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Socio-Economic Sustainability of Rearing Deoni Cattle in Bidar District of Karnataka, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The desi cow has been a part of the Indian life since ages immemorial. The desi cattle are not only seen as a beneficial source but also considered as a family member and respected with a motherly status. One such desi cattle is Deoni. The present study was conducted in the Bidar district of Karnataka, which is one of the native tracts of Deoni. The study targeted three blocks in Bidar-Bhalki, Basavakalyan, and Aurad - due to high Deoni cattle population. Twelve villages were

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randomly selected from these blocks, and data were collected from 120 Deoni cattle owners, each possessing at least one lactating Deoni cow. To assess socio-economic sustainability, an index developed by Rahman (2011) was used with slight modifications. To calculate the socio-economic sustainability, economic sustainability index (ESI) and social sustainability index (SSI) were calculated separately, then pooled to arrive at Socio-Economic Sustainability Index (SESI). Economic sustainability was measured by six key indicators, viz. milk productivity, net profit, lactation length, dry period, calving interval, and marketing, while social sustainability was measured using two indicators, viz. community relation of dairy farmers and their access to resource and support services. The socio-economic sustainability index of rearing Deoni cattle by dairy farmers range from 0 to 1. The results reveal that the majority of the respondents (47.50%) belonged to medium economic sustainability (0.47 to 0.55), 55.33 per cent of the farmers belonged to medium social sustainability (0.48 to 0.63) and 48.33 per cent of the respondents belonged to medium socio-economic sustainability group (0.50 to 0.56), and only 26.67 per cent of the respondents belonged to high socio-economic sustainability (>0.56), depicting that efforts should be made by various actors involved in Deoni cattle farming to improve the sustainability of rearing Deoni cattle through scientific dairy farming practices, marketing, better community relation, and access to resources. The correlation analysis between eight independent variables, viz, age, education, landholding, herd size, social participation, extension contact, mass media exposure, and milk production and socio-economic sustainability revealed that land holding, social participation, extension contact, and milk production were strongly correlated with socio-economic sustainability, whereas Age and mass media were found to have a non-significant relationship with socio-economic sustainability.

Keywords: Deoni cattle; economic sustainability; social sustainability; socio-economic sustainability.

1. INTRODUCTION

Indigenous cattle have played a crucial role in supplying milk and milk products, providing draft power, producing bio-fertilizer and biofuel, as well as promoting human health [1]. One such indigenous breed is the Deoni cattle, a dual-purpose dairy breed maintained under a semi-intensive management system. They are known for their physique and drought power and Deoni cattle is the most important cattle breed found in most drought-prone areas of India [2]. Dairy farming in drought prone enhances sustainable livelihood to farmers and its helps to alleviating poverty and unemployment in especially in rural area. Karnataka state is second position in total drought prone geographical area after Rajasthan [3]. The animals are reared by grazing in fallow lands, dry lands, or along the bunds of farms. The mean lactation milk yield and peak milk yield in Deoni cattle are 881 kg and 4 kg, respectively.

Sustainable agricultural development means the management and conservation of the natural resources and also the technological orientation and institutional change in such a fashion to make sure the acquisition and the continued satisfaction of human needs for present and future generations [4]. In sustainable agriculture, Swaminathan [5] recognized 14 major dimensions covering social, economic, technological, environmental, and political facts of sustainability. Among these, only economic and social dimensions were considered for the present study, which is considered to be important from the livelihood security point of view. A breed-wise survey conducted in 2013 reported that the total Deoni population in India was 3,51,600, consisting of 1,51,236 purebred Deoni and 2,01,145 graded Deoni cattle [6]. Rearing of Deoni cattle is serving as a source of income for resource-poor farmers. It provides employment to the rural community, helps in securing nutritional security as well as to overcome economic risk. Any cattle rearing practices must be sustainable so that it could be retained by future generations as an occupation. With this view, the socioeconomic sustainability of Deoni cattle rearing was studied.

2. METHODOLOGY

Karnataka is a home state for 6 registered indigenous cattle breeds, namely, Deoni, Amritmahal, Hallikar, Khilari, Krishna Valley and Malnad Gidda. Out of which, Deoni is the only dual purpose breed. The study was conducted in Bidar district of Karnataka, which was selected purposively as there was more existence of genetically pure Deoni cattle in that region. Bidar district is the northernmost part of the Karnataka State. The district experiences semi-arid climate

with extreme summer. In Bidar district, Bhalki, Basavakalyan, and Aurad blocks were selected purposively based on the maximum number of Deoni cattle. From each block, four villages were selected randomly. Thus, a total of 12 villages were selected for the study. The respondents were selected based on the criteria that a farmer should possess at least one Deoni cattle, which has completed at least one lactation at the time of investigation. Among Deoni cattle rearers, ten dairy farmers were selected by random sampling method from each village. Thus, a total of 120 Deoni cattle owners were selected for data collection.

Measurement of sustainability: The methodology, developed by Rahman [7] for assessing the sustainability of dairy farms of Self-Help Group in Assam, was adopted and modified to use in the context of Deoni cattle rearing. To calculate the socio-economic sustainability, economic sustainability index (ESI) and social sustainability index (SSI) were calculated separately, then pooled to arrive at SESI. The indicators in each dimension were selected based on Swaminathan's concept of sustainable livelihood security, that is, livelihood options that are economically efficient as well as socially equitable [5].

The Economic Sustainability Index was calculated using six key indicators; viz. milk productivity, net profit (net profit generated per animal per year), lactation length, dry period, calving interval, and marketing accessibility (with a score for selling milk directly from home, 2 for selling within 5 km of the household, and 1 for selling beyond 5 km).

The Social Sustainability Index was measured using two indicators: viz. community relations of Deoni cattle owners and their farmers and their access to resource and support services. Community relations were assessed by assigning 1 point for each of the following: involvement in community activities, participation in local community organizations, and consultation with a progressive farmer regarding Deoni cattle rearing and maintenance, resulting in a maximum score of 3. Access to resources and support services was evaluated by assigning 1 point for each of the following: access to road connectivity, Livestock Extension Officer (LEO), veterinary hospital or AI center, information on local milk demand, water resource, bank, and livestock insurance agency, with a maximum score of 7.

Construction of socio-economic sustainability index: The first step is to construct the index (I_{ij}) for each i^{th} indicator representing the j^{th} dimension of the socio-economic sustainability index.

$$I_{ij} = \frac{X_{ij} - MinX_{ij}}{MaxX_{ij} - MinX_{ij}} \quad (1)$$

$$I_{ij} = \frac{MaxX_{ij} - X_{ij}}{MaxX_{ij} - MinX_{ij}} \quad (2)$$

Where, i = 1, 2, 3……..n indicators
j = 1, 2 dimension of sustainability
X_{ij} = Value of i^{th} indicator of j^{th} dimension

Equation (1) is for indicators having a positive implication on sustainability
Equation (2) is for indicators having a negative implication on sustainability

After obtaining the Iij for all the indicators, the second step is to calculate the indices for various dimensions of the socio-economic sustainability index. It is calculated as the simple mean of their respective variables, that is:

$$ESI = \frac{\sum_{i=1}^{6} I_{ij}}{6} \quad , \quad SSI = \frac{\sum_{i=1}^{2} I_{ij}}{2}$$

Then, the socio-economic sustainability index for Deoni cattle rearing for each respondent.
was determined as a weighted mean of the indices obtained from the equations:

$$SESI = \frac{W_1 \times ESI + W_2 \times SSI}{2}$$

Where, W denotes the weight assigned to the respective dimension of the Socio-economic Sustainability Index.

The resulting index was classified into low, medium, and high categories by dividing the sustainability scale from 0 to 1 into equal intervals. To compare the various indices and sustainability dimensions, the data were generated, organized, and statistically analysed.

3. RESULTS AND DISCUSSION

Socio-economic profile of Deoni cattle owners: Table 1 revealed that more than half of the respondents (55.83%) belonged to the middle age group (36 to 50 years). This research observation was similar to the findings of Thombre et al. [8] Paul et al. [9] Bukya et al. [10]. About 82.50 per cent of the respondents

interviewed were male, while 17.50 per cent were female. It was observed that about 23.33 per cent of the respondents had education up to primary level. This was similar to the research findings of Mande and Thombre [11] Patel et al. [12] Kuralkar et al. [13]. Almost half of the respondents (47.50%) were having medium landholding ranging from 2 to 4 hectares. Nearly 44.17 per cent of the respondents were having a medium herd size of 3 to 4 animals per household. This was almost similar to the findings of Kumar and Chand [14] Patel et al. [12]. More than half of the respondents (59.17%) were a member in one or the other organizations, 01.67 per cent of the respondents had occupied the position of office bearer and 39.17 per cent of the respondents were not the member in any organization. These findings were found to be similar to the findings of Sathyanarayan et al. [15] Singh [16]. The majority of the respondents (60.83%) had medium extension contact and this was in line with the findings of Mali (2013); Singh et al. [17]. About 60.00 per cent of the respondents had a medium level of mass media exposure.

Economic Sustainability Index (ESI): Milk productivity, Net profit, Lactation length, Dry period, Calving interval, and Marketing were considered as economic indicators to measure the productivity, profitability, and viability of the cattle rearing practices.

Table 2 indicates that average milk productivity of Deoni cattle was found to be 3.07 ± 0.08 liters. This finding was in line with the findings of Meena et al. [18]. The productivity of the animal could be improved by proper nutritional management. Since owners of Deoni were mostly small and medium farmers, they tried to optimize profit by using their available resources. The average net profit per annum from the Deoni cattle rearing for the respondents was found to be ₹5,107 (for the year 2018-19). Das (2010) studied indigenous cattle rearing in Assam and reported the net profit from cattle rearing as ₹2,447.28 per annum. The mean lactation length in Deoni cattle was found to be 251.88 ± 0.87 days. This was found similar to the findings of Kuralkar et al. [13] and high compared to the findings of Bhutkar et al. [19] and Basak and Das [20]. The mean dry period was found to be 162.63 ± 1.33 days. The finding was similar to the findings of Prakash et al. [21] and high as compared to the findings of Mayekar et al. (2017). The mean calving interval found to be 413.75 ± 0.77 days. This result was low compared to the findings of Basak and Das (2018). The study revealed that the majority of the respondents (65.83%) used to sell milk through informal milk channels like milk vendors, halwai and tea stalls, etc., while 34.17 per cent respondents used to sell milk through the formal channel like milk cooperative society. There was no proper marketing channel for the milk. Farmers were selling milk at distressed prices.

Table 3 shows the mean scale value of above discussed economic indicators after multiplying the value of economic indicators with their respective weights. It is noticeable in Table 3 that milk productivity, net profit, and lactation were contributing to the economic sustainability of Deoni cattle. But marketing has got low value due to improper marketing channels. Hence, providing proper marketing channels help further to boost economic sustainability. The low value of the dry period and calving interval was a good indicator of economic sustainability.

A majority of the respondents (47.50%) belong to the medium economic sustainability category (0.47 to 0.55), followed by high (>0.55) and low (up to 0.46) economic sustainability categories which consist of 26.67 per cent and 25.83 per cent of the respondents, respectively (Table 6). The economic sustainability of rearing Deoni cattle can be increased by improved scientific dairy farming practices to increase the milk production and by strengthening market infrastructure.

Social Sustainability Index (SSI): Respondents' relationship and participation in their social system, access to resources such as water, markets, transport, and veterinary aid, etc. and support services such as extension and finance services were taken as underlying factors to measure social sustainability of Deoni cattle rearing.

From Table 4, it was found that majority of the farmers (61.67%) were having medium community relation, followed by a low (35.00%) and high (3.00%) community relationship. A high value of community relationship means the strong relationship and high participation in the social system. It enhances one's social mobility and has a similar effect on the others in their social system. The support received from the community can considerably affect the farming activity of respondents, so inspection of respondents' association with their social system is very essential. A majority of the respondents

(77.50%) had a medium access to resources and support services, followed by 11.67 per cent and 10.83 per cent of respondents were having a high and low access to resources and support services, respectively. During the study, it was observed that there was fair road connectivity to some villages, and banking services, water supply, and veterinary services were medium, and there was a very poor marketing facility for disposal of Deoni cow milk. The region is resource-rich, but the resources were underutilized. Hence, the government and the local organizations should make an effort for mobilization and proper utilization of available resources.

The mean scale values of social indicators for the Deoni cattle rearers are shown in Table 5. The community relation has got scale value of 0.55. So, we can say that the respondents were having medium community relation in the village with their fellow farmers and the access to resources and support services has got a value of 0.46, which indicates that the respondents were having low access to the resources and thus efforts should be made to help farmers in proper and efficient utilization of available resources in the village.

A majority of the farmers (53.33%) were falling under a medium level (0.48 to 0.63) of social sustainability, followed by low level (up to 0.47) and high level (>0.63) of social sustainability comprising of 25.00 per cent and 21.67 per cent of the respondents, respectively (Table 6). Social sustainability can be improved by increasing access to resources and support services, good community relation in society, and increasing the herd size per household.

Table 1. Socio-economic profile of deoni cattle owners

(n=120)

Sl. No.	Variables	Categories	Frequency	Percentage (%)
1	**Age (in years)**	Young (up to 35)	22	18.33
	Range: 28-63	Middle (36 to 50)	67	55.83
	Mean: 43.21	Old (>50)	31	25.83
2	**Gender**	Male	99	82.50
		Female	21	17.50
3	**Education**	Illiterate (0)	18	15.00
		Functionally literate (1)	13	10.83
		Primary (2)	28	23.33
		Middle (3)	24	20.00
		High school (4)	21	17.50
		Higher Secondary (5)	14	11.67
		Graduate and above (6)	02	1.67
4	**Landholding (ha)**	Landless (0 ha)	4	3.33
		Marginal (<1 ha)	8	06.67
		Small (1-2 ha)	30	25.00
		Semi-medium (2-4 ha)	57	47.50
		Medium (4-10 ha)	18	15.00
		Large (>10 ha)	3	2.50
	Herd Size (SAU)	Small (Up to 3.15)	50	41.67
5	Mean: 4.4	Medium (3.16 to 5.59)	53	44.17
	Range: 1-25	Large (> 5.59)	17	14.17
6	**Social Participation**	Not a member (0)	47	39.17
		Member (1)	71	59.17
		Office bearer (2)	02	1.67
7	**Extension Contact**	Low (< 1.80)	33	27.50
	Mean: 1.85	Medium (1.81 to 2.08)	73	60.83
	Range: 1-4	High (> 2.08)	14	11.67
8	**Mass Media Exposure**	Low (Up to 3.17)	36	30.00
	Mean: 3.88	Medium (3.18 to 4.05)	72	60.00
	Range: 2-10	High (> 4.05)	12	10.00

Table 2. Economic parameters to measure economic and social sustainability of rearing Deonicattle

(n=120)

Sl. No.	Variable	Category	Frequency	Percentage
1.	**Milk Productivity** (l/day/animal) Mean value: 3.07 ± 0.08	Low (Up to 2.40)	21	17.50
		Medium (2.41 to 3.51)	68	56.67
		High (>3.51)	31	25.83
2.	**Net Profit (**Rs.) Mean: 5106.74	Low (Up to 4443.10)	40	33.33
		Medium (4443.11 to 6038.47)	52	43.33
		High (>6038.47)	28	23.33
3.	**Lactation (days)** Mean: 251.88 ± 0.87	Low (Up to 245.31)	37	30.83
		Medium (245.31 to 258.60)	44	36.67
		High (>258.60)	39	32.50
4.	**Dry Period (day)** Mean: 162.63 **±** 1.33	Low (Up to 151.54)	29	24.17
		Medium (151.54 to 170.28)	55	45.83
		High (>170.28)	36	30.00
5.	**Calving Interval (days)** Mean: 413.75 ± 0.77	Low (Up to 411.17)	42	35.00
		Medium (417.18 to 419.13)	44	36.67
		High (>419.13)	34	28.33
6.	**Milk selling (Channels)**	Formal	41	34.17
		Informal	79	65.83
		Medium (2.89 to 4.07)	93	77.50
		High (>4.07)	14	11.67

Table 3. Mean scale value of economic indicators

Sl. No.	Economic Indicators	Mean scale value
1.	Milk productivity	0.54
2.	Net profit	0.47
3.	Lactation length	0.56
4.	Dry period	0.37
5.	Calving interval	0.40
6.	Marketing	0.37

Table 4. Social parameters to measure economic and social sustainability of rearing Deoni cattle

(n=120)

Sl. No.	Variable	Category	Frequency	Percentage
1.	**Community relation**	Low	42.00	35.00
		Medium	74.00	61.67
		High	04.00	03.33
2.	**Access to resources and support services** Mean: 3.23	Low (Up to 2.88)	13	10.83
		Medium (2.89 to 4.07)	93	77.50
		High (>4.07)	14	11.67

Table 5. Mean scale value of social indicators

Sl. No.	Social Indicators	Mean scale value
1.	Community relation	0.55
2.	Access to resources and support services	0.46

Socio-economic Sustainability Index (SESI): The socio-economic sustainability index of rearing Deoni cattle was worked out by considering both economic and social dimensions of sustainability (Table 6). It was observed that majority of the respondents (48.33%) were falling under medium socio-economic sustainability group (0.50 to 0.56),

followed by high (>0.56) and low (up to 0.49) socio-economic sustainability group, comprising of 26.67 per cent and 25.00 per cent of the respondents, respectively.

Sustainability of rearing Deoni cattle means degree up to which it cannot be replaced with any other source of income available and affordable to the respondents. If the index value is 1, it means that it should not be replaced and it is the best option for livelihood security out of all the options available and affordable to the respondents. Deoni cattle rearing was a traditional practice for farmers' livelihood security and were rearing Deoni cattle from generations mainly on low or zero input system by utilizing natural resources available in the study area. The main question was that whether it should be replaced with another high yielding breed of cattle or not. The answer was that, for maintaining high yielding exotic cattle breed, there was a requirement of financial resources, which the farmer was unable to bear those expenses. The bullock of a crossbred cow has got the poor draft performance. By rearing Deoni cattle, respondents had the following advantages:

- These animals were well acclimatized to the region and have got high disease tolerance and can thrive well and perform better under low resource condition.
- Milk was a cheaply available and most acceptable animal protein source for the vegetarian population.
- Regular income from the sale of milk, manure, dung cake, and use of bullocks for agricultural operations on other farmers' fields.
- The maintenance cost of rearing Deoni cattle was very low.
- Being indigenous cattle, milk of Deoni cattle has A_2 β casein, which is considered to be safe for human health. Nowadays, consumers are health-conscious and they preferred to buy A_2 milk for their good health even at high prices.

Table 6. Economic Sustainability Index (ESI), Social Sustainability Index (SSI) and Socio-economic sustainability index (SESI) of Deoni cattle rearing

(n = 120)

Variable	Category	Frequency	Percentage (%)
Economic Sustainability			
ESI	Low (Up to 0.46)	31	25.83
Mean: 0.50	Medium (0.47 to 0.55)	57	47.50
	High (>0.55)	32	26.67
Social Sustainability			
SSI	Low (Up to 0.47)	30	25.00
Mean: 0.53	Medium (0.48 to 0.63)	64	53.33
	High (>0.63)	26	21.67
Socio-economic sustainability			
SESI	Low (Up to 0.49)	30	25.00
Mean: 0.51	Medium (0.50 -0.56)	58	\48.33
	High (>0.56)	32	26.67

Table 7. Relationship between independent variables and socio-economic sustainability of Deoni cattle rearing

Sl. No.	Variables	Correlation coefficient "r"
1	Age	0.130
2	Education	0.238**
3	Landholding	0.552**
4	Herd size	0.318**
5	Social participation	0.579**
6	Extension contact	0.563**
7	Mass media exposure	0.168
8	Milk production	0.638**

*** Significant at 0.01 level of probability*

3.1 Relationship of Independent Variables with Socio-Economic Sustainability of Deoni Cattle Rearing

The result of the correlation analysis between eight independent variables and socio-economic sustainability index of Deoni cattle rearing was depicted in Table 7. It was observed that land holding, social participation, extension contact, and milk production were strongly correlated with socio-economic sustainability. Education and herd size also had a positive correlation with socio-economic sustainability. Age and mass media were not correlated with socio-economic sustainability and were found to have a non-significant relationship at the 0.01 level of significance.

Higher education levels and increased extension contact among respondents improve cattle rearing practices, leading to greater productivity and income from this occupation. Similarly larger herd sizes and high milk production empower respondents to earn more income and make cattle rearing a profitable livelihood. Age does not matter in the socio-economic sustainability of Deoni cattle rearing but need of livelihood, interest of the person, and traditional rearing practices of keeping are more important for individuals. Mass media exposure of the respondents was not found to be related to socio-economic sustainability. Possible reasons for this might include the lack of available content on Deoni cattle in mass media, illiteracy, and engagement in agricultural operations and inadequate access to mass media resources.

4. CONCLUSION

The study revealed that the majority of farmers in the region are middle-aged or older with low educational levels, which impacts the adoption of scientific dairy practices. The Deoni cattle, integral to local livelihoods, are well adapted to the environment but show low milk yield and persistency due to inadequate nutrition. Improving education, training on fodder conservation, access to veterinary services, and availability of indigenous cow semen at AI centers are critical. Additionally, enhancing milk marketing channels and promoting larger herd sizes could significantly boost socio-economic sustainability of Deoni cattle rearing. There is also a need for government interventions to improve infrastructure, support renewable energy adoption, and ensure better resource utilization. By improving the sustainability, it would provide better option for livelihood security for the future generations.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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