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Mapping forestry practices against sustainable development goal targets

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The timber industry, at the crossroads and under severe pressure to achieve the Sustainable Development Goals (SDGs) by 2030, would see forestry practices such as harvesting, processing, trade, and silvicultural management at loggerheads with the SDGs' transformational agenda (Santos et al., 2019). The mismatch originates from the pursuit of short-term monetary benefits over the long-term exigencies of ecosystem health and human wellbeing (Bettles et al., 2021; Galante et al., 2012). Such practices lead to deforestation and loss of biodiversity, soil degradation, and worsened vulnerability to climate change, contrary to SDG6 (clean water), SDG12 (responsible consumption and production), SDG13 (climate action), and SDG15 (life on land) (Mbow et al., 2014; Asamoah et al., 2020).

Despite forestry's role in sustainable development, many forestry policies are reportedly devoid of strong sustainability frameworks (Sayer et al., 2019). Deforestation due to agricultural expansion, infrastructure, and industry creates disruptions for ecosystems and biodiversity. Beyond environmental risks, deforestation has further been assessed by the United Nations Development Programme (UNDP, 1994) in human security terms. Forest loss weakens ecological resilience, heightens economic instability, and threatens food security, especially for communities whose livelihoods are based on forest ecosystems. Research has often focused on carbon sequestration rather than being aligned to SDGs. Among the list of SDGs, SDG15 is vital in addressing biodiversity loss, ecosystem protection, and sustainable land use. Within its goal, SDG15.1 is concerned with conservation, while SDG15.3 strives for land degradation neutrality. However, many forestry policies have failed to incorporate those principles. Economically viable monoculture plantations, such as Radiata Pine in New Zealand, contribute to biodiversity loss, contradicting SDG15.1, which promotes the conservation and sustainable use of terrestrial ecosystems (Ramage et al., 2017; Folke et al., 2019). While monoculture may support restoration on degraded lands, large-scale adoption often prioritizes profit-making over ecological sustainability. Furthermore, SDG6.6 for the protection of water-related ecosystems and their functions suffers from soil degradation as a consequence of deforestation (Amezaga et al., 2019). Although SDG12.2 emphasizes sustainable land use and responsible resource use, forestry policies constantly favor short-term carbon sequestration incentives over long-term ecological resilience (Sayer et al., 2019; Bukoski et al., 2022).

This article is intended to review how forestry practices meet SDGs, outlining gaps in environmental sustainability, governing policies, and economic trade-offs. Using a literature-based analysis, it addresses strategies to balance sustainability with economic livelihoods. However, contemporary forestry governance provides limited information on

broader socioecological concerns to achieving SDGs (Adams and Turner, 2012; Louman et al., 2019; Razafindratsima et al., 2021). As a result, existing research often bypasses forestry's link to public health, poverty, and consumption (Ebi et al., 2020; Harris and Lyon, 2013).

New Zealand's forestry sector exemplifies the causal pathways whereby governance gaps enter into decision-making and create a negative environmental impact. Policy mechanisms like the Emissions Trading Scheme (ETS), actively promote monoculture plantations, often at the loss of biodiversity (MPI, 2022). Through these policies work toward the attainment of SDG8 (economic growth), their social and environmental consequences are yet manifest (Ma et al., 2022). These prioritizing fast-growing exotic over native biodiversity, risk biodiversity loss, contradicting SDG15.1 (Ramage et al., 2017; Bukoski et al., 2022). A more holistic approach is needed to reconcile carbon sequestration with biodiversity conservation (MPI, 2022; Folke et al., 2019). Beyond carbon policies, unsustainable forestry practices, including unregulated chemical use (Coutts and Ulrich, 2020), clear-cutting, and mechanical deforestation (Pizzirani et al., 2019) are some of the major drivers triggering soil degradation, water pollution, and destroy habitats, undermining SDG6 and SDG15 (Louman et al., 2019; Niu et al., 2021). Responsible watershed management, like protecting riparian zones and minimization of soil disturbance support SDG6.6 (Amezaga et al., 2019).

This brings us to the need for a switch toward a more all-inclusive forestry model, given that the gaps in good governance present some trade-offs with respect to the needs of the environment. Sustainable forestry goes beyond timber production to regard forests as essential ecosystems that support the rich biodiversity of various species and offer social and economic benefits to forest-dependent communities (Razafindratsima et al., 2021; Lawlor et al., 2019, p. 1). Sustainability will only be achieved by balancing conservation and economic viability through community participation, equitable benefit-sharing, and ecosystem resilience that aligns SDG1 (poverty alleviation), SDG2 (food security), and SDG10 (reducing inequalities) to advance economic benefit of local communities in conserving forests for future generations (Katila et al., 2020). Finally, the integration of forestry has been moving into the circular economy for the benefit of reinforcing sustainability, waste reduction, and resource use maximization, supporting SDG12.

To reach the targets set by SDGs, forestry should move from short-term models toward timber. For example, monoculture plantations have limped through with issues of immediate economic gain at the cost of ecosystem degradation and diminished ecosystem resilience. By marrying diverse, native tree species in forestry systems, the future-enhanced productivity and biodiversity will mean better soil health and more resilience to pests and climate change stressors beneficial to SDG15. Transitioning initiatives to sustainable models take an economic backsliding. These initiatives may include payments for ecosystem services, tax incentives and biodiversity conservation credits. Therefore, payments are important because they can provide economic incentives for sustainable practices while reducing dependencies

on concentrated logging. Certification schemes such as Forest Stewardship Council (FSC), are promoting responsible forestry by establishing standards for sustainable timber production. However, its action still has limited by the failure to implement and apply them consistently, as a result, not many forests are certificated (Elbakidze et al., 2022). Although certifications can help in the efforts toward sustainability, expanding its adoption and upgrading its standards remain essential for stronger alignment of forestry with SDG goals.

Forest governance is thus relatively simple when seeing the whole forestry sector in the perspective of aligning with SDGs. Governments should develop robust policy frameworks on land conversion, biodiversity, ecosystem, and sustainable practices. Examples include expanding ETS to recognize the ecological value of native forests, not only for potential carbon sequestration, creating a new impetus for sound decisions in the forestry field. Also, such evaluation will enable a wide empirical review of policy and management interventions that will guarantee the economic activities taken do not compromise critical ecosystem functions. To the other end, participation of the community in decisions is critical-to-the-degree that further creates any policy directly reflecting the needs of those people, who stand to be affected by forestry management.

Technology has an indispensable bearing on sustainable forestry. Substantial developments in technology include remote sensing and Geographic Information Systems (GIS), which allow for real-time monitoring of deforestation, carbon storage, and biodiversity health. Data-driven insight allows for more proactive land-use planning and conservation strategies (Negassa et al., 2020). Conversely, climate-smart forestry techniques (including reduced-impact logging, precision silviculture, and biodegradable alternatives to synthetic pesticides) may minimize environmental impact while ensuring economic viability. These innovations reflect the reconciliation between productivity and ecosystem integrity to maintain forest resilience against climate change.

Achieving the SDGs in forestry, finally, will necessitate cooperation at multiple levels in the action of manifold actors. This model needs to be decided through a collaboration between local communities, including Indigenous Forest leaders, and government, corporate players in the forestry business, and researchers. By partnerships, they will share knowledge and pool resources, therefore they can tackle barriers to sustainable development. The strategies to shift forestry away from the extraction mode and toward regenerative ecological management may support biodiversity, livelihoods, and climate resilience.

Author contributions

ARM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. EKP: Conceptualization, Methodology, Supervision, Writing – review & editing. NP: Conceptualization, Methodology, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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