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# Beyond economic motives: Value of indigenous dairy cattle breed for the livestock keepers 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 assess the economic value of different benefits of one of the best indigenous cattle breeds of India, Sahiwal. 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. Development of specific market for milk and milk products of Sahiwal, promotion of the breed as symbol of peace and unity through various cultural and heritage parks, and revival of organic farming can incentivize the Sahiwal rearing farmers which can then supplement the conservation efforts of the government.

**Keywords:** Choice experiment, Conservation, Cultural value, Indigenous cattle, Sahiwal, Total economic value

India is home to 16.5% of the world's cattle population with 43 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. 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.

Along with these direct consumptive use values, Indian cows have been a crucial part of the country's ecological and cultural heritage too due to their long association with the native people. Festivals like *Govardhan Pooja* and *Gopashtami* which are celebrated in India are centered on the cow (Agoramoorthy *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. 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 threat 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. 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 (Hammond 1999, FAO 2000). 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 to assess relative importance of different components of the total economic value of the breed.

## MATERIALS AND METHODS

This study was conducted on the Sahiwal breed that is

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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%. 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. Their contribution to adaptability is also well documented in other countries. Despite this, they form only 2.5% of total cattle population in India and out of that also only 22% are pure and rest are graded. The fast changing socio-economic levels, ecological profile, 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 further decline in the already sparsely distributed population of Sahiwal cattle.

*Study area:* The study was carried out in the breeding tract of Sahiwal in India comprising 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 (Fig. 1). In the first stage, entire breeding tract of Sahiwal in India was selected. After that, on the basis of field information, two blocks having higher number of Sahiwal cattle were 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

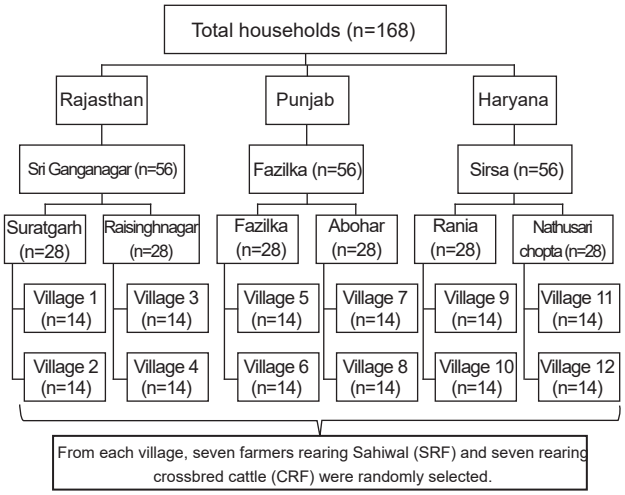


Fig. 1. Sampling framework.

rearing were selected from 12 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, several non-marketable features of the indigenous breeds are also important for the farmers which market price often fails to capture. Choice experiment, a stated preference technique was used for estimating the total economic value of the breed.

Prior to the generation of choice sets, information was collected from the locals about various uses of the Sahiwal breed and its cultural and religious importance. These benefits were compiled and then broadly categorized into: direct consumptive use value, direct non-consumptive use value and indirect use value. All the attributes and their levels are presented in Table 1. 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 to establish the cattle breeds adaptable to local climate in the future whereas existence value relates to the mere presence

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

| Attribute | 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 ₹/annum (Donation) | Monetary attribute | 0, 500, 1000, 1500, 2000 |

of Sahiwal breed devoid of any use or non-use value for humans. 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.

These attributes were then used to generate orthogonal choice sets having two scenarios using JMP software of SAS. Each scenario presented a hypothetical conservation plan. A total of 12 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. Finally, the 12 choice sets were divided into two blocks and each respondent was randomly given a single set of six choice sets. The respondents were then asked to select their most preferred scenario out of the three scenarios in each choice set. So a total of six choices were obtained from each respondent. The collected data was then analyzed using random parameter logit model to obtain the willingness to pay (WTP) estimates. In the model estimates, 1000 Halton draws were used. 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 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; $\beta_n$, 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 $\varepsilon_{nj}$ , 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)

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

*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 socio-economic characteristics of sample households rearing Sahiwal and Crossbred cattle. The average age of household head was 45.13 years. 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 was 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. 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.

*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

Table 2. Socio-economic characteristics of sample households

| Particular | | Unit | 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 |

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

| Attribute | Coefficient | 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.

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 a positive value was placed on the direct consumptive use value but it was relatively less than the value placed on other attributes. This might partially be 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 not the only indicator for justifying the conservation efforts.

Positive WTP for direct use value indicated 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 a premium of ₹5 per litre for the milk of Sahiwal while farmers in Fazilka were selling Sahiwal milk at a premium price of ₹50 per litre. They were also 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 suggested by Zander *et al.* (2013) for two Italian cattle breeds.

The share of different values in total economic value is shown in Table 4. Total economic value was arrived at by taking the sum of WTP for highest level of each attribute which works out to be ₹2500.62 per household per year. Direct non-consumptive use value occupied the major share in total economic value followed by indirect use

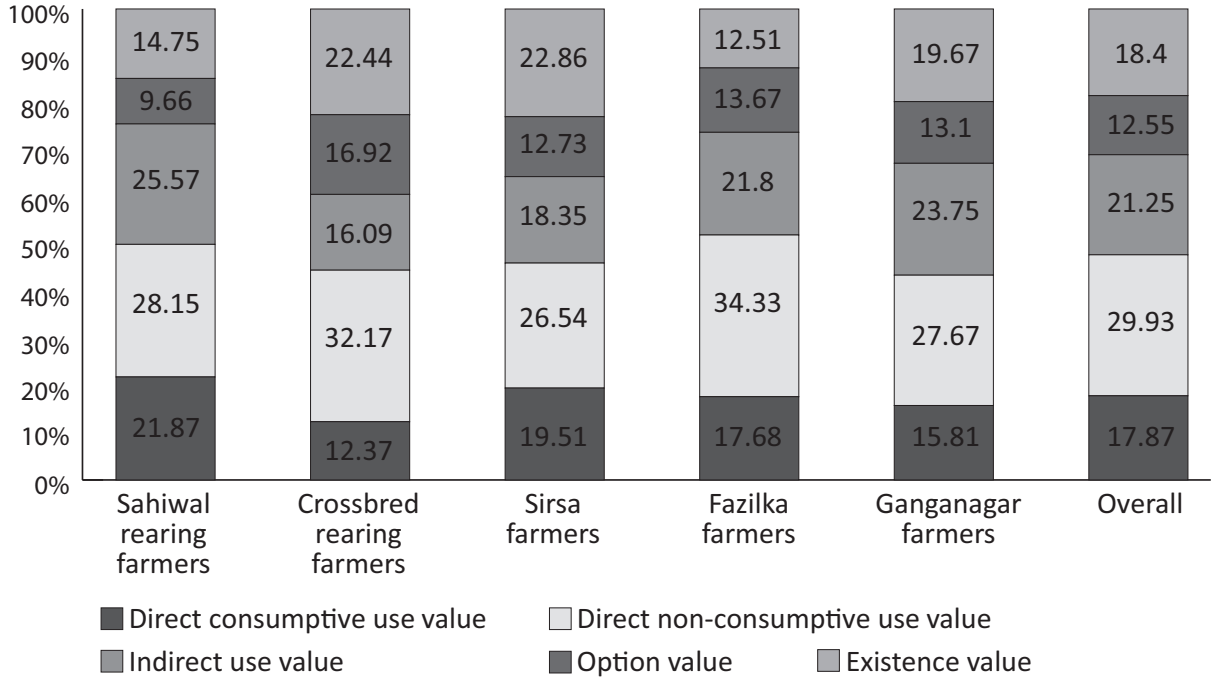


Fig. 2. Percentage share of different attributes in total economic value of Sahiwal breed for different categories of dairy farmers.

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

| Attribute | 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 (₹/year/household) | | 2500.62 | 100.00 |

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 *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% 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.

Association and perception about benefits of a specific breed vary among the farmers who are rearing it and the ones who are rearing other breeds (Fig. 2). Sahiwal rearing farmers gave more weightage to direct consumptive use value and indirect use value than crossbred rearing farmers. 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. Less weightage given to direct use value can be a reason behind substitution of Sahiwal breed by crossbred rearing farmers. On the same line, contribution of dung of Sahiwal cattle for maintaining soil health was attributed more value by Sahiwal rearing farmers. On the other hand, percentage share of non-consumptive use value, existence value and option value was higher in the case of crossbred rearing farmers. Higher percentage share for non-consumptive use value shows that households might be rearing crossbred due to economic considerations but they still assign high importance to the cultural value of Sahiwal and were ready to pay for the maintenance of these values. 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.

Culture, rituals and local ecology change with change in geographical area, which further leads to differences in the valuation of non-market components of a breed (Fig. 2). Among the three areas, percentage share of WTP for improved level of cultural values was highest for Fazilka. 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. In Fazilka and Sriganganagar, soil health had second highest percentage share in total WTP. 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. Among the three districts, willingness to pay was highest in Fazilka (₹2,924) followed by Ganganagar (₹2,582) and Sirsa (₹2,300) which indicates that people in Fazilka and Ganganagar give more importance to Sahiwal. Thus, more conservation efforts can be directed to these areas.

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 crossbreds 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 neighbouring nations.

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