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### The decline of bull population in India: Economic, ecological, and health impacts based on a study of Theni Malaimadu cattle

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#### Abstract

This study explores the socio-economic and ecological impacts of declining bull populations in Theni district, India, with a focus on Theni Malaimadu cattle. Analysis of household expenditure and income shows that traditional farming methods, primarily using Theni Malaimadu cattle for sale of male calves and manure as fertilizer, contribute significantly to rural livelihoods. Manure sales provide a primary source of income, illustrating the importance of these cattle in organic farming. Households relying on Theni Malaimadu cattle earn an annual net income of INR 65,500, comprising 48.23% of total income. Families with more than two bulls reported an income of INR 96,545, while those with fewer averaged INR 57,369, demonstrating the economic benefits of maintaining bull populations. Additionally, the Social Return on Investment (SROI) model revealed an average SROI of 3.76 for households with more than two bulls, versus 2.40 for those with fewer, indicating broader social benefits. Findings emphasize the importance of preserving indigenous breeds, like Theni Malaimadu cattle, for socio-economic resilience, sustainable agriculture, and ecological balance.

**Keywords:** Bull population, ecological balance, agricultural sustainability, Theni Malaimadu cattle, livelihood impact assessment, social return on investment

#### Introduction

India has one of the largest and most diverse cattle populations globally, with indigenous breeds, particularly bulls, playing a crucial role in traditional farming systems. These breeds, well-adapted to local conditions, significantly contribute to rural livelihoods and agricultural sustainability by supporting organic farming practices with a lower ecological footprint (Gupta, 2021; Singh *et al.*, 2022) <sup>[5, 19]</sup>. However, the population of native bulls has dramatically declined in recent decades, threatening economic stability and environmental health (Kumar *et al.*, 2020) <sup>[10, 11]</sup>. Bulls are essential for maintaining soil fertility through manure production, which enriches soil organic content and reduces reliance on chemical fertilizers (Narayan, 2021) <sup>[13, 14]</sup>. Breeds like Theni Malaimadu cattle demonstrate greater disease resistance and adaptability to resource-scarce environments, making them suitable for sustainable, low-input farming. Their utilization minimizes pollution and fosters biodiversity (Patel & Rao, 2019) <sup>[15]</sup>. The decline in bull populations has intensified as rural communities move away from traditional livestock farming due to urbanization and mechanization, adversely affecting rural economies

(Anitha & Rajkumar, 2023) <sup>[1]</sup>. Indigenous cattle enhance agricultural productivity and support rural economies through direct income from sales of calves and manure (Sundaram, 2019) <sup>[20]</sup>. As the viability of small-scale farming is challenged by mechanization and market pressures, preserving indigenous breeds is crucial for socio-economic stability (Verma & Singh, 2020; Dhawan & Kumar, 2022) <sup>[23, 3]</sup>.

This study focuses on Theni Malaimadu cattle in Tamil Nadu's Theni district, an indigenous breed known for its adaptability and historical value in local agriculture. By examining the economic, social, and environmental impacts of these cattle, the research aims to highlight the multifaceted role of bull populations in sustainable farming systems. Utilizing models such as Livelihood Impact Assessment (LIA) and Social Return on Investment (SROI), the study investigates the implications of declining bull populations, emphasizing the costs of mechanization and the loss of benefits associated with organic farming. The findings underscore the socio-economic value of Theni Malaimadu cattle and the necessity for conservation and policy measures to support traditional livestock farming,

ensuring ecological balance and rural livelihood sustainability.

### Materials and Methods

**Data Collection:** Data were collected through both qualitative and quantitative surveys in the Theni district, covering 53 herds of Theni Malaimadu cattle. The surveys examined livestock management practices, economic returns, and the social benefits of traditional farming, following the methods outlined by Patel and Rao (2019) <sup>[16]</sup>. This comprehensive approach enabled an in-depth analysis of local farming practices and the associated financial implications.

**Economic Analysis:** Household expenditure and income were analysed to determine the financial impact of Theni Malaimadu cattle on rural households. Tables 1 to 2 present an economic breakdown, covering categories such as labour, veterinary costs, and gross income from cattle-related activities (Raj *et al.*, 2021) <sup>[17]</sup>.

**Livelihood Impact Assessment (LIA):** The LIA model assesses income losses due to reduced bull population, increased agricultural expenses, morbidity, mortality and

rising veterinary costs. This model is critical in understanding the long-term financial effects on maintaining bull population (Dhawan & Kumar, 2022) <sup>[4]</sup>.

**Social Return on Investment (SROI):** The SROI analysis compares the societal benefits of organic farming with more than two bulls against fewer bulls farming methods. This model evaluates the return on investment in maintaining bull population, examining health improvement and community benefits (Verma & Singh, 2020) <sup>[24]</sup>.

### Results

#### Economic Analysis of Theni Malaimadu Cattle Farming

Theni Malaimadu cattle farming generates significant income for rural households, with a net annual income of INR 65,500, equating to 48.23% of total household earnings (Table 3). The cost-effective nature of these cattle, primarily fed on local vegetation without additional feed expenses, underscores their suitability for resource-limited farmers (Sivaraman, 2023) <sup>[18]</sup>. For one year, the Labour cost for managing of Theni Malaimadu cattle would typically be ₹1,20,000 (₹10,000 per month per person). However, if a family member takes on this grazing responsibility, the household can save this entire cost.

**Table 1:** Annual Household Expenditure Breakdown for Theni Malaimadu Cattle Owners

| Expenditure Category                                   | Amount (INR) |
|--------------------------------------------------------|--------------|
| Construction of temporary enclosure & sheds            | 12,000       |
| Equipment per year                                     | 5,000        |
| Average number of Theni Malaimadu cattle owned         | 60           |
| Cost of feed per year                                  | 0            |
| Labour cost (10,000 per month per person for one year) | 1,20,000     |
| Veterinary aid per year                                | 500          |
| Miscellaneous per year                                 | 500          |
| Total Expenditure per year                             | 1,38,200     |

**Table 2:** Gross Annual Income from Theni Malaimadu Cattle and Related Activities

| Income Source                         | Amount (INR) |
|---------------------------------------|--------------|
| Sale of 3-6 months calves (6 animals) | 60,000       |
| Sale of young animals (2 animals)     | 1,00,000     |
| Sale of manure (6 tonnes)             | 36,000       |
| Total Gross Income in a year          | 1,96,000     |

**Table 3:** Total Net Annual Income Analysis for Theni Malaimadu Cattle Owners

| Description                                                           | Amount (INR) |
|-----------------------------------------------------------------------|--------------|
| Total Net Annual Income                                               | 65,500       |
| Total Net Annual Income per cattle                                    | 1,300        |
| Total Average Annual Household Income                                 | 1,35,800     |
| Percent Contribution of Theni Malaimadu cattle to total annual income | 48.23%       |

### Livelihood Impact Assessment (LIA)

The LIA analysis (Table 4) shows that families with more than two bulls receive a higher average income (INR 96,545) than those with fewer (INR 57,369), demonstrating the financial advantage of traditional livestock management.

This economic disparity suggests that the decline in number of bulls holding could weaken rural economies dependent on cattle for sustainable farming (Anitha & Rajkumar, 2023) <sup>[2]</sup>.

**Table 4:** Livelihood impact analysis based on number of bulls hold by Theni district farmers (in INR)

| Number of Bulls hold by Owner | Price per herd livestock production | Costs associated with production | Average of LIA |
|-------------------------------|-------------------------------------|----------------------------------|----------------|
| >2                            | 1,04,091                            | 7,545                            | 96,545         |
| <2                            | 70,321                              | 12,952                           | 57,369         |
| Mean                          | 77,330                              | 11,830                           | 65,500         |

### Social Return on Investment (SROI)

The SROI model (Table 5) reveals that households with more than two bulls holding report an SROI of 3.76, as opposed to 2.40 for those with fewer bulls. This finding

illustrates the broader social value derived from organic farming practices, including reduced chemical dependency and enhanced soil health, as a function of bull-driven farming (Mehta & Prasad, 2019)<sup>[12]</sup>.

**Table 5:** Social Return on Investment (SROI) based on number of bulls hold by Theni district farmers (in INR)

| Number of Bulls hold by Owner | Average Social Value Created | Average Investment | Average of SROI |
|-------------------------------|------------------------------|--------------------|-----------------|
| >2                            | 1,04,091                     | 42,398.18          | 3.76            |
| <2                            | 70,321                       | 33,603.10          | 2.40            |
| Mean                          | 77,330                       | 35,428.49          | 2.68            |

### Discussion

The results underscore the socio-economic and environmental significance of Theni Malaimadu cattle for rural households in Theni district. Households maintaining traditional cattle farming practices report higher incomes, with bull ownership contributing to resilience against rising mechanization costs (Kapoor *et al.*, 2021)<sup>[9]</sup>. Utilizing family member as labour for grazing in the Western Ghats' periphery saves households INR 1,20,000 annually in Labour costs, which reinforces the economic advantages of traditional, family-managed livestock systems. These findings align with previous studies showing that indigenous breeds are well-suited to sustainable farming due to their adaptability to local environments and resource efficiency (Thomas & Sharma, 2021)<sup>[22]</sup>. The decline in bull populations not only increases economic strain on smallholders but also disrupts ecological practices historically embedded in rural India. Organic farming with indigenous cattle plays a vital role in sustainable agriculture by reducing the need for chemical fertilizers, thereby improving soil health and crop productivity (Joshi *et al.*, 2022)<sup>[8]</sup>. Maintaining bull populations could mitigate the ecological impacts of increased mechanization, especially given the environmental costs of fuel and machinery (Sundaram, 2019)<sup>[21]</sup>.

### Conclusion

This research underscores the multifaceted value of Theni Malaimadu cattle in rural Theni district, advocating for policy measures to sustain indigenous breeds and traditional farming methods. Economic and social analyses affirm that these cattle not only provide substantial income for smallholders but also contribute to sustainable agricultural practices by enhancing soil health and reducing dependency on chemical inputs. The SROI and LIA models further emphasize the socio-economic advantages of maintaining bull populations, providing robust evidence for initiatives focused on livestock preservation and ecological resilience. While this study offers valuable insights, further investigation with a larger sample is necessary to enhance the accuracy and generalizability of the results. Future policies should prioritize incentivizing traditional cattle farming to foster sustainable agriculture and rural development.

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