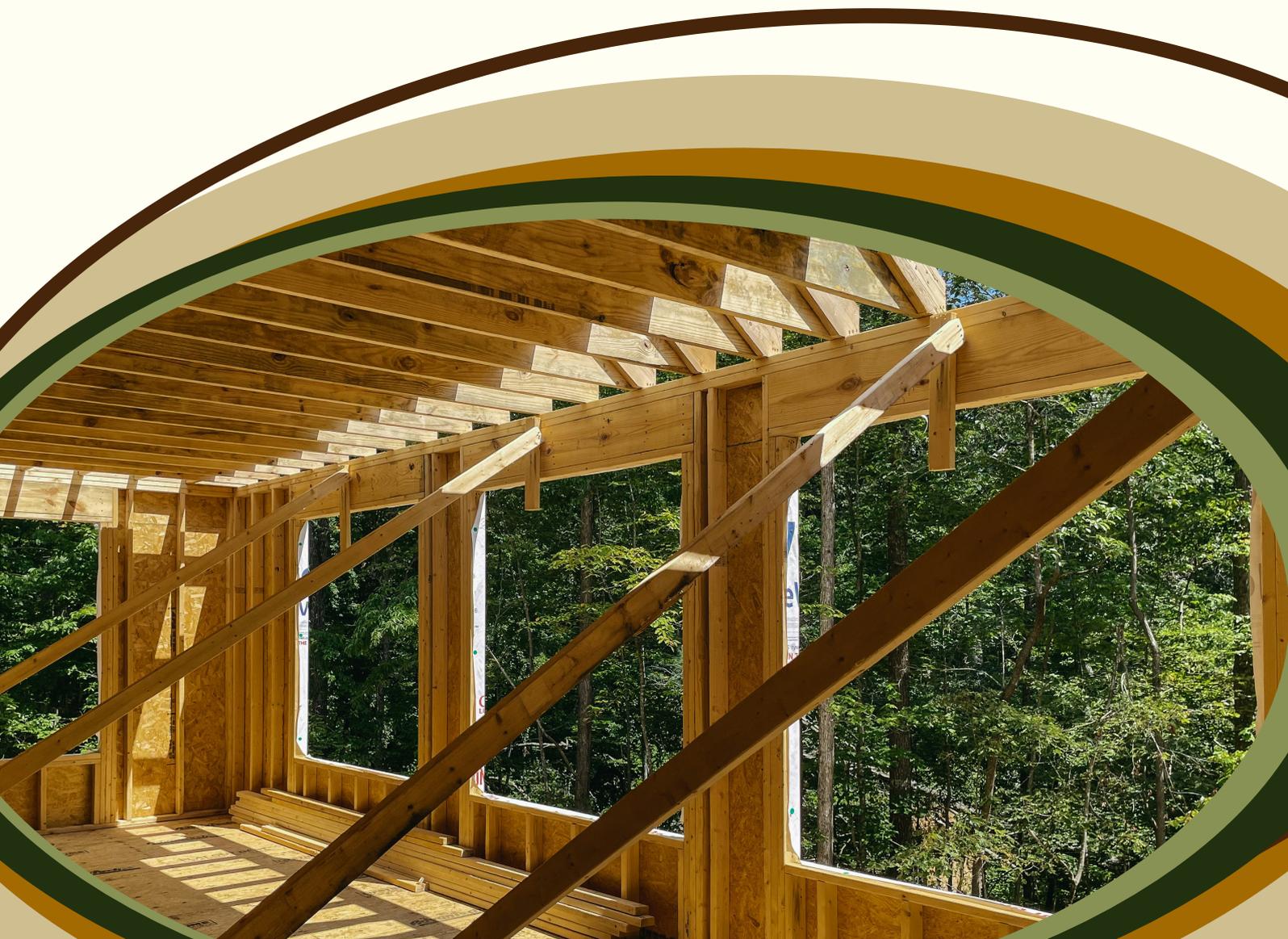


POLICY-RELEVANT PRIORITY ACTIONS

identified in the

Expanded Policy Brief on Advancing Forest-Based Bioeconomy Approaches



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Mass timber construction.
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INTRODUCTION

A **sustainable bioeconomy is a politically recognised strategic pathway** for delivering socio-economic prosperity, decent jobs, and climate resilience within planetary boundaries. Achieving this transition requires integrated, cross-sectoral policies that reduce environmental pressures, rather than shifting negative impacts across sectors, ecosystems, or regions. Forests are a foundational pillar of the bioeconomy alongside other sectors, providing renewable materials and energy, supporting livelihoods, storing carbon, and safeguarding biodiversity. At the same time, forests are under mounting pressure from degradation, deforestation, and climate-related risks such as wildfires, pests and diseases. A well-regulated bioeconomy, with credible safeguards (including for forests), can help meet rising demand for bio-based solutions while protecting nature and supporting social equity.

A **forest-based bioeconomy is a holistic and integrated system** covering timber, fibre, bioproducts, non-wood forest products (NWFP), and forest ecosystem services (FES), from both **managed and unmanaged forests**. It spans the full value cycle: production, harvesting, processing, reuse, recycling, market development, and delivery through **adaptive forest management, ecological restoration and regeneration**. Successful forest-based bioeconomy approaches depend on i) secure rights and coherent governance; ii) access to finance and markets; iii) strong innovation systems and partnerships; iv) transparent data and monitoring; and v) reliable, sustainable biomass supply. Regional and international cooperation can accelerate progress by aligning terminology, standards, certification, and shared metrics, and by leveraging financial resources and sustainable innovations, technology, and knowledge transfer. Key barriers remain, mainly as fragmented policies, tenure insecurity, limited finance and infrastructure, weak enforcement, lack of market access, limited innovation, and under-recognition of forest values beyond timber.

The forest-based bioeconomy can replace carbon- and resource-intensive materials with long-lived wood products and advanced bioproducts, strengthen local value chains through processing, biorefining, agroforestry, and cooperative models, and monetise a wider range of forest values from NWFP to bundled FES such as carbon, biodiversity, water, and recreation. These opportunities can generate rural jobs and supply low-carbon inputs to sectors including construction, energy, textiles, chemicals, and health. However, uptake is constrained by weak incentives and demand compared with fossil-based alternatives, complex and unharmonised regulations, administrative burdens, policy uncertainty, tenure insecurity, and fragmented cross-sector governance. Gaps in finance, market access, infrastructure, skills, and innovation (particularly for smallholders, cooperatives, and small and medium enterprises-SME) further limit scaling, monitoring, and enforcement. This document summarises policy-relevant key messages extracted from the International Union of Forest Research Organizations (IUFRO)'s Expanded Policy Brief on Advancing a Sustainable Forest-Based Bioeconomy. It identifies strategic priorities and practical entry points for decision-makers seeking to scale an integrated forest-based bioeconomy that delivers positive outcomes for climate, biodiversity, and inclusive development. Furthermore, it distils international good practices and emerging lessons. This summary is structured around six interconnected priority areas:

- **Policy meets practice** – strengthen multi-level governance, streamline permitting, and use demand-side measures and safeguards to deliver results.
- **Sourcing wealth and financing opportunities** – expand blended and performance-based finance and align fiscal, tax, and trade policies to unlock investment.
- **Building the future with wood** – scale climate-smart wood construction and bio-based materials, guided by circularity, cascading use, and safeguards.
- **Forest potential beyond wood** – increase the visibility and value of NWFP and FES through governance, sustainable management, innovation and market development.
- **Advancing forest-based value chains** – improve supply security and territorial approaches to keep more value locally, support inclusive growth, enter global markets and meet consumer needs.
- **Growing forest-based innovations** – invest in research, standards, skills, and innovation to move solutions from pilots to markets.

These themes are mutually reinforcing components of a wider transition, anchored in **circularity, climate resilience, social inclusion, and shared value creation across forest landscapes**.

In addition to the recommendations provided in the following sections for each of the six themes mentioned above, the following actions offer immediate and strategic pathways to support a scalable, inclusive, and climate-smart forest-based bioeconomy:

Policy recommendations for cross-cutting issues within the forest sector

System enablers

- **Clarify rights and responsibilities** for timber, NWFP and FES, including access, benefit-sharing, and traditional knowledge.
- **Improve governance, enforcement, and traceability** using harmonised rules, simpler permitting, transparency, and safeguards.
- **Use outcome-based finance to reduce risk** and link payments to verified results (e.g., emissions reductions, hectares restored, biodiversity indicators, local income).
- **Strengthen innovation systems** via incubators, demonstration sites, standards, and multi-actor platforms connecting policy, finance, technology, and local communities.
- **Secure bioeconomy-related long-term funding for research, extension, vocational training, and targeted support** for SME, cooperatives, and forest owners.
- **Strengthen Measurement, Reporting, and Verification (MRV)** and data transparency to support credible markets and outcome-based finance.
- **Establish project preparation and technical assistance facilities** to build a pipeline of bankable, safeguarded projects, especially for SME/cooperatives and Indigenous Peoples and Local Communities (IPLC) enterprises.
- **Streamline approvals and permitting** through clear, risk-based pathways, while maintaining safeguards.

Products, energy, and value from forests

- **Embed circularity and cascading use** in technical standards and public procurement policies and prioritise durability, repair, reuse, and recycling.
- **Strengthen demand-side pull** through green (public) procurement, corporate offtake, and credible product labelling for consumers for verified low-carbon, deforestation-free supply.
- **Use residual woody biomass for energy production only where appropriate and safeguarded** (e.g., wildfire-risk reduction). Limit bioenergy to residues and end-of-life streams.
- **Modernise building codes and standards** to enable safe, high-performance wood buildings and clear approval routes for engineered timber.
- **Promote local, regional and international market development and strengthen producers' capacities.**

Ecosystems, resilience, and nature's services

- **Strengthen forest resilience and climate adaptation** (e.g., to mitigate impacts from wildfire, pests, drought, extreme weather) through adaptive forest management, ecological restoration, and landscape planning.
- **Protect, enhance and restore FES**, (carbon, biodiversity, water, soil, and cultural values) through adaptive forest management.
- **Promote NWFP and FES** in national bioeconomy and forest management strategies, policies, land-use planning, statistics, and budgets, alongside timber.

POLICY MEETS PRACTICE

Scaling a forest-based bioeconomy depends on resource efficiency and on creating more value per unit of biomass through cascading use and circularity within sustainable limits. It also requires coordinated governance across ministries and government levels, as well as demand-side measures that create early markets. Delivery improves with public awareness, trust, long-term partnerships (including youth innovators), and regional/international alignment of standards, terminology, and shared metrics.

PRIMARY CHALLENGES

Despite promising examples, **several barriers** limit the broader adoption of sustainable forest-based bioeconomy approaches:

- **Unclear or overlapping rights** to land, timber, non-wood forest products (NWFP), and forest ecosystem services (FES), **combined with weak enforcement**, discourage long-term forest management, restoration, and investment.
- **Fragmented mandates and siloed policymaking** across forestry, agriculture, environment, housing, energy, trade, and finance create contradictory incentives and implementation gaps.
- Building codes, environmental rules, and product standards often **lag behind innovation** and remain designed around conventional materials and linear business models.
- **Newer wood products, NWFP, and FES** are not consistently reflected in legislation, statistics, forest inventories, and management plans. This keeps them **outside core policy decisions**, permitting practices, and budget frameworks.

- **Participation gaps persist.** The unequal involvement of Indigenous Peoples and local communities, women, and youth in policymaking and monitoring undermines legitimacy and leads to measures that do not reflect local priorities or knowledge.
- **Many new bio-based products fall into regulatory grey areas.** Authorities may be uncertain how to classify them or which approval pathway to apply, resulting in longer, costlier, and more fragmented permitting processes. This regulatory uncertainty disproportionately affects sectors with long investment horizons, such as forestry and long-lived processing assets.
- **Forest-related disturbances** such as wildfires, pests, diseases, as well as post-disturbance recovery, **are managed and financed inconsistently.** This weakens long-term forest management and restoration efforts and reduces confidence among investors and businesses considering engagement in forest-based value chains.

Within existing legal and institutional frameworks, several easily actionable measures can be adopted quickly:

- **Set up cross-ministerial task forces and “one-stop” permitting mechanisms** to reduce uncertainty and accelerate investment (e.g., coordinated permitting approaches for circular bioeconomy projects).
- **Formally recognise NWFP and FES in legislation, statistics, and planning tools** (e.g., list priority NWFP and key FES, integrate them into management plans, clarify access/benefit-sharing where relevant, and assign clear institutional responsibility).
- **Pilot performance-based regulation and standards** by allowing engineered wood and hybrid systems where agreed safety/durability criteria are met; define bioproduct rules by performance outcomes (e.g., recyclability, toxicity) rather than prescribing materials; use public projects as pilots.
- **Strengthen territorial multi-actor platforms** (farmers/communities, companies, local governments, civil society organisations - CSO, researchers) to jointly plan, implement, and monitor bioeconomy actions and safeguards.

These measures rely primarily on improved coordination and clearer responsibilities rather than creating entirely new regulatory architectures.

SHORT-TERM ACTIONS

STRATEGIC OPPORTUNITIES

To close the gap, implementation needs institutionalisation: clear mandates, faster risk-based permitting, firm safeguards, and transparent, verifiable outcomes. The table below summarises the priority actions by level and actor to turn policy intent into implementation at scale.

Level	Key actions	Actors
Global, National	Strengthen safeguards and enforcement , apply sustainability standards consistently, and improve supply-chain traceability.	GOV, PRI, CSO, RES
	Create demand pull and a level playing field via green public procurement and tax/trade alignment.	GOV, PRI, DFI
	Use outcome-based finance linked to verified CO ₂ , restoration, biodiversity or livelihood outcomes, supported by strong MRV systems.	DFI, GOV, PRI, RES
Global, National, Sub-National	Coordinate forest, climate, rural development and industrial strategies across ministries and levels; enable cross-border alignment and institutionalise science-policy-practice interfaces .	GOV, RES, CSO
	Fostered circularity and cascading use in standards and procurement , ensuring that bioenergy draws from residuals and meets safeguards.	GOV, PRI, CSO, RES
	Reduce regulatory uncertainty by harmonising rules and speeding approvals for bio-based products, particularly those with long investment timelines.	GOV, PRI
Global, National	Apply performance-based rules for engineered wood/hybrids and bio-based products using outcome criteria like recyclability and safety.	GOV, RES, PRI
	Clarify rights, access and benefit-sharing for land, timber, NWFP and FES; recognise traditional knowledge; ensure meaningful participation of IPLC, women and youth.	GOV, CSO, RES, PRI
	Mainstream NWFP and FES in inventories, land-use plans and national accounts; build market and governance capacity.	GOV, RES, CSO, PRI
	Support innovation-to-scale ecosystems (accelerators, demonstration sites, standards, and public-private-research partnerships) to move beyond pilots to commercial deployment.	RES, GOV, PRI, DFI
	Invest in skills, SME support and advisory services , ensuring long-term capacity for inclusive implementation.	GOV, RES, PRI, CSO, DFI
	Ensure forest resilience with sustained funding for prevention and recovery (fires, pests, diseases) and landscape and restoration efforts, increasing investor confidence.	GOV, DFI, PRI, CSO, RES
	Promote place-based value chains and territorial integration , connecting forests to regional priorities and retaining local value, via cooperatives, SME, distributed processing and priority sectors (e.g., textiles, food, cosmetics).	GOV, PRI, DFI

GOV = Government; CSO = Civil Society Organisation(s); DFI = development finance institution (incl. MDB - Multilateral Development Bank(s)); RES = Research; PRI = private sector actors (incl. large firms, SME, investors, insurers, corporate buyers/offtakers, industry associations), unless specified otherwise.

SOURCING WEALTH AND FINANCING OPPORTUNITIES

Forest-based investment scales faster when tenure is clear, rules are predictable, dispute resolution is credible, and there is a pipeline of bankable projects. For policymakers, this means prioritising legal clarity, regulatory stability, and coordinated investment pipelines as preconditions for capital mobilisation.

Blended finance (grants, concessional loans, guarantees, equity) can attract private capital for restoration, processing capacity, and innovation. **Outcome-based instruments** (Payment for Ecosystem Services - PES, carbon and emerging biodiversity credits) can create new revenue streams if contracts and Measurement, Reporting, and Verification (MRV) are robust.

Public investment in infrastructure (roads, energy, digital networks, testing labs, industrial parks) reduces transaction costs and strengthens investor confidence. **Forest investments need patient capital:** long timelines, delayed returns, and transition periods. Project preparation facilities and technical assistance help turn ideas into bankable projects. They also help meet safeguards and MRV requirements.

Examples include Finland's mixed financing for large bio-based mills; Brazil's blending of climate and forest funds, credit, and performance payments for restoration and concessions; Ghana's combined use of loans, premiums, climate finance, and corporate programmes in cocoa landscapes; and European Union debates on mobilising private capital via public programmes and development bank lending through local banks.

PRIMARY CHALLENGES

Key constraints are weak bankability, unclear revenue models, and thin pipelines of investable projects, rather than 'too little finance' alone.

- Smallholders, small and medium enterprises (SME), and cooperatives often **lack collateral, financial literacy, and track record**; standard products rarely fit their cashflow profiles and risk realities.
- Large industrial investments require **high upfront capital and face long payback periods**, technology risk, and market uncertainty, underscoring the need for stable and de-risking policies.
- **Ecosystem service markets** (beyond carbon) **remain narrow, fragmented, and volatile**, limiting long-term contracts and bankable structures without stronger MRV and demand signals.

- Restoration and agroforestry transitions often face **"income valleys"** before new systems become productive; bridging finance to overcome this is limited.
- Non-wood forest products (NWFP) producers face **weak infrastructure**, limited testing/quality-assurance capacity, limited access to variable niche markets, reduced capacity and barriers to enter in global markets.
- First-of-a-kind bioproducts/textile-fibre plants often **lack risk-tolerant capital** at demonstration and early commercial stages.
- Fiscal and trade regimes often continue to **favour fossil-based or land-extensive models** over sustainable forest-based production.

Countries can take practical steps to improve the financing of forest-based bioeconomy:

- **Create targeted programmes** for NWFP and local enterprises that provide early-stage investment, working capital, and support for quality/certification requirements.
- **Expand intermediate lending** via local banks/microfinance institutions by using public or development bank credit lines, guarantees, and advisory support with simplified procedures.
- **Scale outcome-based mechanisms** (PES, carbon or biodiversity credits) by standardising MRV, registries, and contract templates. Publish eligibility rules and performance indicators.
- **Use guarantees and insurance** to manage transition and climate risks by linking portions of credit/premiums to verified forest and climate outcomes where feasible.
- **Use long-term offtake agreements to purchase future production** and, where appropriate, contracts-for-difference to close early price gaps for priority bioproducts.
- **Create "innovation-to-scale" funding windows** for piloting, demonstration, and early commercial plants to bridge the "valleys of death".

SHORT-TERM ACTIONS



STRATEGIC OPPORTUNITIES



Finance scales when governments create investable conditions: legal clarity, predictable rules, bankable pipelines, and MRV that makes outcomes credible. The **table below summarises the key actions by level and actor** to crowd in capital, share risk, and build pipelines at scale.

Level

Key actions

Actors

Level	Key actions	Actors
Global	Create cross-country blended-finance vehicles using pooled public risk-sharing and technical support.	GOV, DFI, Private investors, local banks
	Scale outcome-based payments by harmonising registries and contract templates and reduce transaction costs for PES and carbon or biodiversity credits.	GOV, RES, DFI
Global, National	Realign fiscal policy by phasing out deforestation-linked incentives and introducing tax advantages for restoration, Sustainable Forest Management, circular manufacturing, and certified NWFP.	GOV, Finance ministries/treasuries
	Reduce trade frictions by lowering non-tariff barriers for sustainable wood and NWFP and integrating forest-based products into industrial and export strategies.	GOV, PRI
	Align green finance taxonomies to restoration, circular upgrades, and FES qualify for green bonds and climate-finance instruments	DFI, GOV, Private financial institutions
Global, National, Sub-National	Expand insurance and risk-transfer to address disturbances (e.g., wildfires, fire, pests, droughts) and market risks to improve bankability.	DFI, PRI, GOV, Insurers/reinsurers
Global, Sub-National	Promote regional coordination through joint flagship initiatives with shared standards, pooled risk-sharing, and common pipelines.	GOV, DFI, RES, PRI (SME, local banks)
National, Sub-National	Align rural credit with forest-positive land use by redirecting credit flows towards low-carbon agriculture, agroforestry, and restoration.	GOV, DFI, PRI (SME, local banks)
	Coordinate investment priorities by aligning national priorities around a small number of high-impact value chains to mobilise finance at scale.	GOV, DFI, PRI
	Invest in enabling infrastructure/systems (processing hubs, and logistics, quality/testing labs, energy supply and digital MRV and traceability systems).	GOV, DFI, PRI, RES
	Strengthen producer organisations through training, advisory support and incubators so organisations become bankable partners.	GOV, CSO, RES, DFI, PRI
	Build an “investable project pipeline” by supporting business planning, safeguards, and bankable proposal structuring.	GOV, DFI, PRI
	Deploy national/regional blended-finance platforms for sawmills, engineered wood, NWFPs processing and product development, and FES projects (tailored to SME/cooperatives).	GOV, PRI, DFI
	Expand SME access via local banks and microfinance institutions (MFI) using public or development bank credit lines, guarantees, and technical assistance.	GOV, Regulators, DFI, PRI (local banks, SME, cooperatives)

GOV = Government; CSO = Civil Society Organisation(s); DFI = development finance institution (incl. MDB - Multilateral Development Bank(s)); RES = Research; PRI = private sector actors (incl. large firms, SME, investors, insurers, corporate buyers/offtakers, industry associations), unless specified otherwise.

BUILDING THE FUTURE WITH WOOD

The use of wood-based solutions with robust safeguards in place can deliver a triple win: lower emissions, more affordable housing, and healthier forest landscapes. Many countries now recognise wood as a key pillar of low-carbon construction and circular manufacturing.

Examples include the growing use of engineered wood and mass timber in mid- and high-rise buildings and in public “flagship” projects (housing, schools, municipal buildings), particularly in Nordic and Central European countries; the European Union’s Bioeconomy Strategy reinforces this direction by prioritising wood and fibre-based construction to cut embodied emissions and increase carbon storage in buildings.

Modern bioproduct mills and integrated sawmills operate with near-zero waste by transforming residues into bioenergy, panels, and other biomaterials. Public “lighthouse” projects and wood-based research campuses have demonstrated that timber construction can meet high performance and design standards, building trust and confidence among regulators, insurers, developers, and consumers. “Wood-first” procurement policies and design competitions have supported de-risked adoption, while cooperative forest ownership models and strong Sustainable Forest Management (SFM) standards help ensure a reliable and socially accepted supply.

In some countries, **timber is also gaining traction in renovations and vertical extensions**, using prefabricated, lightweight timber elements that reduce disruption, cost, and embodied carbon emissions. A key policy question is how to account for carbon stored in wood buildings in a consistent way.

PRIMARY CHALLENGES

Despite momentum, barriers remain, mainly relating to:

- **Regulatory constraints:** building and fire codes are often geared towards building with concrete and steel, making approvals for timber structures complex and inconsistent across jurisdictions.
- **Measurement gaps:** inconsistent life cycle and carbon accounting make comparisons among materials difficult.
- **Limited capacity:** standardisation, testing, and permitting capacity are uneven, especially outside early-adopter regions.
- **Perceived risk and weak demand:** wood use in construction is still seen as niche or high-risk material by some developers, insurers, and financiers, and buyers/public awareness remains limited.
- **Market fragmentation:** SME-dominated, uncoordinated markets limit scale, drive up costs, and rely on in-house solutions.
- **Sustainability concerns:** increased harvesting without safeguards raises concerns around biodiversity and wider ecosystem functions.
- **Business case gaps:** decision-makers and investors often lack clear, comparable evidence on costs, delivery time, and whole-life benefits (incl. carbon), making it harder to justify timber solutions.
- **The project-based nature of the construction sector** hinders systematic learning and feedback loops, preventing the accumulation of best practices within (and beyond) municipalities.

Several immediate actions can accelerate the uptake of sustainable wood construction:

- **Modernise building regulations** to be performance-based, allowing timber and hybrid solutions that meet safety and structural standards.
- **Mandate whole-life carbon (WLC) assessments** for public buildings to create demand for low-carbon materials and reward durable, circular solutions.
- **Launch more public demonstration projects** (e.g., schools, social housing, municipal offices) using sustainable timber to showcase feasibility and stimulate local industry.
- **Expand training and capacity-building** for architects, engineers, builders, and inspectors in wood design, circular construction, and design-for-disassembly.

Deploy proven solutions (e.g., use of prefabrication approaches, hybrid timber–concrete retrofits) to shorten build times, reduce waste, and improve energy performance; **streamline permitting** for standardised timber systems with verified safety criteria to reduce delays and scale market-ready solutions; **align wood uptake with circular economy policies** by embedding reuse, recyclability, modularity, and end-of-life value recovery in procurement and design guidance.

SHORT-TERM ACTIONS

STRATEGIC OPPORTUNITIES



To shift wood construction from niche to mainstream, policy should concentrate on a few system levers: performance-based codes, whole-life-carbon methods, skills/testing capacity, demand pull (public procurement), and long-term fibre supply with safeguards. The table below summarises priority actions by level and actor to scale safely and credibly.

Level	Key actions	Actors
Global	Promote model performance-based building codes and whole-life-carbon (WLC) methodologies , including standardised system boundaries and data protocols.	GOV (intergov./international), RES
	Develop shared approaches to account for long-term carbon storage in wood buildings , enabling consistent recognition across countries.	GOV (intergov./international), RES
	Support global platforms for mass timber and bio-based construction , including exchanges and open access libraries for WLC, design templates, and procurement tools.	GOV (intergov./international), DFI, PRI
	Develop guidance for biodiversity and landscape safeguards (e.g., harvest thresholds, landscape planning, restoration) to align wood use with climate and nature goals.	GOV (intergov./international), RES, CSO, IPLC
Global, National	Share open-source reference designs and tested details for common building types and climate zones.	RES, GOV, PRI
	Safeguard and expand planted forests where appropriate to secure long-term fibre supply and protect natural forests, while increasing the use of agricultural by-products and other side-streams to diversify wood-based products.	GOV, CSO, RES, PRI
Global, Sub-National	Integrate wood solutions into housing, climate, and industrial strategies ; align building policies, wood supply, and investment signals through cross-sector partnerships.	GOV, PRI, RES, CSO, DFI, Insurers
	Streamline approvals for standardised timber and hybrid systems through performance-based criteria and verified safety evidence.	GOV, PRI
	Update building and fire codes to be performance-based and require WLC assessment for major public buildings/renovations.	GOV
	Fund public pilot buildings (e.g., schools, housing, health facilities) and publish open performance data and user feedback to build buyer/public confidence in wood.	GOV, DFI, PRI
	Use green public procurement to create demand pull and a level playing field for low-carbon materials, including wood.	GOV, PRI
	Link urban climate targets to the mitigation benefits of timber through wood-first procurement and carbon-based building standards , backed by standardized carbon assessment and safeguards.	GOV, RES, PRI
	Invest in testing infrastructure and training and align SFM/restoration targets with climate and biodiversity goals.	GOV, RES, PRI
	Co-develop a national skills roadmap with universities, vocational institutions, and professional bodies.	GOV, RES

GOV = Government; CSO = Civil Society Organisation(s); DFI = development finance institution (incl. MDB - Multilateral Development Bank(s)); RES = Research; PRI = private sector actors (incl. large firms, SME, investors, insurers, corporate buyers/offtakers, industry associations), unless specified otherwise.

FOREST POTENTIAL BEYOND WOOD

Unlocking the full potential of forests requires greater recognition of the economic, ecological, and cultural contributions of non-wood forest products (NWFP) and forest ecosystem services (FES). When integrated into bioeconomy and agrifood strategies, they can support strengthening nutrition, health, livelihoods, biodiversity, and climate resilience, especially for rural Indigenous Peoples and Local Communities (IPLC). Where appropriate and safeguarded, forest-based tourism can also support diversifying income and strengthen conservation incentives.

NWFP already supply foods, fibres, cosmetics, medicines, biochemicals, and inputs for sustainable agriculture, supporting conservation and income generation. At the same time, FES, such as carbon sequestration, water regulation, biodiversity conservation, and cultural values are also increasingly recognised as valuable assets. However, scaling requires reliable governance, outcome-based finance, viable value chains, innovation and robust monitoring. Results are strongest when policy, finance, technical support, and markets move together.

On the management side, improvements start by implementing sustainable management of open-access NWFP extraction and promoting the multiple-use management and cultivation of priority species. Examples of NWFP include Brazil's açai minimal impact management and cultivars development, the Republic of Korea's quality system for wild-simulated ginseng, and West/Central African alliances around shea and baobab that link management, standards, and branding to strengthen women's cooperatives and market access. A common success factor in these examples is integrating traditional knowledge with scientific evidence and monitoring, so that rules are locally legitimated and ecologically robust. Examples of successful implementation of FES include long running water supply schemes in Austria, France, and the USA; incorporation of forests in New Zealand's Emissions Trading Scheme (ETS) contributing to the country's climate mitigation efforts; and ecotourism in Namibia and Peru.

PRIMARY CHALLENGES

Scaling NWFP and FES faces several structural barriers:

- **NWFP and FES are often absent** from national accounts, industrial strategies, rural development and bioeconomy-related policies, and statistics, making them 'invisible' in planning and budgeting despite their relevance for livelihoods and life-support roles.
- **Weak or unclear legal status for many NWFP**, including inconsistent access and benefit-sharing arrangements, reduces incentives for long-term investment and responsible management.
- Open access harvesting regimes **lacking management plans** can drive overexploitation, conflict, and low incentives to invest in quality or regeneration.
- **Limited knowledge** on sustainable harvest levels, inventories, domestication potential, and ecological impacts, especially for slow-growing or culturally important species.
- **Limited understanding** of Payment for Ecosystem Services (PES) opportunities and requirements, especially within rural and Indigenous communities.
- **Incomplete valuation methods**, Measurement, Reporting, and Verification (MRV) systems, **and governance arrangements**, particularly for bundled services or cultural values.
- **Fragmented finance and thin project pipelines**. Investors can perceive this as high risk, while producers face volatile markets, limited credit access, and weak bargaining power.
- **Weak linkages to markets**; limited involvement of the industrial sector; and the need to strengthen producer capacities to meet demand, add value locally, and supply quality products.

Countries can take practical steps to accelerate scaling:

- **Develop and update NWFP and FES strategies**, identify priority species/services, and integrate them into forest management plans, bioeconomy policies, industrial strategies, and national statistics.
- **Clarify access and benefit-sharing frameworks**, explicitly recognising traditional knowledge and customary governance.
- **Strengthen management knowledge** through trainings, species-specific guidelines, domestication trials, nurseries, and monitoring systems for priority NWFP and key FES.

SHORT-TERM ACTIONS



- **Implement pilots that bundle ecosystem services**, (e.g., carbon and biodiversity), with simple, transparent contracts and clear benefit-sharing rules.
- **Use public procurement** where relevant (e.g., food and other natural products) to create predictable early demand and promote fair trade.
- **Expand capacity-building** for producer organisations, small and medium enterprises (SME), and local authorities on quality standards, safety, certification, and monitoring.
- **Link NWFP value chains to specialty products and differentiated markets, foster residue valorisation and align with cross-sectorial regulations, for example in forest-derived bio-based agrifood inputs** (e.g., natural fertilisers, plant protection products, bio-based additives) with agrifood reforms and circular bioeconomy policies.

SHORT-TERM ACTIONS

STRATEGIC OPPORTUNITIES



Scaling NWFP and FES requires moving from isolated projects to investable, safeguarded portfolios, anchored in clear rights/benefit-sharing, credible MRV, and stronger market linkages. The **table below sets out the priority actions by level and actor** to make these values visible, financeable, and scalable.

Level	Key actions	Actors
Global	Develop guidance and global platforms on NWFP and FES value chains and support integration into national accounts, statistics, and reporting.	GOV (intergov. / international), RES, CSO, IPLC, PRI
	Support global pilots for bundled ecosystem-service markets (e.g., carbon + water + biodiversity), with strong safeguards & common valuation/verification methods.	GOV (intergov./ international), DFI, RES, CSO, IPLC, PRI
	Promote international principles/safeguards on traditional knowledge , rights, and cultural values (incl. support access and benefit sharing frameworks, eco-labelling, geographical indications).	GOV (intergov./ international), CSO, IPLC, PRI
	Develop/update national NWFP/FES strategies and embed priority products/services into legislation/planning/statistics.	GOV
National, Sub-National	Create blended finance instruments for NWFP/FES projects and support inclusive certification/branding/price-stabilisation.	GOV, DFI, Private (financial institutions)
	Co-develop PES schemes with communities and invest in awareness/capacity-building.	GOV, DFI, PRI, CSO, RES
	Invest in knowledge-based management plans (e.g., harvest guidelines, domestication trials, monitoring) and ensure IPLC participation in governance/benefit-sharing.	GOV, RES, CSO, IPLC
	Integrate NWFP value chains and products into rural development plans and ensure visibility in procurement/extension/food programmes.	GOV, PRI

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ADVANCING FOREST-BASED VALUE CHAINS

Strengthened forest-based value chains raise value per unit of biomass through diversified products, differentiated markets, and more inclusive territorial development—anchored by long-term fibre security. Integrated mills and biorefineries increase value by converting side streams into energy, panels, and biomaterials, supported by diversified feedstocks (including underused species and residues where appropriate) and stronger participation of youth- and women-led enterprises.

Case studies illustrate this upgrading: Finland’s Äänekoski bioproduct mill demonstrates near-zero waste processing and residue valorisation within a regional cluster; Brazil’s “standing forest” models connect restoration value chains and public concessions with local, traceable processing (e.g., Amazônia 4.0 for cocoa, açai, oils, and Brazil nuts); and Ghana’s cocoa agroforestry and cooperatives help smallholders incorporate traceability, quality management, and progressive value addition.

Territorial approaches and modern processing can **spread benefits more evenly while reducing waste without increasing harvest volumes**, and EU policies plus high-value non-wood forest products further expand sustainable market opportunities.

PRIMARY CHALLENGES

As forest-based value chains grow, **several challenges and trade-offs constrain** their ability to sustainably meet growing demand:

- Scaling biomass supply for wood products, bioenergy, and bioproducts **can harm biodiversity, water, and climate** if harvests/plantations outpace restoration and conservation, or if leakage damages high-value ecosystems.
- Formalising NWFP and agroforestry **could marginalise traditional harvesters and small suppliers** unless tenure, contracts, and access rights are inclusive and safeguarded.
- Increasing sustainability, quality, and traceability requirements is important to gain market access, but **can overwhelm small and medium enterprises (SME) and community enterprises** due to high compliance costs, fragmented standards, and limited working capital.

- Advanced value chains may capture little value locally, with branding and logistics controlled by external actors, while **local communities remain confined to low-paid raw material roles**.
- **Regulatory complexity and differing national requirements** slow scale-up, raise costs, and fragment markets, limiting economies of scale, particularly for SME.
- **Rising climate and disaster risks** (fires, pests, droughts) threaten fibre security, livelihoods, and processing investments.

Several actions can be initiated quickly (and scaled over time) to improve value, inclusion, and sustainability:

- **Prioritise productivity and higher-value outputs** (value per unit of biomass) rather than expanding harvest volumes.
- **Apply cascading use and residue valorisation** (including biorefinery approaches) to increase value while reducing pressure on forests.
- **Use integrated landscape planning** (plantations, natural forests, agroforestry, restoration) to balance production, conservation, and livelihoods.
- **Adopt a “mosaic” supply approach** (sustainable forest management - SFM, plantations, agroforestry, trees outside forests, restoration) within the wider agricultural landscape to meet demand, manage risk, and sustain biodiversity, including species diversification and use of underutilised species/residues where suitable.
- **Expand verification tools** (digital traceability; remote sensing; open tools for Measurement, Reporting, and Verification - MRV) to support compliance, target incentives, and enable market access.
- **Pilot inclusive business and finance models** (cooperatives, shared processing hubs, blended/outcome-based finance, restoration concessions) to retain local value.

SHORT-TERM ACTIONS

- **Support youth- and women-led SME and cooperatives** through targeted capacity-building (quality, branding, traceability) and access to shared processing and service hubs.
- **Invest in research, development and innovation and knowledge transfer** to upgrade priority value chains and address SME/cooperative bottlenecks.
- **Promote collaboration platforms to link SME and the industrial sector** and advance strategic and commercial relationships to develop new markets and adopt open innovation models.
- **Support climate-risk preparedness** and risk-sharing tools (e.g., insurance, early-warning systems).
- **Assess urban–rural/value-chain linkages** to strengthen rural livelihoods, restore productivity (forest frontiers/secondary forests), and ease pressure on urban hotspots.
- **Promote demand side measures** (eco-labels, sustainable public procurement, consumer awareness) to accelerate market uptake of bio-based products.

SHORT-TERM ACTIONS

STRATEGIC OPPORTUNITIES



Value-chain upgrading is fastest when fibre supply planning, standards/market access, and territorial infrastructure advance together, creating more value per unit of biomass without increasing forest pressure. The **table below summarises priority actions by level and actor** to boost competitiveness, inclusion, and sustainability.

Level

Key actions

Actors

Level	Key actions	Actors
Global	Advance mutual recognition of product/testing standards and streamline cross-border rules on plant health, safety, and technical requirements for wood and NWFP.	GOV (intergov./international), RES
	Promote global guidance and financing for inclusive value-chain upgrading in priority forest landscapes, including tools for cooperative and SME participation in processing, branding and logistics.	DFI, RES, CSO
	Support global knowledge exchange and open toolkits for advanced processing and product innovation (including underutilised species and residues), enabling countries to raise value without increasing forest pressure.	DFI, RES, GOV (intergov./international)
Global, National	Support landscape restoration programmes and cross-border learning platforms that connect verified producers and territories with buyers and blended finance.	DFI, GOV, CSO, PRI (SME)
Global, National, Sub-National	Improve market data and price transparency for wood, NWFP, and Forest Ecosystem Services through regular statistics, open dashboards, and price reporting; support advisory services to help SME and cooperatives meet standards and access markets.	GOV, RES
National, Sub-National	Build public trust in plantations and active forest management for sustainable raw material supply and carbon sequestration through clear communication.	GOV, CSO, PRI (SME)
	Make supply support (subsidies, infrastructure, tax incentives) contingent on legality, traceability, verified restoration outcomes, and social and environmental safeguards.	GOV (local), CSO, PRI (SME)
	Develop regional processing clusters with shared services (e.g., power, testing labs, logistics, compliance) and strengthen cooperatives and producer organisations to move into higher-value roles and negotiate fair contracts.	GOV, DFI, PRI (SME, Coop)
	Adopt long-term plans to increase sustainable fibre supply combining Sustainable Forest Management, planted forests, agroforestry, trees outside forests, and restoration.	GOV

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GROWING FOREST-BASED INNOVATIONS

Innovation across technology, finance, institutions, and social systems is expanding the frontiers of the forest-based bioeconomy. Engineered wood, fibre-based packaging, lignin-based chemicals, wood textiles, and bio-based plastics are diversifying low-carbon material options. At the same time, **digital tools** (remote sensing, artificial intelligence-based modelling, digital twins, and advanced control systems) **are improving forest data, process efficiency, and digital monitoring tools** that support Measurement, Reporting, and Verification (MRV) for forests, wood and non-wood forest products (NWFP) as well as ecosystem services. Faster technology transfer, open learning, and skills development, especially for small and medium enterprises (SME) and youth, help move solutions from pilots to markets.

Examples show how innovation translates into scale: biorefineries such as Borregaard (Norway) illustrate integrated process innovation and side-stream valorisation that can increase yields, reduce waste, and generate multiple products from one facility. **Financial innovation**, including blended finance for restoration and bioeconomy, green and sustainability-linked bonds, and emerging biodiversity/nature credit schemes can expand investment options when linked to credible MRV. **Social and institutional innovation** is equally important: territorial platforms such as Amazônia 4.0 (Brazil) demonstrate how community labs, advanced tools, and local governance can reinforce each other, while innovation hubs (e.g., Australia's forest and wood clusters or the New European Bauhaus) show how multi-actor systems accelerate uptake.

PRIMARY CHALLENGES

Despite progress, **wide-scale adoption of innovative practices remains slow** due to the following aspects:

- Many countries and regions have **limited research and development (R&D) funding**, demonstration finance, and institutional capacity.
- **Emerging technologies** (e.g., lignin and hemicellulose valorisation) **struggle to scale** because regulatory frameworks, codes, and standards lag behind innovation, leading to long and uncertain approval processes.

- **Operational barriers** include inadequate testing infrastructure, fragmented data standards, and weak transport and logistics, particularly in remote areas.
- **Risk aversion** in both public and private sectors constrains ambition and investment in new approaches.
- **Fragmented funding cycles and unclear benefit-sharing** rules weaken continuity, trust, and long-term scaling.

Several **technically mature innovation options** can scale quickly with targeted support:

- **Deploy digital MRV and open-data platforms** (satellite monitoring, sensor networks, AI) to reduce costs and strengthen credibility for payments for ecosystem services (PES) and carbon/biodiversity credits.
- **Adopt prefabrication approaches, circular manufacturing, and standardised timber construction systems** to improve efficiency, reduce waste, and increase reuse/recyclability.
- **Use grants, so-called challenge funds, incubators, and advisory support for SME** (including women, youth, and Indigenous enterprises) to move innovations from prototypes to market-ready solutions.
- **Run pilots for establishing biodiversity and water credits** (building on carbon-market experience) to test bundled ecosystem-service approaches with safeguards.
- **Establish territorial "living labs"** combining R&D, MRV, materials testing, circular production, and social innovation to generate replicable models (e.g., community labs and territorial platforms).

SHORT-TERM ACTIONS

STRATEGIC OPPORTUNITIES

Innovation reaches markets when policy reduces “time-to-approval” and “time-to-finance”: clear standards and pathways, shared testbeds, open protocols/data, and risk-tolerant capital for demonstration and first-of-a-kind plants. The **table below highlights priority actions by level and actor** to move from pilots to scale.

Level	Key actions	Actors
Global	Establish international platforms, testbeds and “living labs” for forest-bioeconomy innovation ensuring open access to results and set global standards for data interoperability.	GOV (intergov./international), DFI, RES
	Update policy guidance for new wood products, NWFP, forest ecosystem service (FES) schemes and circular business models; support public–private innovation partnerships; mobilise blended capital for priority innovation.	GOV (intergov./international), DFI
	Facilitate global knowledge exchange across innovation hubs, territorial platforms, and community labs; promote sharing of open-source tools, standardised methods, and replicable case studies.	GOV (intergov./international), RES, CSO
Global, National	Scale digital MRV tools (e.g., satellite and sensor-based monitoring) to reduce verification costs and strengthen credibility for ecosystem-service markets.	GOV, RES, PRI
	Establish national and regional living labs and testbeds to trial innovations (materials, MRV, circular manufacturing) with shared protocols and open learning.	GOV, RES, PRI
	Strengthen standardisation and testing infrastructure (fire safety, structural performance, life cycle assessment/whole-life carbon - LCA/WLC) to support approvals and market confidence.	GOV
	Update national regulations and technical standards to recognise emerging forest-based products and services.	GOV, CSO
	Establish innovation challenge funds and risk-sharing instruments with inclusion targets (e.g., women, youth, Indigenous enterprises).	GOV, DFI
	Support long-term multi-actor partnerships (triple/quadruple/quintuple helix) involving government, industry, finance, research, and communities.	GOV, PRI, CSO, IPLC
	Institutionalise co-governance of innovation priorities, traditional knowledge protection, and benefit-sharing mechanisms within forest-based clusters and territorial bioeconomy initiatives.	GOV, PRI, CSO, IPLC
	Establish national and regional living labs and testbeds to trial innovations (materials, MRV, circular manufacturing) with shared protocols and open learning.	GOV, RES, PRI
National, Sub-National	Strengthen standardisation and testing infrastructure (fire safety, structural performance, life cycle assessment/whole-life carbon - LCA/WLC) to support approvals and market confidence.	GOV
	Update national regulations and technical standards to recognise emerging forest-based products and services.	GOV, CSO
	Establish innovation challenge funds and risk-sharing instruments with inclusion targets (e.g., women, youth, Indigenous enterprises).	GOV, DFI
	Support long-term multi-actor partnerships (triple/quadruple/quintuple helix) involving government, industry, finance, research, and communities.	GOV, PRI, CSO, IPLC
	Institutionalise co-governance of innovation priorities, traditional knowledge protection, and benefit-sharing mechanisms within forest-based clusters and territorial bioeconomy initiatives.	GOV, PRI, CSO, IPLC
	Establish national and regional living labs and testbeds to trial innovations (materials, MRV, circular manufacturing) with shared protocols and open learning.	GOV, RES, PRI
	Scale digital MRV tools (e.g., satellite and sensor-based monitoring) to reduce verification costs and strengthen credibility for ecosystem-service markets.	GOV, RES, PRI

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COUNTRY & ORGANIZATION-LED INITIATIVE

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