the present scenario. Marginal WTP was highest for improved level of cultural values followed by improved status of soil health. This indicates the high cultural significance of the Sahiwal breed. Respondents were also willing to pay highly for the existence of the breed.

Interestingly, though positive value was placed on the direct consumptive use value but it was relatively less than the value placed on other attributes. This might be partially due to the availability of milk from buffalo and other indigenous breeds like Rathi which was almost equally liked by the local people. Similarly, in the study of Italian Pentro horse (Cicia *et al.*, 2002), meat consumption got lower score than the other listed reasons for their conservation. The

horse breed was having traditional association with the local people and highest score was obtained by the option value and existence value followed by the traditional value. This shows that direct economic value is but not the only indicator for justifying the conservation efforts.

Table 3: Welfare estimates of various components of non-market benefits of Sahiwal breed (₹/year/ household)

Attributes	Coefficients	Standard Error	Marginal WTP/ WTA
PRODUCTS_yes	0.8102***	0.1537	446.98
CULTURAL_improving	1.3567***	0.1981	748.43
CULTURAL_stable	0.4671***	0.1340	257.68
SOIL_improving	0.9633***	0.1551	531.41
SOIL_stable	-0.2977	0.1371	-164.25
RISK_low	0.5689***	0.0857	313.81
EXISTENCE_90%	0.8338***	0.1367	459.99
EXISTENCE_50%	0.4021**	0.1304	221.83
DONATION	-0.0018***	0.0002	

LR-chi^2 (9) =101.25; p=0.0000; No. of observations= 3024; *** 1% significance level and **5% significance level.

Positive WTP for direct use value indicate that there is a scope for development of specific market for milk and milk products of Sahiwal. These markets are already operational in some pockets. Few farmers even in our study area were fetching higher price for milk and ghee of Sahiwal. Dairy farmers in some parts of Sri Ganganagar were getting ₹ 25 per litre for crossbred milk and ₹ 30 per litre for the milk of Sahiwal while farmers in Fazilka were selling Sahiwal milk at ₹ 50 per litre. They were earning additional ₹ 100-200 for per kg ghee of Sahiwal. Similarly, markets are gradually developing in metro-cities also where consumers are willingly paying premium price for products of indigenous cattle. Expansion of these markets can significantly contribute to the conservation efforts. Development of niche product market as a viable option for providing co-funding for the continued maintenance of breeds was also suggested by Zander K.K. *et al.* (2013) for two Italian cattle breeds- the Modicana and the Maremmana.

The share of different values in total economic value is shown in Table 4. We arrived at total economic value by taking the sum of WTP for highest level of each attribute which works out to be ₹ 2500.62 per household per year. It can be seen from Table 4 that direct non-consumptive

use value occupies the major share in total economic value followed by indirect use value and existence value. This shows that cultural aspect of Sahiwal is valued more than their direct consumptive use value. These findings are in line with Collado D.M. *et al.* (2014) who studied the non-market values associated with the threatened Alistana–Sanabresa cattle breed in Spain. They found that cultural and existence value accounted for 80 per cent of the total economic value of the breed suggesting that in-situ conservation strategy will be required to secure such values. The study also suggested agritourism in addition to the direct support as a means for incentive payment.

Table 4: Percentage share of different attributes in total economic value

Attributes	TEV component	WTP estimate	Percentage share of TEV
PRODUCTS_yes	Direct consumptive use value	446.98	17.87
CULTURAL_improving	Direct non- consumptive use value	748.43	29.93
SOIL_improving	Indirect use value	531.41	21.25
RISK_low	Option value	313.81	12.55
EXISTENCE_90%	Existence value	459.99	18.40
Total Economic Value of non-market benefits		2500.62	100.00

Association and perception about benefits of a specific breed can vary among the farmers who are rearing it and the ones who are rearing other breeds. Thus, it is interesting to know what values are placed on various benefits of Sahiwal breed by Sahiwal and crossbred rearing farmers. Table 5 presents these results. For both categories of farmers, all the coefficients except stable level of soil health were found to be significant and had expected sign. Highest value was attributed to the cultural aspects by both the groups. This was followed by improved level of soil health for the Sahiwal rearing farmers and existence value (90% live animals) for the crossbred rearing farmers. Sahiwal rearing farmers gave lowest value to the option value of the breed whereas crossbred rearing farmers attributed lowest value to the direct consumptive use value of Sahiwal.

Interestingly, willingness to pay for maintenance of cultural value was remarkably higher in the crossbred rearing households than the ones rearing Sahiwal. This shows that households might be rearing crossbred due to economic considerations but they gave high importance to the cultural value of Sahiwal and were ready to pay for the maintenance of these values.

Table 5: Valuation of total economic value components of Sahiwal breed by Sahiwal and Crossbred rearing farmers (₹ /year/household)

Attributes	Sahiwal Rearing Farmers		Crossbred Rearing Farmers	
	Coefficients	Marginal WTP/ WTA	Coefficients	Marginal WTP/ WTA
PRODUCTS_yes	1.0694*** (0.2271)	537.27	0.5610** (0.2295)	310.51
CULTURAL_improving	1.3898*** (0.2550)	691.73	1.4593*** (0.3305)	807.65
CULTURAL_stable	0.6039** (0.1917)	300.59	0.3919** (0.2022)	216.91
SOIL_improving	1.2626*** (0.2409)	628.39	0.7299** (0.2321)	403.95
SOIL_stable	-0.353 (0.2224)	-175.67	0.2690 (0.1954)	148.87
RISK_low	0.4769*** (0.1180)	237.35	0.7674*** (0.1649)	424.75
EXISTENCE_90%	0.7282** (0.2106)	362.44	1.0179*** (0.2100)	563.38
EXISTENCE_50%	0.5483** (0.1940)	272.91	0.3427* (0.1941)	189.66
DONATION	-0.0020*** (0.0004)		-0.0018*** (0.0003)	

Sahiwal owner (Log-likelihood ratio= -269.55; LR-chi^2 (9) = 52.59; p=0.0000; No. of observations= 1512) and CB owner (Log-likelihood ratio= -302.70; LR-chi^2 (9) = 54.20; p=0.0000; No. of observations= 1512) *** 1% significance level, **5% significance level and *10% significance level. Figures in parentheses show standard error of the estimates.

Similarly, crossbred rearing households were also willing to pay relatively higher amount for continued existence of the 90% live animals of the breed irrespective of the fact that whether they will be receiving any benefit or not. Comparatively higher willingness to pay of crossbred rearing farmers for lower risk due to climate change in future is justified as they are more vulnerable to such risk. In contrast to this, Sahiwal rearing farmers were willing to pay more than crossbred rearing farmers for availability of Sahiwal milk and milk products for consumption. This indicates that Sahiwal rearing farmers highly prefer breed specific products for consumption whereas the crossbred rearing farmers have already replaced them with buffaloes or other

indigenous cattle breed like Rathi and are fine with it. On the same line, contribution of dung of Sahiwal cattle for maintaining soil health was attributed more value by Sahiwal rearing farmers than the crossbred rearing ones.

Share of different attributes in total economic value for both Sahiwal and crossbred rearing farmers is depicted in Table 6. It can be observed that Sahiwal rearing farmers give more weightage to direct consumptive use value and indirect use value than crossbred rearing farmers. On the other hand, percentage share of non-consumptive use value, existence value and option value is higher in the case of crossbred rearing farmers. Less weightage given to direct use value can be a reason behind substitution of Sahiwal breed by crossbred rearing farmers.

Table 6: Percentage share of different attributes in total economic value of Sahiwal breed by Sahiwal and Crossbred rearing farmers

Attributes	TEV component	Percentage share of TEV	
		Sahiwal rearing farmers	Crossbred rearing farmers
PRODUCTS_yes	Direct consumptive use value	21.87	12.37
CULTURAL_improving	Direct non- consumptive use value	28.15	32.17
SOIL_improving	Indirect use value	25.57	16.09
RISK_low	Option value	9.66	16.92
EXISTENCE_90%	Existence value	14.75	22.44

Culture, rituals and local ecology change with change in geographical area which may further lead to differences in the valuation of non-market components of a breed. Table 7 depicts the area specific welfare estimates for these components. There was considerable difference in the valuation of various components by the farmers of the three regions. In general, among the three areas, willingness to pay (WTP) was higher in Fazilka. Specifically, WTP for improved level of cultural values was comparatively quite high in the Fazilka region. This can be due to the proximity of Indo-Pak border and presence of pastoral community for whom Sahiwal forms an important part of cultural heritage. Besides cultural value, farmers of Fazilka were ready to pay higher amount for improved soil health and lower risk due to climate change in future. On the

contrary, for continued existence of 90 per cent live Sahiwal animal, farmers of Sirsa were willing to pay the highest amount.

Table 7: Area specific welfare estimates of components of total economic value of Sahiwal breed (₹ /year/household)

Attributes	Sirsa		Fazilka		Sriganganagar	
	Coefficients	Marginal WTP/ WTA	Coefficients	Marginal WTP/ WTA	Coefficients	Marginal WTP/ WTA
PRODUCTS_yes	0.8152** (0.2694)	448.82	1.1357** (0.3453)	516.96	0.7041** (0.2854)	408.17
CULTURAL_ improving	1.1088*** (0.1635)	610.46	2.2052*** (0.5732)	1003.85	1.2325*** (0.3041)	714.49
CULTURAL_ stable	0.5166** (0.1734)	284.42	0.3173* (0.2935)	144.45	0.5588** (0.2266)	323.94
SOIL_improving	0.7666** (0.1852)	422.07	1.4004** (0.4247)	637.48	1.0578*** (0.2673)	613.21
SOIL_stable	0.2261 (0.2330)	-124.47	-0.3537 (0.2981)	-161.02	-0.4583 (0.2426)	-265.67
RISK_low	0.5320*** (0.1550)	292.89	0.8781** (0.2623)	399.70	0.5836*** (0.1440)	338.32
EXISTENCE_90%	0.9549*** (0.2539)	525.76	0.8037** (0.2838)	365.86	0.8761*** (0.2303)	507.87
EXISTENCE_50%	0.2432* (0.2183)	133.88	0.7327* (0.3035)	333.53	0.3696* (0.2209)	214.27
DONATION	-0.0018*** (0.0004)		-0.0022*** (0.0005)		-0.0017*** (0.0004)	
Log-likelihood ratio	-198.14		-178.61		-178.608	
LR-chi^2 (9)	27.26		56.78		56.78	
p	0.0003		0.0000		0.0000	
No. of observations	1008		1008		1008	

1% significance level, **5% significance level and *10% significance level. Figures in parentheses show standard error of the estimates.

If we look into the percentage share of different attributes in total economic value (Table 8) then it can be observed that highest value was given to improved level of cultural values of the Sahiwal breed in all the three areas. This reemphasizes the importance of cultural beliefs and rituals associated with Sahiwal breed for the local people. Cultural values were followed by improved level of soil health in Fazilka and Sriganganagar. Presence of pastures in these areas can be one of the reasons for importance attributed to soil health. Stall feeding is not very common in Fazilka and Ganganagar and farmers leave their cattle for grazing. Dung left behind by cows while grazing enhances the soil fertility in pasture land. In the case of Sirsa, the percentage share of existence value was found to be surprisingly very high. Third highest value was attributed to availability of milk and milk products of Sahiwal for consumption in Sirsa and Fazilka whereas in Sriganganagar third place was accounted by existence value.

Table 8: Percentage share of different attributes in total economic value

Attributes	TEV component	Percentage share of TEV		
		Sirsa	Fazilka	Sri Ganganagar
PRODUCTS_yes	Direct consumptive use value	19.51	17.68	15.81
CULTURAL_improving	Direct non-consumptive use value	26.54	34.33	27.67
SOIL_improving	Indirect use value	18.35	21.80	23.75
RISK_low	Option value	12.73	13.67	13.10
EXISTENCE_90%	Existence value	22.86	12.51	19.67

Table 9: Willingness to Pay estimates for two hypothetical scenarios

(₹ / year/household)

Regions/ Groups	Scenario A	Scenario B
Fazilka	2923.85	1394.64
Sirsa	2300.00	1160.01
Ganganagar	2582.06	1284.70
Sahiwal rearing farmers	2457.18	1348.12
Crossbred rearing farmers	2510.24	1141.83
Overall	2500.62	1240.30

We can also estimate the total willingness to pay of the respondents for different scenarios. Assume that scenario A comprises- PRODUCTS_yes, CULTURAL_improving, SOIL_improving, RISK_low and EXISTENCE_90% variables and depicts the best hypothetical

scenario whereas scenario B is the next best alternative and includes- PRODUCTS_yes, CULTURAL_stable, SOIL_stable, RISK_low and EXISTENCE_50% variables. Table 9 shows WTP estimates for these two scenarios.

It can be observed that overall willingness to pay (WTP) was ₹ 2500.62 for Scenario A and ₹ 1240.30 for Scenario B. Among the three districts willingness to pay was highest in Fazilka followed by Ganganagar and Sirsa for both the scenarios. This indicates that people in Fazilka and Ganganagar give more importance to Sahiwal. Thus, more conservation efforts can be directed to these areas. Interestingly, willingness to pay estimates for Scenario A was slightly higher in the case of crossbred rearing farmers than Sahiwal rearing farmers. This shows that even the farmers who are not rearing Sahiwal, value them for various non-market benefits.

Conclusion

Milk yield and its quality constitute only a part of multiple benefits from indigenous cattle. As is evident in the case of Sahiwal, direct non-consumptive use value occupied the major share among different components of total economic value followed by indirect use value and existence value. Thus, these values should also be taken into consideration for decisions on conservation. In-situ conservation should be encouraged for preserving the cultural values associated with the breed. The respondents were willing to conserve the breed even if they were rearing crossbred due to economic concerns. This shows that any conservation program for Sahiwal will get the support of local community. Development of market for milk and milk products of Sahiwal can incentivize the Sahiwal rearing farmers which will supplement the conservation efforts of the government. Revival of organic farming and awareness regarding antibiotic residues can further strengthen it. Moreover, Sahiwal breed can also be promoted as symbol of peace and unity through various cultural and heritage parks that are present along Indo-Pakistan border as they are being reared from the pre-partition time and are a common link between two neighboring nations.

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