



Empowering Tribal Communities Through Sustainable Lac Harvesting

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Abstracts

Sustainable lac cultivation holds significant potential for strengthening rural economies, promoting environmental conservation, and empowering marginalised communities. Lac cultivation, an important non-timber forest product, offers a variable source of income for tribal and forest department households. This paper explores the role of sustainable lac enterprises as a catalyst for community empowerment through improved livelihoods, capacity building, and equitable participation. By integrating traditional knowledge systems with modern scientific practices, communities can enhance lac productivity, maintain ecological balance, and adapt to changing environmental conditions. The present study highlights successful models of community-based lac production that have improved income stability, promoted women's participation and strengthened local governance mechanisms. In Bridging management policies and on-ground practise, sustainable lac enterprise management demonstrates a viable pathway toward building resilient rural economies and achieving the broader goals of sustainable development. This approach underscores the need for collaborative strategies that align ecological integrity with socio-economic empowerment, ensuring that lac cultivation continues to thrive as both a livelihood source and a tool for environmental sustainability.

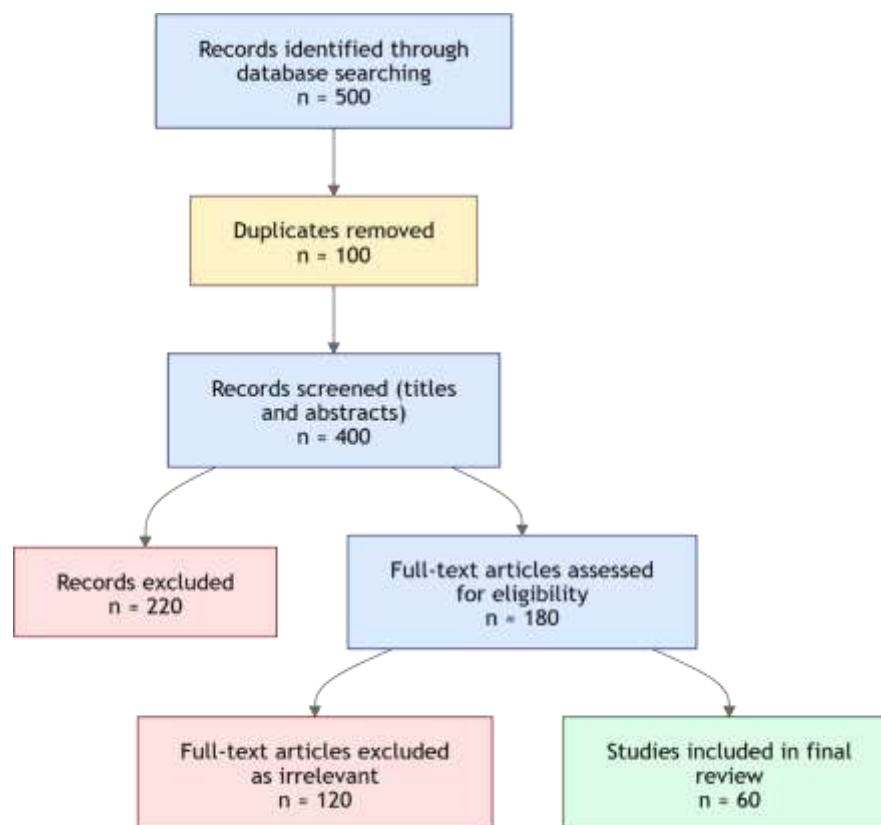
Keywords: Lac cultivation, Community empowerment, Environmental conservation, Sustainable development, Rural resilience, Inclusive governance

1. Introduction

Sustainable harvesting of lac (shellac) has many-fold positive effects on the tribal communities, as it preserves forest ecosystems, at the same time supporting the livelihoods of rural communities. The lac insects (mainly *Kerria lacca*) produce resin, wax and dye on trees (e.g. kusum *Schleichera oleosa*, palas *Butea monosperma*, ber *Ziziphus mauritiana*). Sustainable harvesting of lac - through rotational harvesting and conserving host trees - sustains biodiversity and offers predictable incomes to forest-reliant households. This review determines the way in which the tribals, particularly women, can be empowered through inclusive value-chain interventions (training, women SHGs, cooperative marketing, and market linkage programs) to enhance returns on lac and enhance community agency. This systematic review is a synthesis of different sources (peer-reviewed articles, official reports, and NGO case studies) to inform policy and practice. Thus sustainable lac farming could be expanded as a poverty-reduction strategy as well as a biodiversity strategy, backed by technical extension, cooperative marketing, women-empowerment programs, and land/forest tenure security.

2. Methodology

The search strategy included academic databases (Web of Science, Scopus, Google Scholar) and institutional databases (FAO, TRIFED, national forestry/agriculture agencies) in 2003-2026. Keywords comprised of combinations of keywords lac or shellac or *Kerria lacca* and tribal or NTFP or sustainable harvesting or value chain or livelihood or policy. Reference lists of key papers and reports were hand-searched for additional sources. The search was limited to English-language publications. Peer-reviewed articles, technical reports, theses, and official documents that are centered on lac cultivation or harvesting and its socio-economic or ecological factors, particularly those related to forest/tribal populations were included. The documents were required to cover at least one of the following themes: lac biology/ecology, sustainable harvesting practices, tribal livelihoods, value chain/market, gender or pertinent policy frameworks. Publications that were not about lac or tribal settings, non-forestry/non-agriculture NTFPs, news articles, and non-English languages were not included. Publications that did not have a full text were also not included. Under study selection the preliminary list of ~500 records were obtained. The total records after the duplicate removal (n=100) and title/abstract screening were 180 records to undergo full-text review. Out of these 120 were not included (reasons: e.g. peripheral topic, insufficient data). Finally, there was analysis of approximately 60 studies/reports. The PRISMA type ,of flow is summarized as follows:



Source: Compiled by authors

Lastly, the methodological quality of the sources was assessed. In the case of quantitative studies (e.g. surveys, experiments), we evaluated sample size, sampling and data analysis. In the case of qualitative case studies, the clarity of purpose, participatory procedures, and data triangulation was evaluated. The selection comprised of peer-reviewed and official studies. Grey literature (NGO working papers) was utilized carefully, and it was cross-verified with evidence published. There was no assignment of scores to the studies in a formal way, instead, it was mentioned as the limitations found in general (e.g. small sample size or no control groups in intervention studies) to put the findings into perspective.

3. Dimensions of the study

The study was purposefully categorised into nine dimensions for better understanding on the sustainable lac cultivation and its impact on different stakeholders.

3.1 Ecology And Biology of Lac

Lac is a scale insect resinous secretion, secreted by the scale insects of the host trees (*Kerria lacca* and others). It is rare being the only natural raw material obtained of insects. More than 400 tree species worldwide are known to harbor lac insects, though only a small number are commercially grown: kusum (*Schleichera*), palas (*Butea*) and ber (*Ziziphus*) in India. Lac insects consume plant sap and are only able to develop on these few hosts, laying eggs on branches and depositing a protective resin. There are two primary lac strains (kusmi and rangeeni) that are used in rotating parts to yield as many as four crops annually.

Lac cultivation is an extremely diverse ecosystem. There are numerous predators and parasitoids of lac insects; over 30 primary parasites and 45 secondary parasitoids have been documented. A multi-trophic web, this implies that the conservation of endangered species can actually be achieved by the promotion of lac culture: as a result of abandoned lac plantations, fauna is lost. The presence of natural enemies (moths, ants, fungi, etc.) may decrease the yields by more than 50 percent, which is why they should be managed properly. Lac composition (resin, wax, dye) is useful and non-toxic diverse industries (food glazing, pharmaceuticals, varnishes, electronics).

Research lays stress on the ecological merits of lac. As an example, Chakrabarti, and Dutta (2026) observe that lac is collected in a sustainable manner: in contrast to timber harvesting, lac cropping does not damage the ecosystem by harvesting the entire ecosystem, but rather by preserving a portion of it. In Jharkhand, there is a practice of rotational lac cultivation that omits whole cycles of the host-tree to enable regeneration of *Ziziphus mauritiana* and *Butea monosperma*. Relative to this, conventional agriculture has the potential of enriching resources. Thus, lac cultivation simultaneously conserves forest cover and species.

3.2 Sustainable Harvesting Practices

Sustainable lac harvesting will involve a balance of yield and host-tree and insect health. The traditional tribal knowledge offers some practices: farmers will pick broodlac (insect eggs) selectively on branches at the right time, leave some trees unproductive to the cycle, and not to overharvest (e.g. leaving 30% of crops unharvested to control pests, as in similar NTFP foraging). Scientific extensions (e.g. ICAR protocols) train growers in Package of Scientific Lac (PSCL) cultivation - including broodlac storage, inoculation timing, post-harvest processing. According to case studies (e.g. Udyogini-PACS project), the use of PSCL resulted in a 20-40% higher yield,

relative to wild collection (Goud, 2016, unpublished field reports).

The timing of harvest is important: lac is harvested in phases (seedlac when it has been cured, and sticklac when the resin has fully developed). Sustainable practice includes removing the branches in a controlled manner that will leave behind sufficient broodlac to replenish host trees the following season. Better ways (e.g. irrigating host trees during dry seasons) can raise production without cutting down the trees. However, productivity is climate-dependent; in case of drought or untimely rainfall, crops may be ruined as observed in Chhattisgarh experiments. These combined managements have environmental benefits. As an illustration, the Gariaband (Chhattisgarh) study above discovered that resuscitated lac culture even saved kusum forests and boosted seasonal earnings (3000-6000 per harvest). Overall, the literature agrees that sustainable lac farming both allows the preservation of forest trees and enhances the resiliency of households (Thomas, 2012; Goud, 2016).

3.3 Socio-Economic Impacts on Tribal Communities

In the tribal areas, lac farming has been proved to be a good livelihood improver. The minor forest produce (MFP) sector of India, which includes lac, supports the livelihoods of at least ~275 million Indians (lac is 40 per cent of the income of many forest tribes). NTFP (including lac) contributes 30- 50% of rural household income in such states as Jharkhand, Chhattisgarh, Odisha and MP. The high value of lac and its multiple cropping make it particularly desirable: lac is very remunerative, needs little labour and can be grown on the degraded or fallow land.

In terms of income, incomes of lac are high annually. A complete household survey (included in MP) in a single year revealed that seasonal incomes of one NTFP harvest were ₹5000-8000. Jharkhand and Chhattisgarh case studies had women stating that they used the lac earnings in the education, health and household assets of children. Notably, lac income tends to come during the lean farming period (e.g. summer months), which serves to cushion crop failure. Poverty incidence in a forest is reduced by diversification in 5+ NTFPs by an estimated 25% (Shackleton and Shackleton, 2004) - lac is an important component in this portfolio.

3.4 Value and Trade: India has an annual production of lac/year of approximately 20,000 tonnes and tens of millions of shellac as export (US\$36M in the H1 FY2026). Domestic collector price of crude lac (seedlac) is about INR 1000-1200/kg which would translate to an average of 3-6k/tree harvest. But intermediaries take a significant amount of value: collectors usually receive only a fraction of end-user price (10-20 percent). Greater processing (crushing, wax removal, shellac flaking) can increase incomes, as shown in cluster units in Madhya Pradesh which showed 35-55% higher prices of graded lac with SHGs (MP Forest Dept, 2020).

3.5 Employment & Empowerment: Lac collection provides millions of jobs - it is estimated that 3-4 million people who are forest-dependent (mainly tribal) are directly benefiting the lac sector. Since lac is a labour-intensive crop to process, it can offer all-year-round employment during the off-season. Power is also a visible phenomenon: researchers indicate that, through the income derived out of lac, tribal families were able to invest in education and social capital (Thomas, 2012; Mulalic & Olsen, 2004 in [45]). In one survey, tribal women used lac earnings to reinvest in agriculture or local institutions which enhanced community governance.

3.6 Value Chain and Market Access

The lac value chain contains a number of steps: cultivation - harvesting - primary processing - value- addition - market. Inoculation and harvest (seedlac, sticklac) are done by tribal producers (who are landless or have small holdings). Collectors typically do primary processing (boiling, drying, crushing to extract broodlac). After additional refining to shellac flakes and a separation of the dye, this is done in larger units (typically in the Malda district of Jharkhand or Odisha). Lastly, shellac is either directly exported or sold directly to industries (coatings, food, jewellery).

The diagram below represents the lac value chain insect to market. It emphasizes important processes in which tribal producers and stakeholders engage (inoculation, harvest, processing, value-addition, and trade).

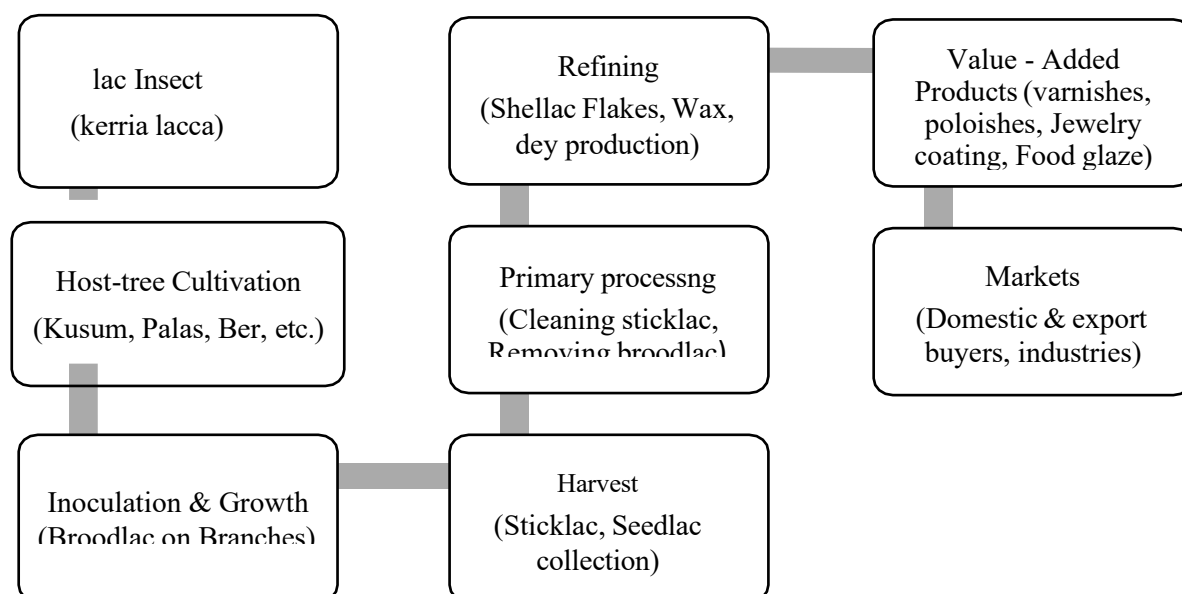


Figure 2: Lac value chain

The key stakeholders are the producers (tribal farmers/workers), local traders/intermediaries, processing cooperatives, industry buyers and the export councils. It is worth noting that cooperatives such as the Jharkhand State Cooperative Lac Marketing Federation (JASCOLAMPF) and foreign buyers (Europe, US, Japan) are the

determinants of prices and demand. The chain is broken, however. According to Chakrabarti and Dutta (2026), sellers are not as powerful due to poor infrastructure (no cold storage, poor transport) and the absence of market information. Excess dependence on export markets is also risky: the demand on the overseas market may lead to price crashes in the country (as it happened with the Simdega project).

These bottlenecks are the subject of intervention program. As an example, Van dhan Vikas Kendra scheme by TRIFED organized clusters of tribal producers having shared processing and marketing facilitation. By 2022, 62% of these scheme beneficiaries were women and the scheme offer grading/packaging training. SHEFEXIL (Shellac and Forest Products Export Promotion Council, Ministry of Commerce) maintains capacity building, quality testing laboratories and even an NTFP Information Centre. These actions have started interconnecting manufacturers with bigger markets (TRIFED e-commerce portal, export fairs) to achieve higher prices.

3.7 Market Value: The global market of shellac is expanding (US\$165M in 2024, estimated US\$196M in 2033) and India is the key contributor to it 50-60%. Lac has a higher per-unit value compared to bulk commodities (Table: key NTFPs, note lac INR 2000-2500 cr/year). However, in most cases, lac producers do not have bargaining power. Value chain empowerment strategies (e.g. producer cooperatives, direct sale platforms) are essential to make sure tribal communities are able to share more of this value.

3.8 Gender Role in Lac harvesting

Women play a key role in the production of lac: the literature estimates that women perform 60-80% of NTFP labor, including lac harvesting and initial processing. They spend 4-6 hours a day on the associated activities (drying, sorting) which sometimes cannot be recognized in the household count. Although women contribute to the labor force, they have less control over income since the patriarchal culture and access to markets contribute to their low control of income.

Case studies indicate the prospect of specific empowerment. In Gumla (Jharkhand), women-only lac producers' organizations of Udyogini mastered cultivation and direct sales. The research identified the presence of disadvantaged women who were able to obtain new skills and leadership roles in refining value chain. Women also raised net income (e.g. a Jharkhand cooperative realized 40% higher prices after women groups grading) by organizing themselves into SHGs. But on the other hand, in places where women do not participate, families lose out: a survey in Jharkhand revealed that the lac income of the women was largely used in food and education, leading to a better household welfare.

Government programs also focus on women: e.g. Van Dhan clusters are 62% female, but leadership in committees still skews male. The cross-study recommendations involve all-women producer groups and credit/ input in terms of self-help groups (as depicted in the model of Mahua Federation in Madhya Pradesh). Real empowerment also needs not only training, but also to support the rights of women to land and resources (connecting to Forest Rights Act) and to take up the decision-making positions in the cooperatives.

3.9 Policy and institutional Frameworks

The last two decades have seen an increase in policy support of lac as an MFP. Key developments include:

- **Forest Right Acts (2006):** Allows tribal communities to legally harvest and manage MFPs (including lac) on community lands. The total implementation would guarantee the access of the tribes to the lac-producing trees.
- **NTFP Development Schemes:** Lac, broodlac, training and market linkages are offered by both state and central governments (through the Ministry of Tribal Affairs and state forestry depts.) to farmers of lac. As an illustration, the Lac Mission and Lac Production programs of Jharkhand province and Odisha have input support.
- **TRIFED & Marketing:** TRIFED was a federation of tribal cooperatives that was created to market tribal products. Through its Van Dhan scheme and Tribes India brand, the producers of lakhaarth (lac manufacturers) are enabled to market value added lac products in the country.
- **SHEFEXIL Initiatives:** Shellac and Forest Products Export Promotion Council (under Commerce Ministry) is targeted to lac in particular. The focus of its Program for Inclusive Growth is on tribal (particularly women) cultivators, which will enhance production and establish local processing facilities. It has also established a one-stop info centre among lac stakeholders.

Nonetheless, there are still coordination gaps. According to Chakrabarti and Dutta, responsibility may be watered down by overlapping jurisdiction of forestry, commerce and tribal welfare ministries. At ground level, market interventions cannot survive without guaranteed land rights; business inertia in institutionalizing community rights continue to be a challenge. The policy reports point to the importance of connecting lac cultivation to larger forest-conservation incentives (e.g. payment of ecosystem services) and mainstreaming lac in rural development planning.

4. Case Studies and Best Practices

Some of the detailed projects demonstrate the successful lac empowerment:

- **Jharkhand (Gumla) Udyogini/PACS Model:** An organization of more than 8,000 tribal women in Women Enterprise Groups. They were taught how to cultivate scientific lacs, produce broodlac and business skills. Innovations were community broodlac farms (to address larvae deficits) and local Village-Level Service Centres (VLSCs) to collect and process lac. The project was marked by substantial income increases (almost doubling of raw lac yields) and qualitative empowerment: women started to consider Lac host trees as household resources.
- **Madhya Pradesh SHG Value Addition:** The MP MFP Federation connected the Self-Help Groups of women with markets in Mahua and lac. Women received 35-55% more money than men did when they trained in grading/packaging and bypassing traders in lac (and other NTFPs). This model (with Mahatma Gandhi National Rural Employment Guarantee) is scalable in terms of women-led value addition.

- **Chhattisgarh - Tribal Entrepreneurship:** NGOs of the Bastar region implemented a handicraft (shellac) lacquerware where tribal artisans created local non-farm jobs and local demand on the lac. Such value addition, although not a major production activity, demonstrates how tribal communities can obtain additional lac value.
- **Model Villages (Interventions by NGOs/State):** In Jharkhand and Odisha, there are now examples of successful cooperatives that pool lac collectively, uphold quality, and sell via e- platforms (e.g. an Odisha tribal coop is selling shellac to Europe under Fair Trade certification).

The success factors are common in each case: inclusive institution-building (usually led by women), training and technology transfer, and direct market linkages.

Table 1: Comparative Table: Key Interventions

Intervention/Program	Stakeholders	Outcomes/ Achievements
Scientific lac cultivation training (e.g. ICAR's PSCL, Krishi Vigyan Kendras)	Tribal cultivations, Agricultural extension, forestry dept	Increased yields/ quality of lac; improved knowledge of broodlac handling; higher incomes
Women's Self-Help Groups & Cooperatives (e.g. Udyogini, TRIFED Van Dhan SHGs)	Tribal women, NGOs, community orgs, TRIFED	Grater market Participation; better prices via group marketing; Women's leadership and income empowerment
Market Linkages & Value- Addition Units (e.g. SHEFEXIL- sponsored processing units, Tribes India retail)	Producers, Exporters, SMEs, SHG federations	Expanded domestic and international sales Value- added product (costings, jewellery); premium pricing
Financial & Input Support (e.g. brooder farms, credit schemes)	Bank/ coops, govt agencies (MFP development), farmers	Easier access to broodlac and credit; lower input costs; more sustainable brood supplies
Policy Reforms & Rights (e.g. Forest Rights implementation)	Tribal communities, forest dept, local governance	Secured access to host trees; motivation for stewardship; legal support for NTFP enterprises

5. Challenges and Research Gaps

- **Biophysical risks:** Lac cultivation is susceptible to climate and pests. Rains or outbreaks of moths at the wrong time can destroy harvests. Combined pest management and climate- resistant management (e.g. drought-resistant host tree management) require additional studies. A vulnerability to biotic agents is highlighted by over 50% probable loss.
- **Broodlac shortage:** There is a shortage of sustainable broodlac sources (being taken unsustainably out of wild fir trees). One of the solutions is the creation of community brood farms, which still needs research into the methods of rearing and disease management.
- **Market inefficiencies:** Market lacks price transparency in most tribal producers even though their exports have been growing. Market structures, effects of fair-trade certification, and the cost-benefit of suggested interventions require more research. There are limited impact assessment of schemes such as Van Dhan or SHGs on the income levels.
- **Gender dynamics:** Systematic research on the development of gender norms with increasing lac incomes is limited though the evidence in cases indicates that women inclusion has benefits. It is still uncertain whether women have the power to make decisions, whether they will be able to share benefits intra-household in lac enterprises, and whether they will be able to share land use in land use disputes.
- **Policy Implementation:** There exists a gap between policy intent and ground reality. As an example, even with FRAct, most tribal communities do not have title deeds to NTFP lands. The barriers (bureaucratic, social) need to be researched, and the states with successful implementation and those with lagging ones should be compared.
- **Geographic setting:** A large amount of literature is dedicated to India (with a particular emphasis on central/eastern states). There is limited analysis of lac initiatives in other lac- producing countries (e.g. Thailand, China, Myanmar) and how tribal contexts compare. Expanding geography may reveal lessons to be transferred.

6. Implication for Policy and Practices

The evidence indicates that the promotion of sustainable lac production is a win-win situation of forest protection and tribal development. Policies should:

Strengthen extension services: Invest in village-based training (e.g., agroforestry extension) to spread best practices (broodlac handling, rotational cropping). Connect tribal areas with agricultural universities and Krishi Vigyan Kendras to provide continuous support.

Build women's enterprises: Facilitate formation of women-centric producer groups and cooperatives,

granting them training in business and leadership. Programs such as Van Dhan must be designed in such a way that women take up decision making roles and preferential financing.

Enhance accessibility to the market: Have more local processing plants (e.g. broodlac laboratories, lac crushing centers) to access the value at the source. Promote cooperatives and individual players to develop market platforms (local auctions, e-markets) with a reduced number of intermediaries. Quality certification (organic, fair trade, GI tags) should be further encouraged by export councils and federations to get high prices.

Ensure resource rights: Accelerate the recognition of forest rights (individual and community) over lac host trees. The tenure is necessary to ensure that cultivators are motivated to invest on the long-term management of trees.

Foster public–private partnerships: Government, NGOs, and private industry (e.g. varnish or food companies) can co-invest in R&D (e.g. pest-resistant lac strains, new value-added products). The industries (commitments to buy tribal cooperatives) would stabilize demand through inclusive procurement policies.

Integrate with conservation agendas: Lac is a supporter of biodiversity, thus forest management plans ought to incorporate lac agroforestry areas. Communities could be paid to conserve lac host tree forests via Payments for Ecosystem Services (PES) schemes.

7. Conclusion

Sustainable harvesting of lac is an avenue that holds potential to empower the tribes by offering low-impact forestry and high cash earnings. The systematic review demonstrates that through proper interventions, particularly those that strengthen marginalised women and enhance market connections, the cultivation of lac can have a beneficial impact on livelihoods and lead to forest conservation. Nonetheless, these advantages will have to be maximised through a combined policy initiative, investment into tribal institutions, and specific research to overcome deficiencies. Future action must strictly test pilot projects (e.g. SHG models), investigate regional differences (other than India) and track ecological results in order to inform adaptive management. Overall, a community-based approach can enhance the potential of using these interventions as a means for tribal empowerment.

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