

Human Resource Innovation for Sustainable Medicinal Plant Bioresource Enterprises: Integrating Global Best Practices with Tribal Community Experiences in the Western Ghats of Maharashtra, India

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Abstract: Sustainable bioresource enterprises represent an important pathway for integrating rural livelihood generation, biodiversity conservation, and inclusive community development. However, their long-term viability depends not only on ecological resources and market access, but also on human resource (HR) innovation, including skill formation, indigenous knowledge integration, participatory governance, leadership development, and digital capacity building. This paper adopts a narrative review design, supported by an embedded case study, to examine how HR innovation shapes the sustainability of medicinal plant and non-timber forest product (NTFP) enterprises. The review synthesises global evidence from community forestry in Nepal, community concessions in Mesoamerica, and community conservancies in southern Africa alongside Indian tribal enterprise models, including the Van Dhan Vikas Yojana, the Gram Mooligai Company Limited, tribal handicraft cooperatives, and Farmer Producer Organisations, to identify recurring dimensions of HR innovation: skill development, participatory governance, indigenous knowledge integration, gender-inclusive enterprise design, benefit-sharing systems, digital training, and certified market linkages. These global and national experiences are then examined against an applied case study of the Applied Environmental Research Foundation (AERF) in the Western Ghats of Maharashtra, where FairWild-certified value chains for *Terminalia chebula* (Hirida) and *Terminalia bellirica* (Behada) have converted informal fruit collection into structured, certified livelihoods for tribal and forest-dependent households in Bhimashankar (Pune district) and Sangameshwar, Devroohk (Ratnagiri district). The review finds that HR innovation functions as the connective mechanism linking bioresource availability to enterprise capability and, in turn, to livelihood, gender, and conservation outcomes; where such investment is absent or partial, enterprises tend toward weak or unstable performance. The study concludes by proposing a five-pillar HR innovation model skill development, indigenous knowledge integration, collective governance, certified value-chain management, and digital/market-linkage capacity and by outlining policy, enterprise, community, and research recommendations for scaling tribal bioresource enterprises in India and comparable forest-dependent economies.

Keywords: Human Resource Innovation; Sustainable Bioresource Enterprises; Non-Timber Forest Products; Tribal Entrepreneurship; Indigenous Knowledge; Western Ghats.

1. Introduction

Enterprises built on renewable biological resources agriculture, forestry, non-timber forest products (NTFPs), and herbal medicine occupy a central place in rural development and environmental stewardship. More than 2.5 billion people worldwide depend, at least in part, on community-managed natural resources, or commons, for their livelihoods (<https://www.wri.org/insights/numbers-indigenous-and-community-land-rights>). India alone is home to over 104 million people belonging to Scheduled Tribes, roughly 8.6% of the national population, a substantial share of whom live in biodiversity-rich rural and forested regions (Xaxa, 2014; Behera et al., 2024). An estimated 275 million rural and tribal Indians rely on NTFPs for subsistence and supplementary income (Jagtap et al., 2024). Despite this resource endowment, tribal and forest-dependent regions remain among the country's most socio-economically disadvantaged, with poverty incidence, literacy, and market access lagging behind national averages (Ministry of Tribal Affairs, 2023-24). Closing this gap is central to the Sustainable Development Goals' commitment to leave no one behind and to broaden the base of inclusive growth.

Human resource (HR) innovation understood here as new approaches to capacity building, training, organizational design, and people management that enable rural communities to operate natural-resource-based enterprises is increasingly recognized as central to this agenda. The World Economic Forum (2023) has argued that investment in people through education, training, and health is a primary determinant of workforce productivity and innovative capacity, while the neglect of human capital has repeatedly been identified as a constraint on rural development outcomes (Gnych et al., 2020; Chambers and Conway, 1992). Government assessments of Scheduled Tribe welfare in India have likewise emphasized targeted skill development, literacy support, and institution-building as prerequisites for inclusive growth in tribal regions.

This focus is given support from empirical evidence. The study of small and medium enterprises in Thailand reveals that innovative HR practices, especially training and incentive programs contribute to innovative capability and competitive advantage, which further increase productivity and profitability (Wongsansukcharoen and Thaweepaiboonwong, 2023). Rural livelihood programmes that are rich in skills development have been found to increase capabilities and decrease the poverty vulnerability of tribal people in the eastern states in India (Khosla and Jena, 2023). In all these environments, there are some common HR innovations contextualized skills training, leadership development, inclusive governance, and intentional incorporation of indigenous knowledge – that emerge as enablers of sustainable bioresource management (Gupta, 2016; Pretty, 2003).

Despite this, literature on HR innovation and bioresource enterprise sustainability is still scattered: papers have tended to focus on single interventions (a training programme, a certification scheme, a government mission), with relatively little transnational and Indian work, and even less work with a single, well-documented applied case. This study aims to fill this gap by bringing together a structured synthesis of global literature and Indian literature and by including a case study of the Applied Environmental Research Foundation (AERF) which has documented FairWild-certified medicinal-plant value chains in the Western Ghats of Maharashtra as one of the more thoroughly documented examples of HR-innovation-driven bioresource enterprise in South Asia.

2. Case-Study Approach

This study adopts a narrative review design supported by an embedded case-study approach, a combination well suited to a topic HR innovation in bioresource enterprises where the evidence base is heterogeneous in method, geography, and disciplinary origin, and where a single applied case can illustrate mechanisms that cross-sectional literature alone cannot capture.

Literature was identified from Scopus, Web of Science, Google Scholar, ScienceDirect, SpringerLink, and Taylor & Francis Online, supplemented by government reports, NGO documents, and institutional publications (FAO, 2022, 2023; World Bank, 2016, 2019, 2020; ILO, 2016, 2017; OECD, IFAD, 2021, 2023; IPBES, 2019; UNDP, 2024, WHO, and the Government of India, 2006).

The AERF case was examined through secondary documentation and organizational evidence relating to community-based conservation, access and benefit sharing, certified supply chains, and livelihood outcomes in Bhimashankar (Pune district) and Sangameshwar–Devrookh (Ratnagiri district), Maharashtra.

Findings from the global and Indian literatures were organized into recurring categories of HR innovation which were then used as a common frame for comparing global practice, Indian tribal enterprise experience, and the AERF case.

3. Conceptual Framework: HR Innovation and Sustainable Bioresource Enterprises

Sustainable bioresource enterprises sit at the intersection of ecological management and economic activity. In this setting, the knowledge, skills, and motivation of the people involved are often the binding constraint on enterprise success, more so than the biological resource itself. Purely extractive or top-down approaches to natural-resource-based livelihoods have repeatedly under-delivered for rural communities, which is one reason sustainable human resource management (HRM) has emerged as a framework prioritizing durable social and ecological objectives alongside conventional personnel management (Ehnert et al., 2024; Jamali and Karam, 2018). This extends beyond firm-centred HRM into what some scholars term “Common Good HRM,” in which HR practice is oriented simultaneously toward employees, the community, and the environment. Applied to rural enterprise, this implies supporting local talent, valuing indigenous knowledge, and ensuring equitable participation.

This review's conceptual framework is presented in Figure 1. It is an interlinkage of four stages – (i) Inputs community forest and bioresource assets, tribal and indigenous human capital and traditional knowledge, and enabling policy and institutional support, namely, the Forest Rights Act, 2006 (FRA), the Panchayats (Extension to Scheduled Areas) Act, 1996 (PESA), and the Van Dhan Vikas Yojana (VDVY); (ii) HR Innovation Processes skill development and sustainable-harvest training, integrating indigenous knowledge, participatory governance and leadership development, and digital and financial capacity building; (iii) Enterprise Capabilities value-addition and quality-grading skills, certified and traceable supply chains, collective bargaining and market access, and organizational resilience; and (iv) Sustainable Outcomes livelihood security and income diversification, gender- and youth-inclusive participation, biodiversity conservation, and enterprise sustainability.

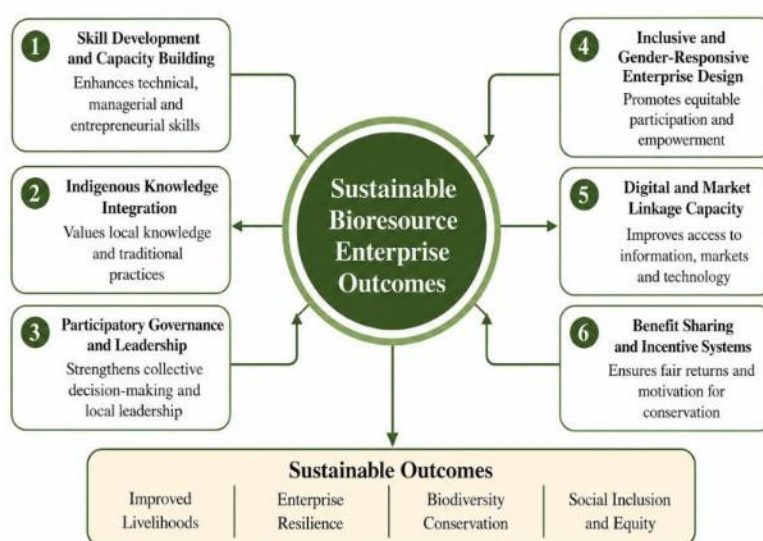


Figure 1. Conceptual framework linking human resource innovation to sustainable bioresource enterprise outcomes.

4. Global Best Practices in HR Innovation for Bioresource Enterprises

Rather than treating global experience as a list of illustrative examples, this section classifies recurring practice into seven analytical categories: skill development, participatory governance, indigenous-knowledge integration, gender-inclusive enterprise design, benefit-sharing systems, digital HR training, and market-linkage capacity building.

4.1 Skill Development for Locally Relevant Competencies

Rural bioresource enterprises frequently face a skills gap in processing, quality control, and marketing rather than in raw-material availability (Naik, 2023). Targeted, locally relevant technical training in sustainable harvesting methods, product processing, and basic business acumen has been shown to raise both productivity and income among bioresource-based enterprises in multiple Indian states. In Bangladesh, agroforestry training for tribal farmers who had previously practiced shifting cultivation improved both livelihood security and forest cover simultaneously, illustrating that skill development calibrated to local language, ecological context, and existing practice tends to produce more durable adoption of sustainable techniques than generic training models (Shobana and Kukar, 2023; Akter et al., 2022).

4.2 Participatory Governance and Local Leadership

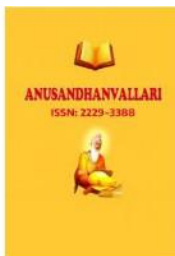
A second recurring HR innovation is the deliberate cultivation of local leadership and participatory governance rather than reliance on external management. Community forestry in Nepal is organized through Community Forest User Groups (CFUGs) locally elected bodies that manage harvesting rules, benefit distribution, and reinvestment in forest development. As of 2024, Nepal's Ministry of Forests and Environment recorded 22,519 CFUGs collectively managing approximately 2.36 million hectares of national forest, equivalent to roughly 35 percent of the country's forest estate, with more than a third of the national population belonging to a CFUG. Reported CFUG income figures vary considerably across studies and time periods from an estimated average of about USD 3,370 per group annually to aggregate national estimates in the tens of millions of US dollars reflecting differences in valuation method rather than a single verified figure; what is consistently documented is that a share of this income (nominally 25 percent) is required to be reinvested in forest development and community programmed. Leadership development has produced comparable effects elsewhere: mentoring and leadership workshops for young people in a tribal district of Odisha supported the emergence of a new cohort of local entrepreneurs managing community forestry and agriculture enterprises, while a culturally tailored mentorship model in a Native American tribal school in South Dakota, incorporating tribal elders and alumni as exemplars, raised student aspirations and educational outcomes (Vijaya and Mishra, 2023; Aschenbrener et al., 2017).

4.3 Indigenous-Knowledge Integration

A third category concerns the deliberate integration of traditional ecological and medicinal knowledge with scientific and market knowledge, rather than its displacement by external expertise. "Indigenous agri-tech" models that combine community knowledge climate-resilient crop varieties, organic practice with digital tools for weather and price information have improved both productivity and climate resilience among tribal farmers. Achieving this kind of integration requires HR investment in its own right: documentation of traditional practice, joint training that brings scientists and community members together, and structured knowledge-exchange workshops, all of which support the co-creation of agroforestry and enterprise models that are simultaneously technically sound and culturally appropriate (Deva, 2023; Pandey and Pal, 2021).

4.4 Benefit-Sharing Systems

Employee engagement and incentive alignment matter even in small, community-run enterprises. Profit-sharing, performance-linked allocation, and transparent benefit rules are associated with sustained member participation in community forestry and NTFP enterprises across Nepal, Mesoamerica, and southern Africa. Community



concessions in the Maya Biosphere Reserve (Mexico and Guatemala), for example, combine legally granted resource rights with capacity building in sustainable logging and NTFP processing; deforestation has been reported to have halted within concession areas while communities derive revenue from timber, food, and medicinal products under agreed sharing rules. The underlying HR principle is that members are treated as enterprise partners with defined rights and a share of surplus, not as casual labour

4.5 Digital and Remote-Learning HR Innovation

Growing rural mobile connectivity has enabled e-learning modules, mobile advisory services, and digital marketplaces as HR tools in their own right. During the COVID-19 pandemic, many Indian rural entrepreneurs sustained training and market contact through video calls and messaging groups, at substantially lower cost than in-person delivery (Ministry of Tribal Affairs, 2022; Pahle India Foundation, 2024).

5. Indian Tribal Community Enterprise Experiences

India's tribal communities offer some of the most extensively documented examples of HR innovation applied to natural-resource-based livelihoods. Historically dependent on forests and agriculture for subsistence, food gathering, craft production, and herbal medicine (Berkes, 2009; Wunder, 2001), many of these communities were pushed to the margins of the post-independence economy, with restricted access to education, formal markets, and, in many cases, the forest resources on which they depended (Bhattacharya, 2003; Sunderland, 2011). Over the past three decades, a combination of legal reform and grassroots enterprise development has sought to reverse this marginalisation. The Forest Rights Act, 2006 (FRA) and the Panchayats (Extension to Scheduled Areas) Act, 1996 (PESA) established legal rights of forest use and self-governance that underpin community-run enterprise (Government of India, 1996, 2006) while national programmes such as the Skill India Mission and the National Rural Livelihoods Mission (NRLM) have incorporated tribal-specific components for entrepreneurship and skills training.

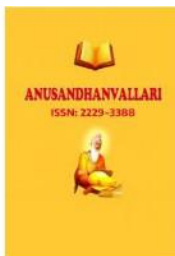
5.1 NTFP-Based Tribal Enterprise Models: Van Dhan Vikas Yojana

The Pradhan Mantri Van Dhan Vikas Yojana (PMVDY), launched in 2018 by the Ministry of Tribal Affairs (MoTA) and the Tribal Cooperative Marketing Development Federation of India (TRIFED), is the flagship instance of HR-led transformation of forest-produce gatherers into value-chain participants (<https://trifed.tribal.gov.in/pmvdy>). The scheme establishes Van Dhan Vikas Kendras (VDVKs), value-addition units of roughly twenty tribal members each, fifteen of which are grouped into a Van Dhan Vikas Kendra Cluster (VDVKC) of about 300 forest-dwellers, and equips each cluster with training and equipment for grading, processing, packaging, and marketing minor forest produce

(<https://www.pib.gov.in/PressReleasePage.aspx?PRID=1712326>; <https://trifed.tribal.gov.in/pmvdy/guideline>).

Verified official figures illustrate the scheme's trajectory rather than a single static number. By 31 March 2021, TRIFED had sanctioned 33,360 Van Dhan Kendras, subsumed into 2,224 VDVKs, across 23 states and 2 union territories. Under the subsequent Mission Van Dhan initiative, this had scaled by 29 November 2021 to 52,976 Van Dhan Self-Help Groups subsumed into 3,110 VDVKs, covering 9.27 lakh (927,000) beneficiaries across 27 states and union territories, with roughly 1,600 clusters having begun value-addition and processing operations and cumulative sales exceeding ₹1,500 lakh (<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1776206>). The most recent official update available at the time of writing (Ministry of Tribal Affairs, Tribal Day press note) reports 4,661 VDVKs sanctioned and 12.80 lakh (1.28 million) beneficiaries covered nationally, with cumulative VDVK sales of approximately ₹129.86 crore

The HR innovation embedded in Van Dhan lies less in the physical infrastructure than in the accompanying capacity-building: members are trained in product handling, hygiene, value addition, basic enterprise



management, and, increasingly, online marketing, alongside support for forming cooperatives and federations to achieve scale (Agarwal and Gibson, 1999; Ribot and Larson, 2009).

5.2 Community-Owned Medicinal Plant Enterprises: The Gram Mooligai Model

Tribal communities across central and southern India, including the Gond and Korku communities, hold substantial ethnobotanical knowledge (Chhatre and Agarwal, 2009; Sunderlin et al., 2005). The Gram Mooligai Company Limited (GMCL), established in Tamil Nadu, is frequently cited as India's first community-owned herbal enterprise structured as a public limited company in which women herb-gatherers hold shares. Torri and Herrmann report that more than 4,000 rural women shareholders were trained in the environmentally sustainable cultivation, collection, and processing of medicinal plants, with NGO-supported instruction in Ayurvedic product manufacture and quality control complemented by the women's own traditional healing knowledge. Distinctive HR innovations in this model include peer-led training, in which literate members teach others, and a shareholding structure that positioned women with limited formal literacy as owners and decision-makers rather than as wage labour. A widely cited account describes the transformation of a long-serving tribal herb healer, previously selling by the roadside at minimal margin, into a GMCL stakeholder with access to formal markets and materially improved pricing (<https://www.downtoearth.org.in/environment/a-green-company-in-a-grey-market-12746>) GMCL has since been described in the literature as an "alternative bioprospecting" model demonstrating that combining enterprise equity with training can reconcile conservation and commercial use of medicinal biodiversity, and has informed subsequent herbal cooperatives in Rajasthan and the Northeast (Torri and Herrmann, 2011).

5.3 Craft-Based Tribal Entrepreneurship and Digital Market Linkages

Beyond forest produce, HR innovation has supported the continuation of traditional crafts handloom weaving, bamboo work, and metalwork as viable enterprises. A study of the Kisan tribe's handicraft sector in Sundargarh district, Odisha, found that training artisans in design, branding, and e-commerce enabled access to substantially larger markets, with young artisans paired with professional designers to modernize product lines without displacing cultural authenticity, and with reported increases in both sales and artisan earnings (Pradhan et al., 2023). A proposed "Global Handicraft Index" similarly identifies management and market-facing skills, rather than capital alone, as the primary determinant of long-term viability in artisan sectors (Yadav et al. 2022). In West Bengal, Rajbanshi community women have sustained traditional weaving and fibre crafts through cooperative formation and micro-entrepreneurship training that enabled access to microcredit and urban markets (Roy, 2023), reinforcing that tribal enterprise development depends on investment in both technical skill and organizational/social capital, not on finance alone (Romano and Reinecke, 2023).

5.4 Agriculture, Farmer Producer Organisations, and Organic Value Chains

Tribal agriculture spans terrace farming in the Northeast and shifting cultivation in central India, with productivity often constrained by limited access to modern techniques. Integrated development projects in the Eastern Himalayas have provided training in improved cultivation methods including the System of Rice Intensification, horticulture, and livestock husbandry with reported gains in yield and diversification of income beyond subsistence. Training in organic farming and farm entrepreneurship has similarly supported crop diversification and market participation among tribal households in Sikkim and North Bengal (Choudhury et al., 2023; Kalyani et al., 2023).

Farmer Producer Organizations (FPOs) have emerged as a significant HR vehicle in this space, enabling group training, pooled marketing, and stronger collective bargaining position for smallholders, including tribal farmers. Long-term viability depends substantially on smallholder self-efficacy and the deliberate cultivation of cooperative social capital, alongside continued institutional support for governance and financial management,

while separate analysis identifies enabling and inhibiting factors for FPO sustainability that closely track the HR-innovation categories.

5.5 Recognition of Indigenous Knowledge in Health and Herbal Enterprise Systems

A final, cross-cutting model concerns the formal recognition through certification, documentation, and integration into public systems of indigenous healers and their knowledge, rather than its marginalisation by biomedical institutions. Initiatives that integrate traditional healers (vaidyas) into public health outreach, including assessment and certification of their plant-based knowledge alongside training in basic modern healthcare, have reported improved trust-mediated health outcomes and stronger preservation of ethnomedical knowledge (Dasgupta and Das, 2024; WHO, 2013, 2019). Recognition of this kind, through certification and intellectual-property mechanisms under the AYUSH ministry's remit, has also opened secondary livelihood pathways for healers into medicinal-plant cultivation and herbal product enterprises.

6. AERF Western Ghats Case Study: HR Innovation, ABS, and Certified Medicinal Plant Value Chains

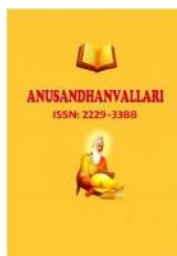
The Applied Environmental Research Foundation (AERF) has worked on community-based conservation in the ecologically fragile northern Western Ghats since the mid-1990s, under a strategy the organisation describes as conservation on the ground, combining ecological integrity with livelihood security through five interlinked programmes: Sacred Grove Conservation; Communities, Conservation and Climate Change; Energy and Biodiversity; Applied Biodiversity Research; and Business and Biodiversity (<https://conservationallies.org/partners/aerf-india/>). Within the Business and Biodiversity programme, AERF established Nature Connect India Pvt. Ltd., a for-profit conservation enterprise mandated to generate both income and conservation impact, which became the first FairWild-certified operation in India in 2015 (<https://www.fairwild.org/news/2020/7/22/five-years-of-fairwild-in-western-ghats>). AERF documentation indicates that some 95 percent of forests in the northern Western Ghats are owned or managed by local communities, historically dependent on logging as a primary income source, which shaped the rationale for developing an alternative, non-destructive income stream tied to fruit collection rather than timber.

AERF operates two principal site models (Figure 2): Bhimashankar (Ambegaon taluka, Pune district) and Sangameshwar–Devrookh (Ratnagiri district), each built around a different *Terminalia* species and a different enterprise structure, with an access-and-benefit-sharing (ABS) mechanism connecting collection, certification, and reinvestment (Figure 3).

6.1 AERF–Pune: Ambegaon (Bhimashankar) Hirda Project Model

AERF has been working since 2006 with the indigenous community Mahadeo Koli of Bhimashankar Wildlife Sanctuary in the sustainable harvesting of *Terminalia chebula* (Hirda) fruit which has been traditionally collected by them from generations. Locally high value immature fruit (Bal Hirda) is distinguished from lower value mature fruit (Motha Hirda) (https://satoyama-initiative.org/case_studies/fairwild-certification-an-approach-for-linking-biodiversity-conservation-with-sustainable-livelihoods-in-the-northern-western-ghats-india/) with the price reported in the range of ₹60-100/kg and ₹5-12/kg respectively. In response to the unsustainable incentives given to collectors as well as the low trader's prices, AERF supported the establishment of Nature Connect as a community-based enterprise with a transparent supply chain, and a role in determining purchase prices and overseeing the processing (deseeding, drying). Producers were also able to access premium, traceable markets instead of opportunistic local trade through FairWild certification, supported by the UK Darwin Initiative, the Keidanren Nature Conservation Fund (Japan) and technical partners such as the Durrell Institute of Conservation and Ecology (DICE, University of Kent) and TRAFFIC.

The amount of the change is evident from documented harvest volumes, which have increased from 3.6 metric tonnes (MT) in 2015 (the first year of certification) to 11.5 MT in 2019. It is said to protect about 4000 *T. chebula*



trees. Certified material is exported to international buyers including Pukka Herbs (UK), which uses certified Hirda and Behada in its Triphala capsules and tea blends, and Banyan Botanicals, which sources certified *T. chebula* for their Triphala products through Phalada Agro Research Foundation, a Bengaluru-based FairWild-registered trader. Nature Connect has been able to contribute to some of the Triphala blending locally since 2018, which means that more value is added in the community enterprise.

6.2 AERF–Ratnagiri: Sangameshwar (Devrookh) Behada Project Model

Many stands of *Terminalia bellirica* (Behada) grow in sacred groves that are managed by local communities, so in Sangameshwar (Devrookh) AERF adopted a parallel model with *T. bellirica* as the main species. Prior to the efforts of AERF, the collection of *T. bellirica* fruit was rare, due to either the distance from the markets or low price, which did not justify the collection effort. Through the village-appointed collectors, remunerated by honoraria, an independent local enterprise (not in a joint-venture structure as in Bhimashankar) was formed, creating an officially registered collection system through which the semi-processed material is moved to the international buyers, mainly Pukka Herbs and. The volumes collected increased from 2.6 MT in 2015 to 12 MT in 2019, where the number of trees being protected was reported to be about 1,000 *T. Bellirica* trees. The model offered a stable market and better prices, which gave the villagers a direct incentive to conserve rather than log the trees, and helped to strengthen existing sacred-grove conservation norms that preceded the enterprise.

6.3 Mapping HR Innovation in the AERF Model

The HR innovation underlying both sites lies in converting local collectors from informal raw-material suppliers into trained participants in a certified bioresource value chain. This includes capacity building in sustainable harvesting techniques, species identification, fruit quality grading, primary processing (deseeding and drying), collective price negotiation, record-keeping for traceability, compliance with FairWild and organic certification standards, and participation in benefit-sharing decisions. Reported training coverage approximately 100 collectors in Bhimashankar and around 10 in Sangameshwar in AERF's early resource-assessment and training rounds, since expanded through the enterprises' ongoing operations illustrates the scale at which this capacity building began, even though comprehensive current household-level participation data are not publicly available. Nature Connect India is reported to manage approximately 7,500 acres of biodiversity-rich forest under sustainable-use agreements and to channel income to more than 500 community members. Critically, the model treats community members as knowledge holders and enterprise partners with a role in setting prices, managing quality, and governing the enterprise rather than as passive wage labour supplying an external buyer (<https://www.darwininitiative.org.uk/documents/DAR20016/23789/20-016%20FR%20-edited.pdf>; <https://www.nmpb.nic.in/>).

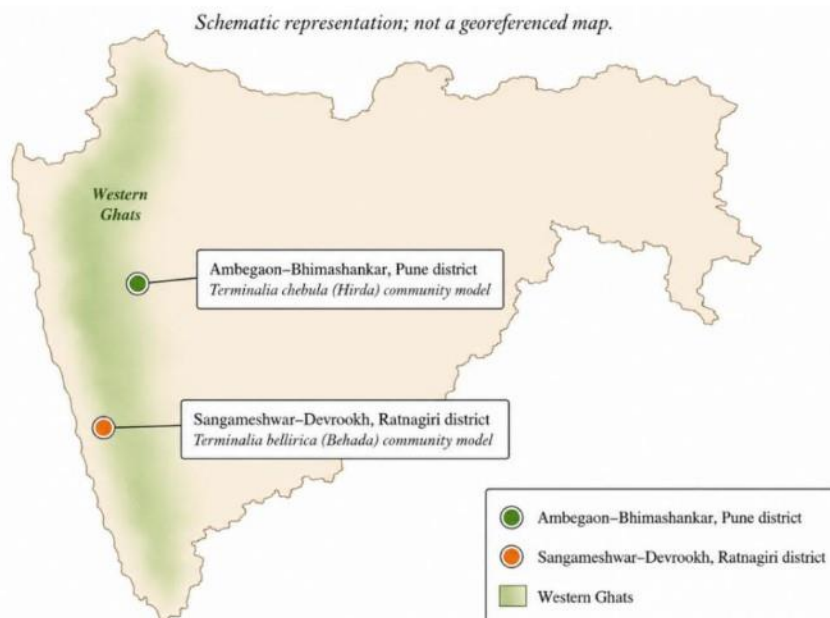


Figure 2. Location of AERF-linked community bioresource enterprise models in the Western Ghats of Maharashtra

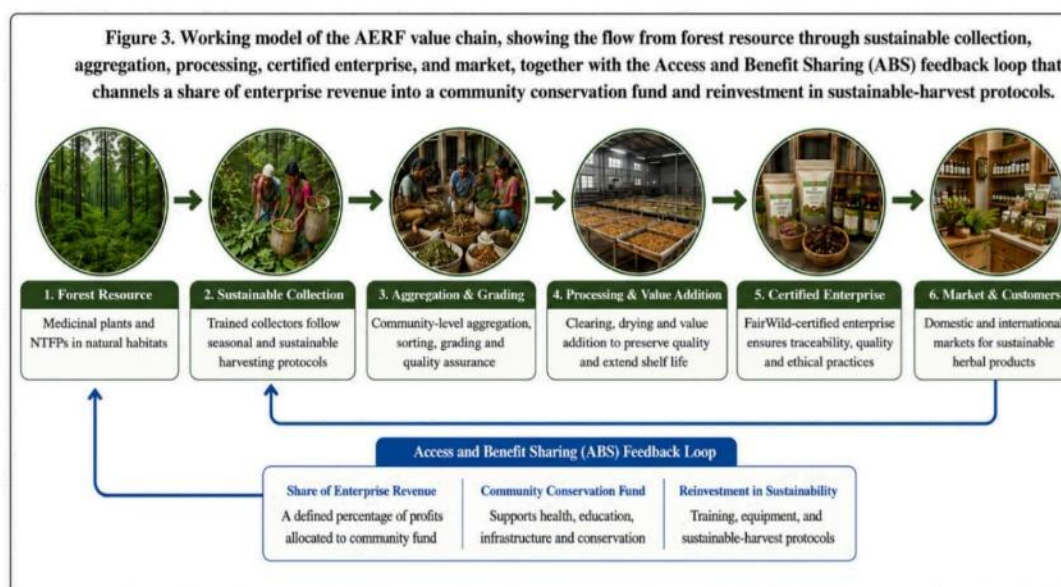


Figure 3. Working model of the AERF value chain.

Taken together, the two sites demonstrate that community-driven, certified value chains for NTFPs can secure biodiversity conservation and rural livelihoods simultaneously. By embedding local ecological knowledge within an internationally recognised certification framework, AERF has produced a model that appears, on the documented evidence, to be replicable elsewhere in the Western Ghats and in comparable forest-fringe settings, though as discussed in Section 9, the strength of this conclusion would benefit considerably from independent primary verification of household-level outcomes.

7. Comparative Discussion

Read across Sections 4 to 6, three patterns stand out. First, the same seven categories of HR innovation identified in the global literature skill development, participatory governance, indigenous-knowledge integration, gender-inclusive design, benefit-sharing systems, digital capacity building, and certified market linkage recur in the Indian tribal experience and in the AERF case, suggesting a reasonably general, transferable structure rather than context-specific coincidence. Nepal's CFUGs and Namibia's conservancies rely on the same participatory-governance logic as Van Dhan's cluster structure and GMCL's shareholding model; Nature Connect's FairWild certification performs, functionally, the same market-linkage role as the Maya Biosphere Reserve concessions or the Shea Network's cosmetic-industry partnerships.

Second, certification and formal market linkage appear to be the element most clearly differentiating higher-performing cases from weaker ones. Where an enterprise combines internal governance and training with an externally verified certification (FairWild at AERF; organic/fair-trade certification for Shea cooperatives; legal concession rights in Mesoamerica), reported outcomes include both premium pricing and stronger conservation incentives. Where certification or secure market access is absent as in many still-developing Van Dhan clusters outcomes remain more variable, consistent with the "partial HR innovation" pathway in Figure 1.

Third, the AERF case adds a dimension not fully captured in the larger, more diffuse national schemes: fine-grained, species-specific value-chain design. Where Van Dhan and GMCL operate at a scale of thousands of clusters or members, AERF's two sites work with a much smaller, more intensively supported group of collectors, closer in character to the Nature Connect and Shea Network models than to a mass government programme. This suggests that HR innovation may need to be calibrated differently depending on enterprise scale: large government-led missions require standardised training and monitoring systems capable of functioning across thousands of dispersed units, whereas smaller, certification-driven enterprises can sustain more intensive, relationship-based capacity building.

9. Conclusion

This review has examined how human resource innovation shapes the sustainability of medicinal-plant and NTFP-based community enterprises, drawing on global evidence, Indian tribal enterprise experience, and an embedded case study of AERF's work in the Western Ghats of Maharashtra. Across these settings, HR innovation functions as the connective mechanism between bioresource endowment and enterprise capability: skill development, participatory governance, indigenous-knowledge recognition, gender-inclusive design, digital training, and certified value-chain linkage recur as the practices most consistently associated with improved livelihood security and stronger biodiversity stewardship, whether in Nepal's community forests, Namibia's conservancies, India's Van Dhan clusters and Gram Mooligai cooperatives, or AERF's FairWild-certified Hirda and Behada value chains.

The AERF case illustrates this mechanism in concentrated form: by converting local collectors from informal, price-taking suppliers into trained participants in a certified, traceable value chain with roles in quality grading, price negotiation, and benefit-sharing governance the model has, on the documented evidence, generated both premium market access and a direct financial incentive for forest and sacred-grove conservation in Bhimashankar and Sangameshwar–Devrookh. Its scalability, however, depends on factors that are only partially within the enterprise's own control: continued institutional mentoring, financial inclusion, rural infrastructure, reliable market access, and transparent governance, each of which was identified in Section 8 as a distinct barrier category.

The five-pillar HR innovation model proposed in this review, skill development, indigenous-knowledge integration, collective governance, certified value-chain management, and digital/market-linkage capacity is offered as a practical synthesis for enterprise designers, NGOs, and policymakers seeking to scale comparable models elsewhere in the Western Ghats and in other forest-dependent regions. Realising its potential will require

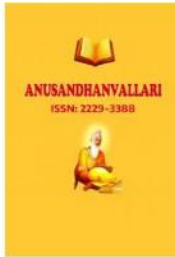
moving beyond one-off training interventions toward sustained HR development ecosystems in which tribal and forest-dependent communities are positioned consistently as knowledge holders, enterprise partners, and conservation stewards, and in which, as argued in Section 9, claims of impact are tracked against verifiable indicators rather than asserted from anecdote alone.

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