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SOCIO-ECONOMIC ASPECTS OF INDI SILKWORM REARING OF THE BODO

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ABSTRACT

This study explores the socio-economic and cultural dimensions of Indi (Eri) silkworm rearing among the Bodo community in the Bodoland Territorial Region (BTR) of Assam. As a traditional livelihood rooted in indigenous practices, Indi sericulture contributes significantly to rural development, economic resilience, and cultural continuity. The practice is deeply interwoven with Bodo identity, involving collective participation across all stages from host plant cultivation to cocoon processing and weaving thereby fostering intergenerational knowledge transfer and community cohesion. Women play a central role in the sericulture value chain, with their involvement enhancing financial autonomy, skill development, and decision-making power within households and community structures. The formation of Self-Help Groups (SHGs) and cooperatives has further institutionalized women's empowerment, facilitating access to credit, training, and market linkages. Economically, Indi rearing offers low-capital entry and year-round income generation, particularly for marginal farmers. Cost-benefit analysis reveals that even small-scale operations can yield stable returns with minimal environmental impact. However, challenges such as inadequate infrastructure, limited market access, youth outmigration, and weak institutional support threaten the sector's sustainability and its potential for upward social mobility. Despite these barriers, the resilience of traditional knowledge systems, coupled with targeted interventions such as gender sensitive policies, skill-building programs, and digital integration can strengthen the sector's developmental impact. Indi sericulture thus emerges not only as an eco-friendly and economically viable livelihood but also as a powerful vehicle for women's empowerment, cultural preservation, and inclusive rural development in Northeast India.

Keywords: Bodo, Indi, Social, Economic, Silkworm

1. INTRODUCTION

Understanding the socio-economic context of a community is essential for analysing its livelihood systems, cultural practices, and long-term sustainability. It reflects the interplay of social structures, economic activities, and environmental factors that shape daily life (Sen, 1999). This is particularly relevant for rural and indigenous populations, whose livelihoods are closely tied to natural resources and traditional knowledge. Their socio-economic landscapes are often shaped by a mix of time-tested customs and adaptations to contemporary challenges such as globalization, environmental degradation, and shifting markets (Ellis, 2000). Elements like demographics, education, gender roles, access to infrastructure, and institutional support all influence these dynamics (Bebbington, 1999). One compelling example of a livelihood that merges ecological sustainability with cultural tradition is sericulture the farming of silkworms. Globally practiced across rural areas, it offers both economic gains and cultural preservation, especially for ethnic groups like the Bodos in Assam (Chakravorty & Ghosh, 2012; Baruah, 2018). Understanding such contexts is vital to designing policies that align with local realities, promoting sustainable development and empowerment.

The Bodo community, one of the largest indigenous groups in Assam, is primarily agrarian. Their settlements, mainly in the Bodoland Territorial Region, thrive in fertile plains that support rice farming and allied rural activities such as animal husbandry, fishing, and traditional weaving (Choudhury, 2011; Sarma & Hazarika, 2017). Women play an especially central role, managing both household and economic responsibilities, including agriculture, weaving, and now sericulture (Das, 2020). Though the community emphasizes collective labour, household-level autonomy remains critical to decision-making (Brahma, 2018). Historically, the Bodos practiced both wetland and shifting (jhum) cultivation, closely integrating their lives with local ecosystems (Singh & Sarma, 2017). Their livelihoods are rooted in forest-based economies and seasonal rhythms, and as pressures from modernization and political changes rise, they increasingly diversify to include off-farm occupations. Sericulture has emerged as a crucial non-farm livelihood that enhances income and reinforces cultural identity, especially among women (Baruah, 2005).

Indi (eri) silkworm rearing, involving Antheraea proylei, has deep roots in Bodo society and Northeast India more broadly. Known locally as Eri or Muga silk, the practice predates organized commercial ventures and is embedded in both the domestic economy and cultural traditions (Choudhury & Kalita, 2015; Gangwar & Singh, 2012). Feeding primarily on castor plants, which grow abundantly in Assam, Indi silkworms offer an affordable entry into sericulture for rural households (Das & Saikia, 2019). This accessibility is critical in areas with limited capital and infrastructure. Historically, Indi silk was used for weaving traditional garments like dokhonas and gamosas and served ceremonial functions (Brahma, 2018). The knowledge of rearing and processing cocoons is passed down through generations, mainly by women, helping preserve cultural continuity (Sarma & Hazarika, 2017). While post-independence institutional support for sericulture has increased, many practices remain grounded in indigenous methods and seasonal cycles (Kalita & Hazarika, 2017).

In the current rural Bodo economy, sericulture plays a vital role in supplementing income, supporting traditional weaving industries, and providing employment especially for women. It is a key buffer in times of agricultural instability and contributes to the growth of rural cottage industries and local markets (Bhattacharjee & Talukdar, 2019; Mishra & Singh, 2021). Additionally, the environmentally friendly, non-violent nature of Indi silk production aligns with sustainable development goals (Saikia, 2014). For marginal farmers and landless labourers, the low capital requirements and widespread availability of castor leaves make Indi silkworm rearing an attractive livelihood. It offers year-round income potential and complements other subsistence activities, helping stabilize household economies affected by erratic weather or fluctuating crop prices (Das & Saikia, 2019). Women, in particular, benefit from the flexibility of sericulture, which they can manage alongside domestic duties, thus gaining financial independence and elevated household status (Brahma, 2018; Sarma & Hazarika, 2017).

Demand for Indi silk has grown, both for traditional attire and modern textiles, opening new market opportunities for rural producers. With increased commercialization, there is greater potential for value addition through yarn spinning and weaving. However, challenges remain, including limited market access, lack of advanced training, and insufficient infrastructure. Strengthening institutional support through cooperative models, skill-building programs, and improved market linkages can help overcome these barriers and maximize the benefits of sericulture (Mishra & Singh, 2021).

The socio-economic context of the Bodo community reveals the interdependence of cultural identity, livelihood diversification, and environmental sustainability. Indi silkworm rearing exemplifies how traditional knowledge and modern economic needs can intersect to form a viable, resilient livelihood. Recognizing and supporting such practices is crucial to inclusive rural development and the long-term empowerment of indigenous communities in Northeast India.

2. THE SOCIO-ECONOMIC PROFILE OF INDI SILKWORM REARING OF BODO HOUSEHOLDS

The Bodo community, one of Assam's major indigenous groups, has long practiced diverse agro-based livelihoods, with Indi silkworm (Antheraea proylei) rearing playing a key role in their rural economy. This section examines the demographic, economic, and resource characteristics of Bodo households engaged in Indi cultivation, emphasizing their traditional knowledge, resilience, and livelihood diversification. Typical rearing households comprise both young and middle-aged members, with active gender participation. Most rearers are aged 30–55, reflecting the experience required for sericulture (Das & Saikia, 2019). Education levels remain low, with limited technical training (Brahma, 2018), which restricts adoption of improved methods. Rearing is largely family-based, with women and elders handling feeding and cocooning, and younger members managing harvesting and marketing (Choudhury & Kalita, 2015; Baruah, 2018).

Landholding is generally small (0.5–2 hectares), used for paddy, vegetables, and castor cultivation (Singh & Sarma, 2017). Many households rely on leased land, managed through community norms (Mishra & Singh, 2021). Mulberry and castor are grown alongside subsistence crops, but erratic rainfall and poor irrigation limit leaf availability (Kalita & Hazarika, 2017). Asset ownership is modest; most households have basic tools and livestock but lack modern sericulture equipment (Das & Saikia, 2019). Many live in kutcha houses with limited access to services (Dutta, 2016; Ministry of Rural Development, 2021). Income sources include agriculture, sericulture, wage labour, and handloom weaving (Das, 2020), though sericulture contributes 25–40% of annual income (Mishra & Singh, 2021). Expenditures are mainly on essentials, with limited investment capacity and vulnerability to debt (Kalita & Hazarika, 2017; Baruah, 2018).

Traditional knowledge such as host plant use, larval care, and low-cost methods is central to sustainability (Choudhury & Kalita, 2015; Dutta, 2016; Das, 2020). However, it remains largely unrecognized in formal programs (Kalita & Hazarika, 2017). Occupational diversification is common; men often farm or migrate for work, while women lead in weaving and cocoon processing (Baruah & Das, 2023; Singh & Sarma, 2017). Though youth migration threatens knowledge transmission, this strategy offers stability against sericulture's seasonal nature and market risks (Mishra & Singh, 2021). Cost-benefit analysis shows that with expenses of ₹8,000–₹12,000, households can earn ₹15,000–₹30,000 per crop, with profits of up to 40% depending on skill, quality, and market conditions (Das & Saikia, 2019; Bhattacharjee & Talukdar, 2019). Yet, limited infrastructure, fluctuating prices, and poor access to services constrain growth (Kalita & Hazarika, 2017), underscoring the need for stronger institutional support.

3. THE ECONOMIC VIABILITY AND CONTRIBUTION OF INDI SILKWORM REARING

Sericulture, the cultivation of silkworms for silk production, is one of India's oldest and most sustainable agro-industries. As the world's second-largest silk producer and the only country producing all four commercial silk types mulberry, eri, tasar, and muga India's sericulture sector plays a vital role in rural livelihoods (Central Silk Board [CSB], 2018). Silkworm rearing provides steady income to millions of rural households, especially in regions suitable for mulberry cultivation. Beyond economic benefits, sericulture generates rural employment, empowers women, and supports sustainable farming practices (Ekka & Bais, 2023). Economically, silkworm rearing in southern states like Tamil Nadu and Karnataka is notably profitable. Sakthivel et al. (2012) reported that mulberry sericulture yields higher returns per hectare than traditional crops such as paddy, maize, cotton, and sugarcane. The introduction of high-yield mulberry varieties like Victory-1, capable of producing 60 metric tonnes per hectare annually, has increased cocoon and raw silk output significantly. Victory-1 now covers about 90% of mulberry gardens in key sericulture areas (The Hindu, 2023).

As a labour-intensive industry, sericulture supports an estimated 9 million people across India (Central Silk Board [CSB], 2018). The sericulture value chain from mulberry cultivation and silkworm rearing to cocoon harvesting and silk weaving offers employment opportunities to marginal farmers and landless workers. Women play a crucial role, engaging in silkworm rearing, cocoon collection, and silk reeling. Over 60% of the sericulture workforce are women, highlighting the sector's role in promoting gender-inclusive development (Yadav & Jadhav, 2017). Programs like Karnataka's Cluster Promotion Programme (2013–2018) increased cocoon yield by 31.95% and raw silk production by 174.86%, significantly benefiting rural women through higher incomes and greater self-sufficiency (Geetha et al., 2020). Environmentally, sericulture supports sustainability by encouraging agroforestry, enhancing biodiversity, and improving soil health. Mulberry cultivation improves soil structure and prevents erosion. The sector uses minimal agrochemicals, making it compatible with organic and regenerative agriculture (Altman & Farrell, 2022). Integration with crop-livestock systems further strengthens ecosystem services and agricultural sustainability.

However, challenges remain. Indian sericulture productivity lags behind countries like China and Brazil due to limited use of high-yielding breeds and inadequate farmer training (Ram et al., 2016). Climate change, including rising temperatures, erratic rainfall, and disease outbreaks, threatens mulberry cultivation and silkworm health. To address these, the Central Silk Board and research institutions are developing disease-resistant, climate-resilient silkworm strains and promoting bivoltine silk production, known for superior quality and efficiency, to reduce import dependence and improve competitiveness (The Hindu, 2023). A cost-benefit analysis reveals sericulture is economically viable for small and marginal farmers. Key costs include land preparation, mulberry planting and maintenance, rearing house construction, silkworm egg procurement, labour, and utilities (Sakthivel et al., 2012). Labour is a major expense due to the continuous care silkworms require. In Tamil Nadu, production costs per 45-day crop cycle for one acre range from ₹18,000 to ₹22,000, with cocoon yields of 120–140 kg per crop. At market rates of ₹500–₹600 per kg, gross income per

crop is ₹60,000–₹84,000, yielding net profits of ₹40,000–₹62,000. With four crops annually, farmers can earn ₹160,000–₹248,000 per year (Bodo Women's Welfare Association, 2021; Central Silk Board [CSB], 2022).

Besides cocoons, by-products like silkworm pupae add to income. Once considered waste, pupae are now sold as animal feed and for pharmaceutical and cosmetic uses, priced at ₹10–₹15 per kg (Ekka & Bais, 2023). This supplementary income boosts sericulture's profitability. Adoption of high-yielding mulberry varieties and improved silkworm breeds has increased cocoon yield from 40–45 kg to over 60 kg per 100 disease-free layings (Central Silk Board [CSB], 2018), enhancing economic returns. In Northeast India, especially among tribal communities like the Bodo in Assam's Bodoland Territorial Region, sericulture remains vital. The Bodo have a strong tradition of eri (Philosamia ricini) and muga (Antheraea assamensis) silk rearing. Eri silk, favoured for its adaptation to local conditions and lower labour needs, uses castor and tapioca leaves instead of mulberry. For the Bodo, eri silk production is both an income source and a cultural practice tied to traditional attire like dokhona and aronai (Goswami & Deka, 2020). Eri silk rearing requires lower investments due to local leaf availability and simple equipment. In Baksa district, Bodo women engaged in eri sericulture earned an extra ₹20,000–₹30,000 annually, depending on output and sales (Bodo Women's Welfare Association, 2021). Government schemes such as the Integrated Sericulture Development Project (ISDP) and support from the North Eastern Development Finance Corporation provide training and tools, improving the sector's viability (Central Silk Board [CSB], 2018). Overall, Indian sericulture is a profitable, sustainable, and inclusive agricultural activity supporting rural economies, empowering women, and promoting environmental health. With continued investment in research, training, infrastructure, and policy support, sericulture can significantly advance India's socio-economic development and strengthen its global silk industry standing.

Silkworm rearing is widely recognized as an effective income source in rural and semi-urban India, where small landholdings and limited job opportunities prevail. With low capital needs and short production cycles, sericulture provides regular income to farming households. The Central Silk Board (2018) reports that farmers cultivating one acre of mulberry can earn a net annual income of ₹160,000–₹250,000, depending on rearing cycles, breed quality, and cocoon prices. Income benefits extend beyond farmers to reelers, spinners, weavers, and traders, supporting a broad rural employment ecosystem. States like Karnataka, Andhra Pradesh, and West Bengal rely heavily on sericulture, particularly as a livelihood for women and landless labourers, who undertake tasks like feeding, cocoon harvesting, and reeling, boosting household income and socio-economic empowerment (Yadav & Jadhav, 2017). Sericulture also provides livelihood security by mitigating seasonal agricultural risks. Its year-round 45-day cycles enable more frequent earnings than seasonal crops. When integrated with intercropping, livestock rearing, and agroforestry, sericulture enhances household resilience and food security (Altman & Farrell, 2022). Programs such as the Cluster Promotion Programme (CPP) and Integrated Sericulture Development Project (ISDP) have bolstered economic sustainability through training, subsidized inputs, and market access. For example, Karnataka's CPP (2013–2018) led to a 174.86% increase in raw silk production and improved household incomes (Agriculture Journal, 2019). Overall, sericulture's low-risk, high-return profile makes it a key component of rural development and poverty alleviation, while also enabling livelihood diversification without displacing other farming activities. Women play a pivotal role in sericulture, especially in feeding silkworms, sorting cocoons, and post-cocoon processing. Over 60% of the sericulture workforce comprises women, who have benefited from training programs that have empowered many to become micro-entrepreneurs in silk yarn production and weaving (Yadav & Jadhav, 2017).

Among tribal communities, the Bodo of Assam exemplifies how traditional eri silk rearing fosters sustainable livelihoods. Eri silk culture, primarily led by Bodo women, relies on castor and tapioca leaves, which are locally abundant and non-competitive with food crops, making the practice ecologically viable and less labour-intensive than mulberry sericulture (Goswami, 2019). In Bodoland Territorial Region districts like Baksa, Kokrajhar, and Udalguri, Bodo families earn an additional ₹20,000–₹40,000 annually from eri cocoon and yarn sales, supplementing farm or wage incomes, improving food security, and reducing seasonal migration (Bodo Women's Welfare Association, 2021). Government initiatives, such as the North Eastern Region Textile Promotion Scheme (NERTPS) and ISDP, have enhanced productivity by providing disease-free layings, technical training, and infrastructure support (Central Silk Board [CSB], 2018). For the Bodo, eri silk rearing is both a cultural tradition and an economic activity that promotes women's empowerment and rural development. Indigenous eri silkworm rearing (Philosamia ricini) plays a critical role in poverty alleviation and income enhancement, especially in Northeast India. It is practiced predominantly by marginalized communities like the Bodo, Mishing, and Karbi, utilizing low-cost, locally available resources. Eri rearing requires minimal land and offers multiple income streams from cocoon, pupae, and yarn production, making it a sustainable livelihood well-suited to the agro-climatic conditions of Assam and neighbouring states (Goswami & Deka, 2020). The silkworms feed on castor and

tapioca leaves, which grow on fallow or marginal land, allowing households with limited resources to participate (Borah et al., 2021). This flexibility enables rearing alongside other agricultural or domestic tasks, ideal for smallholders and women-headed households.

Income studies indicate that Eri rearers can earn ₹15,000–₹40,000 annually from small-scale operations, depending on cycles, yields, and market prices (Central Silk Board [CSB], 2018). In the BTR, many Bodo households report improved income and social recognition, especially among women involved in spinning and weaving eri yarn (Bodo Women's Welfare Association, 2021). Eri sericulture is also more resilient to market and climate fluctuations than mulberry, as it requires fewer controlled conditions and is less vulnerable to diseases. Additionally, because Eri silk is harvested without killing the pupa—earning it the label 'ahimsa silk' it aligns with local ethical values and appeals to domestic and international ethical fashion markets, expanding income opportunities (Goswami & Deka, 2020; Altman & Farrell, 2022). Government schemes like ISDP and NERTPS have facilitated disease-free layings, training, and market access, strengthening Eri livelihoods in Assam, Meghalaya, and Arunachal Pradesh (Central Silk Board [CSB], 2022). The integration of Eri rearing with Self Help Groups (SHGs) and community organizations has improved collective marketing and bargaining power. As a result, Eri rearing is a powerful poverty reduction and empowerment tool, especially for tribal communities, with continued policy support crucial for scaling its benefits. India, as the world's second-largest silk producer and the only country producing all four commercial silk types' mulberry, eri, tasar, and muga holds great socio-economic and cultural significance in sericulture (Central Silk Board [CSB], 2021). However, the silk value chain faces challenges such as uneven market linkages and income disparities. The chain includes pre-cocoon activities (mulberry cultivation and silkworm rearing), cocoon marketing, reeling and spinning, and weaving/finishing/marketing (Rathore et al., 2020). Small farmers dominate pre-cocoon activities, but often lack access to market information, quality disease-free layings, and credit, limiting productivity (Singh & Muthu, 2019).

Cocoon marketing is a critical bottleneck, especially in the Northeast where informal markets and middlemen dominate, resulting in lower prices for producers like the Bodo (Borah et al., 2021). The reeling and spinning sector is largely unorganized, particularly for non-mulberry silk like eri, which relies on manual methods, creating challenges in scalability and quality (Goswami & Deka, 2020). Nevertheless, the rising demand for ahimsa silk in ethical fashion has opened export opportunities, underscoring the need for investment in branding and certification (Altman & Farrell, 2022). In the final stage, weaving and retailing meet strong demand but producers face weak market linkages. Initiatives such as Common Facility Centres, Silk Mark Certification, and e-commerce platforms aim to connect artisans directly to consumers (Central Silk Board [CSB], 2022). The UNDP found that only 20%–30% of retail silk garment value reaches producers, with intermediaries capturing the rest (United Nations Development Programme, 2018). Addressing these imbalances requires policy focus on capacity building, cooperative models, direct sales, and digital market access. Strengthening the value chain is vital for inclusive growth and to unlock the full potential of India's silk industry, especially for marginalized groups like the Bodo eri producers. Compared to traditional livelihoods like paddy farming, wage labour, and livestock rearing, Eri silkworm rearing stands out for low capital needs, ecological compatibility, and resilience. In Assam, Meghalaya, and Arunachal Pradesh, it offers a sustainable, culturally accepted livelihood, particularly for tribal groups constrained by fragmented land and climatic challenges (Goswami & Deka, 2020). Initial investment is modest (₹5,000–₹10,000 per cycle), while net returns can reach ₹15,000–₹30,000 annually (Central Silk Board [CSB], 2021). Eri rearing provides self-employment and social empowerment for women, who spin and weave the yarn, strengthening community economic resilience (Yadav & Jadhav, 2017). Its disease resistance and alignment with ethical values further increase its appeal in niche markets (Altman & Farrell, 2022). Integrated with other livelihood activities, Eri culture promotes income diversification without compromising food production (Borah et al., 2021). Eri sericulture (Indi rearing) is a viable, low-risk livelihood alternative that enhances income, empowers women, and supports ecological sustainability. It holds promise as a strategic asset for poverty alleviation and rural development in Northeast India, with future investments in infrastructure, training, and market access critical to expanding its impact.

4. THE SOCIAL DIMENSIONS AND EMPOWERMENT THROUGH INDI REARING

Indi silkworm rearing, or eri sericulture, is a culturally ingrained livelihood of the Bodo community in the Bodoland Territorial Region (BTR). It holds profound social importance beyond economic benefits, fostering community cohesion, gender empowerment, and the preservation of indigenous knowledge. The Bodos historically regard eri silk not just as an economic resource but also as a symbol of cultural identity and tradition (Goswami & Deka, 2020). The practice involves collective efforts across stages from cultivating host plants and rearing silkworms to weaving which reinforces

social bonds and facilitates intergenerational knowledge transfer (Borah et al., 2021). Festivals and social functions often showcase eri silk, amplifying communal pride and underscoring the craft's social role. Crucially, eri sericulture empowers rural women, who dominate the workforce in silkworm rearing and post-cocoon processing (Yadav & Jadhav, 2017). It offers them supplemental income, skill development, and financial independence, which studies link to enhanced household decision-making and gender equity (Das & Deka, 2019). Women's self-help groups (SHGs) and cooperatives in the BTR further institutionalize empowerment by enabling collective action, capacity building, and market access (Central Silk Board [CSB], 2021).

Indi rearing also conserves indigenous ecological knowledge especially in host plant management, silkworm care, and weaving techniques (Goswami & Deka, 2020) which supports sustainable livelihoods aligned with local biodiversity and agro-climatic conditions. Socio-economic gains from eri sericulture help alleviate poverty and uplift marginalized villages in Assam and BTR (Borah et al., 2021). Despite these advantages, challenges persist such as limited formal education, weak market linkages, and inadequate institutional support, which constrain the sector's full empowerment potential (Das & Deka, 2019). Moreover, youth migration to urban areas threatens the continuity of traditional practices. Government programs like the National Sericulture Mission and Silk Samagra aim to strengthen social aspects by integrating capacity building, women's empowerment, and community engagement (Ministry of Textiles, 2021). Labour division in Indi silkworm rearing is distinctly gendered, with women undertaking most of the delicate and continuous tasks. Bodo women feed eri larvae with castor and tapioca leaves, maintain hygienic rearing environments, monitor silkworm health, and manage disease control tasks demanding close attention, patience, and biological knowledge passed down through generations (Goswami & Deka, 2020). They also carry out labour-intensive post-cocoon activities such as spinning, weaving, and dyeing, which require skill and creativity, highlighting women's central role in value addition (Borah et al., 2021). Men typically perform preparatory and supplementary duties, including cultivating host plants, preparing land, maintaining infrastructure, and handling marketing and trade (Das & Deka, 2019). This division reflects traditional cultural norms and the nature of specific tasks but also aligns with broader patriarchal structures in rural Assam, where women's labour is often undervalued despite its economic significance.

Women's engagement in eri sericulture enhances their economic status by providing independent income and increasing bargaining power within households. Organized SHGs and cooperatives enable women to collectively market products, access credit, and receive training, boosting their socio-economic position and empowerment (Central Silk Board [CSB], 2021). However, women face constraints such as limited access to modern technologies, extension services, and credit tailored to their needs. The dual burden of domestic duties and labour-intensive sericulture often causes time poverty and workload stress. Gender-sensitive policies, improved training, and institutional support are essential to fully unlock women's potential and promote equity in the sector (Das & Deka, 2019). Indi rearing offers women a reliable income source that is less seasonal than many agricultural activities, fostering economic independence and resilience (Goswami & Deka, 2020). The accessibility of eri sericulture to marginalized women, coupled with SHG participation, facilitates financial literacy and credit access, enabling investment in better technologies and income diversification (Central Silk Board [CSB], 2021). Socially, the development of specialized skills fosters pride, confidence, and social networks that extend women's visibility beyond domestic spheres (Borah et al., 2021). Participation in cooperatives strengthens collective bargaining power and social capital, increasing women's voice in community affairs (Das & Deka, 2019). Enhanced economic contributions also improve women's roles in household decision-making on expenditures, education, and health, while leadership in SHGs translates into broader participation in local governance (Yadav & Jadhav, 2017; Goswami & Deka, 2020). Addressing persistent challenges such as land ownership issues, patriarchal norms, and time poverty requires targeted interventions promoting technical skills, credit access, and institutional support with a gender focus (Das & Deka, 2019).

Skill development and knowledge transfer are vital to sustaining and improving Indi sericulture. The Bodo community's traditional sericulture knowledge host plant cultivation, silkworm biology, pest management, and weaving has been orally transmitted mainly by women, preserving cultural uniqueness but limiting exposure to modern innovations (Goswami & Deka, 2020). Government initiatives by the Central Silk Board and Assam Sericulture Mission provide training on improved breeds, disease control, and rearing techniques, supplemented by field demonstrations and digital tools to enhance outreach (Central Silk Board [CSB], 2021; Das & Deka, 2019). SHGs and cooperatives facilitate peer learning and collaborative problem-solving, fostering a supportive environment for technology adoption and resilience (Borah et al., 2021). Yet challenges like low literacy, resistance to change, and inadequate infrastructure persist, necessitating inclusive, culturally sensitive training models that blend scientific advances with indigenous knowledge. Engaging youth through vocational education and entrepreneurship can secure the sector's future (Yadav &

Jadhav, 2017). Social networks underpin the Indi rearing economy by enabling resource sharing, knowledge exchange, and collective action. Family, neighbours, SHGs, cooperatives, and village groups form a web of support that facilitates silk production and market participation (Das & Deka, 2020). Women's and men's cooperative organizations enhance community cohesion and collective identity, reducing risks and improving market negotiation capacity (Borah et al., 2021; Central Silk Board [CSB], 2022). Cultural rituals and festivals linked to eri sericulture reinforce social capital, intergenerational knowledge, and community resilience (Goswami & Deka, 2021). Nonetheless, modernization, migration, and commercialization challenge traditional social networks, risking loss of labour and communal knowledge (Baruah & Das, 2023). Strengthening inclusive community organizations, integrating traditional and modern practices, and leveraging digital platforms are critical to sustaining social cohesion and the viability of Indi rearing (Sarmah & Kalita, 2022).

Social mobility the ability of individuals or groups to improve their socio-economic status remains a complex issue for communities relying on traditional livelihoods like Indi (eri) silkworm rearing among the Bodos in Assam's Bodoland Territorial Region (BTR). While eri rearing offers potential for upward mobility, several structural and socio-cultural barriers limit its full benefits. A key challenge is persistent socio-economic inequality, including restricted access to land, credit, and modern technology (Das & Deka, 2020). Most Bodo rearers are smallholders or landless labourers who lack the resources to scale production. Educational gaps also limit knowledge acquisition and skill development, hindering innovation and diversification across the sericulture value chain (Baruah & Das, 2023). Gender inequalities further restrict progress; despite women's major role in eri rearing, patriarchal norms often deny them decision-making power and property rights, limiting their socio-economic advancement (Goswami & Deka, 2020). Market challenges such as price volatility and poor market access reduce economic gains from silkworm rearing (Borah et al., 2021). Without stable incomes or strong market linkages, many rearers struggle to accumulate capital for reinvestment, keeping them trapped in poverty. Additionally, modernization and shifting aspirations among youth sometimes devalue traditional livelihoods, threatening social continuity and mobility pathways (Sarmah & Kalita, 2022).

Despite these hurdles, Indi silkworm rearing offers important avenues for social mobility, especially through empowerment and entrepreneurship. Its low entry barriers and labour-intensive nature make eri rearing accessible to marginalized groups, including women and landless families, enabling income generation and asset building (Central Silk Board [CSB], 2021). The rise of cooperative societies and self-help groups has strengthened collective bargaining, improving access to credit, inputs, and markets. This collective approach enhances economic stability and elevates social standing (Das & Deka, 2020). Skill development and capacity-building initiatives have further boosted technical expertise and adoption of innovations, allowing some rearers to increase productivity and diversify income through value addition and silk product manufacturing (Yadav & Jadhav, 2017). Such progress challenges traditional views and raises social recognition, vital components of social mobility. Additionally, integrating sericulture with eco-tourism and cultural heritage promotion creates alternative livelihood opportunities that can uplift community members socio-economically (Borah et al., 2021). To fully realize social mobility potential, policies must address structural barriers by improving access to land, credit, and education. Gender-sensitive measures promoting women's land ownership and leadership in sericulture are essential for inclusive advancement (Goswami & Deka, 2020). Enhancing market infrastructure and stabilizing prices can secure incomes and encourage reinvestment. Moreover, combining traditional knowledge with modern technology through participatory extension services can empower communities and sustain positive mobility trajectories (Sarmah & Kalita, 2022).

5. CHALLENGES AND PROSPECTS OF INDI SILKWORM REARING

Indi silkworm rearing, centered on Eri silk production, has been a traditional and vital livelihood for the Bodo community in Assam's Bodoland Territorial Region (BTR). Beyond its economic role, this practice carries deep cultural significance and supports many rural households (Goswami & Deka, 2020). However, despite its importance, Indi rearing faces multiple production and socio-economic challenges that limit its growth and productivity. Still, ongoing developments and institutional support present promising opportunities to enhance the sector's role in sustainable rural development. A major challenge for Bodo rearers is the reliance on traditional rearing methods and indigenous, low-yielding silkworm varieties. While these methods preserve cultural heritage, they often result in subpar cocoon yields and quality due to low disease resistance and productivity (Borah et al., 2021). The lack of widespread availability of improved Eri silkworm breeds and modern rearing technologies further restricts income growth for many small-scale farmers (Goswami & Deka, 2020).

The environmental and biological factors also complicate production. Eri silkworms are vulnerable to diseases like grasserie and flacherie, which can sharply reduce cocoon output if not properly managed (Borah et al., 2021). Additionally, climate change manifests through irregular rainfall, temperature swings, and seasonal shifts, all of which affect the availability and quality of key host plants castor and tapioca that feed silkworm larvae. The Bodo community, which largely depends on natural host plants without supplementary feeding or irrigation, is particularly exposed to these ecological fluctuations (Ram et al., 2016). Market constraints add to the difficulties. Assam's silk value chain is fragmented, involving many intermediaries that dilute profits for primary producers. Bodo Eri rearers often lack direct links to processors, exporters, and end markets, causing price volatility and income insecurity (Central Silk Board [CSB], 2021). This discourages investment in improved inputs and sustainable scale-up efforts. Financial and institutional support for the Bodo community remains insufficient. Access to formal credit, insurance, and subsidies is limited, restricting investments in essential inputs such as disease-free layings (DFLs), rearing infrastructure, and post-cocoon processing tools (Bodo Women's Welfare Association, 2021). Extension services are fragmented, and coordination among sericulture agencies is weak, slowing the spread of innovations needed to raise productivity.

Social and gender dimensions also shape the sector's outcomes. Women constitute a large share of the sericulture workforce, especially in rearing, spinning, and weaving. However, patriarchal norms often limit their access to resources, training, and leadership roles (Yadav & Jadhav, 2017). Empowering women through targeted interventions could significantly enhance productivity and household well-being. Despite these challenges, Indi silkworm rearing holds substantial promise for the Bodo and similar indigenous groups. Eri sericulture is eco-friendly and sustainable, aligning well with the community's cultural values and agricultural systems. Moreover, the non-violent harvesting method used in Eri silk production appeals to consumers who value ethical and sustainable textiles, opening niche markets at both national and international levels (Altman & Farrell, 2022). Government initiatives such as the Integrated Sericulture Development Project (ISDP) and the North Eastern Region Textile Promotion Scheme (NERTPS) have begun to address key constraints by providing inputs, training, and infrastructure support (Central Silk Board [CSB], 2022). These programs aim to boost productivity, improve product quality, and strengthen market linkages. The growth of cooperative societies and self-help groups (SHGs) has also empowered producers particularly women to negotiate better prices and access wider markets collectively (Borah et al., 2021).

The research institutions are actively working on developing improved silkworm breeds, disease management strategies, and climate-resilient host plants, which could stabilize yields and enhance silk quality (Ram et al., 2016). Modernization efforts in spinning and weaving coupled with digital marketing platforms offer new opportunities for value addition and income diversification for the Bodo community. However, the availability of quality host plants remains a fundamental challenge. Castor (Ricinus communis) and tapioca (Manihot esculenta) are essential feed sources for Eri larvae, relied upon by both Bodo and non-Bodo rearers in the BTR. Seasonal fluctuations, limited arable land, and competing agricultural priorities often constrain the adequate cultivation of these plants (Das & Deka, 2019). Furthermore, shifting cultivation and land fragmentation in Bodo areas have diminished the continuous availability of castor and tapioca (Goswami & Deka, 2020). Non-Bodo sericulture practitioners face similar challenges, exacerbated by limited knowledge of host plant management and lack of access to improved planting materials. Indi silkworm rearing among the Bodos remains a culturally embedded and economically significant livelihood despite facing biophysical, market, institutional, and social barriers. Strategic investments in capacity building, infrastructure development, financial inclusion, and market integration alongside sustained policy support are essential to unlocking the full potential of Eri sericulture. Such efforts can enhance productivity, diversify incomes, empower marginalized groups (notably women), and contribute meaningfully to sustainable rural development in Assam's BTR.

Disease outbreaks significantly threaten silkworm productivity in the Bodoland Territorial Region (BTR) of Assam. Eri silkworms are vulnerable to diseases like grasserie, flacherie, and muscardine, causing high mortality and poor cocoon quality (Borah et al., 2021). Traditional rearing conditions among the Bodos often lack proper hygiene and biosecurity, enabling disease spread. Limited awareness and poor access to veterinary extension services prevent many rearers both Bodo and non-Bodo from adopting effective disease control strategies (Central Silk Board [CSB], 2021). The absence of disease-resistant Eri silkworm breeds worsens this challenge. Rearing methods used by Bodo and non-Bodo communities remain largely traditional and low-input. While aligned with cultural practices, these methods often lead to inefficient resource use and lower production. For example, many rearers use open-air setups without controlling temperature or humidity, which are crucial for larval health (Goswami & Deka, 2020). Overcrowding and irregular feeding cause larval stress and raise disease susceptibility (Borah et al., 2021). Non-Bodo sericulturists, often migrants, sometimes miss out on community training programs, limiting their ability to improve practices. Socio-economic factors

add complexity. Both Bodo and non-Bodo rearers face limited access to formal credit and inputs, restricting investment in improved infrastructure and disease control (Das & Deka, 2019). Women, who form a large portion of the sericulture workforce especially among the Bodos, encounter gendered barriers to training and finances, reducing their ability to benefit from better production techniques (Yadav & Jadhav, 2017). Addressing these ecological, technical, and socio-economic challenges such as host plant shortages and poor disease management requires inclusive interventions targeting all communities and emphasizing women's empowerment to unlock Indi sericulture's full potential as a sustainable livelihood in the BTR.

Marketing is another crucial yet challenging aspect of the Indi sericulture value chain. Price volatility in raw cocoons and silk results from seasonal production, inconsistent quality, and fluctuating demand (Central Silk Board [CSB], 2021). Bodo rearers often receive unstable, lower prices due to weak bargaining power and reliance on intermediaries exploiting information gaps (Borah et al., 2021). This unpredictability reduces income stability and discourages reinvestment. Limited market access is a significant barrier, especially for rural producers lacking direct connections to urban and export markets, which forces dependence on middlemen (Das & Deka, 2019). The absence of organized marketing platforms, such as silk bazaars or cooperatives, further hampers fair pricing. Poor transport and digital connectivity in remote areas restrict timely market information (Goswami & Deka, 2020). Non-Bodo rearers face similar exclusion due to marginal socio-economic status. Value addition at the producer level is minimal; most sell raw cocoons without engaging in higher-margin processing activities like spinning or weaving (Central Silk Board [CSB], 2022). This lack of vertical integration limits income and exposes producers to exploitation. Constraints include limited access to processing technology, skill training, and capital (Borah et al., 2021).

The weak branding and certification also reduce market acceptance, particularly in ethical textile niches. Quality inconsistency due to traditional rearing and processing affects consumer confidence and market expansion (Ram et al., 2016). The absence of standardized grading and certification leads to price disparities and mistrust. Institutional and policy gaps further hinder Indi sericulture growth in the BTR. Though schemes like the National Sericulture Policy (2004) and Central Sector Scheme provide subsidies and training (Ministry of Textiles, 2020), their reach and focus on Eri silk remain limited. Formal credit access is poor due to complex procedures and collateral demands, pushing rearers toward costly informal loans (Das & Deka, 2019; Borah et al., 2021). Extension services suffer from staffing and coordination issues, limiting dissemination of improved technologies, especially among women (Goswami & Deka, 2020).

The government programmes such as the Rashtriya Krishi Vikas Yojana (RKVY), Silk Samagra Scheme, and National Rural Livelihood Mission (NRLM) offer potential support through infrastructure, quality inputs, training, and SHG formation, which could empower Bodo women sericulturists which is provided by the Ministries of Agriculture, Textiles, and Rural Development, 2021–2022 (Ministry of Textiles, 2021; Ministry of Rural Development, 2021; Ministry of Agriculture & Farmers Welfare, 2022). Effective local implementation of these schemes is critical. Despite challenges spanning disease management, traditional practices, market inefficiencies, and institutional gaps, Indi silkworm rearing remains a culturally vital and economically promising livelihood in the BTR. Integrated, inclusive strategies addressing technical, financial, and gender barriers can unlock its sustainable development potential. Changing lifestyles driven by urbanization, education, and alternative employment have led to a decline in younger generations' interest in traditional silkworm rearing among the Bodo community (Goswami & Deka, 2020). Many youths now migrate to urban centres for jobs or education, creating a generational gap that threatens the transmission of indigenous sericulture knowledge. Traditional silkworm rearing in the Bodoland Territorial Region is more than an economic activity; it is deeply tied to cultural identity and rituals. Modernization risks eroding these cultural practices, weakening community cohesion and heritage (Borah et al., 2021). At the same time, modernization has increased women's participation in formal training and market activities, promoting socio-economic empowerment. This dual impact highlights the complex balance between tradition and modernity in the sector.

The consumer preferences in domestic and international markets now demand product diversification and higher quality (Central Silk Board [CSB], 2022). While this encourages innovation, it requires skills and investments often beyond the reach of small-scale producers accustomed to traditional methods. Many face difficulties reconciling modern market demands with preservation of artisanal techniques. Thus, modernization presents both opportunities and challenges for Indi silkworm rearing in the BTR. Sustainable development requires sensitive integration of new technologies with indigenous knowledge and policies that encourage youth engagement and capacity building. Indi (Eri) sericulture offers notable opportunities for sustainable development and diversification in the BTR, where it is culturally embedded and eco-friendly. Eri silkworms feed on castor and tapioca leaves crops that require minimal chemical inputs

and grow well on marginal soils making the practice environmentally sustainable (Central Silk Board [CSB], 2022). Integrating agroforestry, such as intercropping castor with food crops, can optimize land use and enhance resilience to climate change (Altman & Farrell, 2022). Organic certification can attract premium markets prioritizing ethical and sustainable production, boosting income for producers.

The strengthening cooperatives and Self-Help Groups (SHGs) are the key to scaling Indi sericulture. These institutions enable collective input procurement, access to modern technologies, and bulk marketing, enhancing bargaining power and lowering costs (Borah et al., 2021). In the BTR, cooperatives have empowered Bodo women by integrating them into production and marketing, promoting inclusion and financial independence (Das & Deka, 2019). Government schemes like the National Rural Livelihood Mission (NRLM) and Silk Samagra support cooperatives' growth and sustainability (Ministry of Textiles, 2021). Community engagement is vital for sustainable development. Indigenous knowledge of the Bodo and other ethnic groups offers valuable insights into eri rearing and silk weaving, which combined with scientific advances can improve productivity and cultural preservation (Goswami & Deka, 2020). Participatory approaches and capacity building through training and extension services ensure cultural respect and inclusivity.

The participation of women it enhances the household incomes and social status (Yadav & Jadhav, 2017). Diversification across the eri silk value chain spinning, weaving, textile design, and handicrafts can create multiple income streams (Central Silk Board [CSB], 2021). Emerging niche markets in eco-fashion and organic textiles offer premium opportunities. Integrating sericulture with rural tourism to showcase cultural heritage and craftsmanship is another promising avenue (Borah et al., 2021). Sustainable development of Indi sericulture in Assam's BTR depends on leveraging its eco-friendly nature, strengthening cooperative frameworks, and fostering community participation. By blending traditional knowledge with innovation and aligning with market trends, Indi sericulture can become a resilient, inclusive, and profitable rural enterprise. Effective policy support, capacity building, and strategic marketing will be essential to unlock its full potential.

6. CONCLUSION

Indi silkworm rearing is of great socio-economic importance to the Bodo community in the Bodoland Territorial Region (BTR) of Assam. This traditional livelihood merges cultural heritage with economic support, serving as a crucial income source, especially for marginalized rural households and women. The Bodos possess rich indigenous knowledge related to eri silk production, which sustains their cultural identity while promoting biodiversity and environmentally sustainable agriculture. Economically, Indi sericulture supplements household incomes through cocoon production and associated activities like spinning and weaving. It offers employment accessible to landless labourers and women, fostering inclusive rural development. Women's involvement in eri silkworm rearing and silk processing boosts their social and financial empowerment, advancing gender equity within the community. Moreover, the labour-intensive nature of this work addresses rural underemployment and encourages self-reliance.

Despite its potential, several challenges limit the socio-economic benefits of Indi sericulture. Institutional weaknesses, such as limited access to credit and weak market linkages, hinder growth. Traditional practices, while culturally significant, can restrict scalability and innovation, especially as younger generations shift toward other livelihoods. Market volatility and lack of modern infrastructure further reduce profits for smallholders, limiting economic gains. To fully realize Indi sericulture's socio-economic potential, efforts must integrate scientific advances with traditional knowledge. Strengthening cooperative institutions and improving market access through value addition and branding are essential. Tailored government schemes and capacity-building programs that address local needs can empower producers and promote sustainable development.

The supporting Indi silkworm rearing as both a cultural asset and an economic enterprise can significantly contribute to poverty reduction, women's empowerment, and rural resilience in the BTR. By enhancing productivity, ensuring fair market returns, and preserving cultural heritage, Indi sericulture can sustain livelihoods and strengthen community cohesion among the Bodos.

CONFLICT OF INTERESTS

None.

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