The forest sector and ecosystem restoration

Background Paper prepared for TFD's Restoration Scoping Dialogue January 31-February 1, 2023

About this paper:

This paper was developed to provide a baseline of information on the current state of knowledge related to the forest sector's role in restoration with specific focus on the role of the private sector. The paper is prepared for participants of The Forests Dialogue's Restoration Scoping Dialogue, convened in New Haven, CT, USA on January 31-February 1, 2023. The paper is developed in consultation with an advisory group of representative stakeholders who provided feedback on earlier drafts.

About The Forests Dialogue

The Forests Dialogue (TFD) is an organization that designs and implements multi-stakeholder dialogues aimed at fostering social learning, building trust, and supporting processes for collaborative and adaptive land management across sectors. TFD believes that structured dialogues are fundamental to breaking deadlocks and creating meaningful change in the forest sector. Housed at Yale School of the Environment (YSE) in The Forest School, TFD's secretariat is directed by a group of 25 steering committee members representing globally significant forest stakeholders. TFD implements its mission through multiple initiatives that address global forest issues identified by TFD's Steering Committee members through a series of dialogues. TFD's process includes mixing international and national perspectives, engaging the private sector in all dialogues, combining field discussions with structured meeting facilitation, and giving participants the mandate to determine outputs and outcomes. Dialogues often occur in countries where the issue is or has historically caused conflict and seek to deliver impact in-country and inform global discourse through grounded examples. Country level dialogue topics and case studies are driven by local priorities, as determined by in-country host organizations and vetted by TFD. The statements, reports, and findings of TFD do not necessarily represent the views of YSE faculty. Learn more about TFD's process, ongoing initiatives, and past work at https://theforestsdialogue.org/

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1. Introduction

Fulfilling ever-increasing needs of a growing human population has strained natural ecosystems to the limit. Indeed, human activities have been impacting natural processes and ecosystems for as long as humans have lived on the planet, but the impact has been egregious during the last two hundred years (Crutzen 2006) due mainly to the expansion of industrial agriculture and infrastructure development. Natural ecosystems are now altered to the extent that their functionalities are significantly compromised triggering multiple existential threats, specifically biodiversity loss, climate change, and the loss of livelihood for billions of people living in the most impoverished regions of the world (Scholes et al., 2018). Recognizing the need to urgently and effectively tackle ecosystem collapse, many national governments and prominent intergovernmental forums including the United Nations Conference of Parties (COPs) emphasize taking a two-pronged approach to enhance ecosystem functionalities – conserving remnant natural ecosystems while also restoring the ones already degraded. Gann et al. (2019) aptly sum it up, "global society must secure a net gain in the extent and functioning of native ecosystems by investing not only in environmental protection, but also in …. ecological restoration (p. S6)."

The recognition that restoration is a critical pathway to avert an environmental catastrophe is now widespread and restoration has become a cross-cutting theme in a broad range of global policy frameworks. The United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention to Combat Desertification (UNCCD), the Convention on Biological Diversity (CBD), the Aichi targets, and the recently negotiated Kunming-Montreal Global Biodiversity Framework unequivocally emphasize the need for scaling up restoration efforts and catalyzing the private sector engagement in these efforts. Ecosystem restoration also forms a core facet of SDGs 14 and 15 (Life Below Water, Life on Land) and it closely aligns with SDG1 (No Poverty), SDG2 (Zero Hunger), SDG6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production), and SDG13 (Climate Action). Given the centrality of ecosystem restoration in global policy dialogue and instruments, several regional and global ecosystem restoration initiatives have been launched, notably the Bonn Challenge, the Initiative 20x20 in Latin America, AFR100 in Africa, ECCA30 in Eastern and Central Europe, and the Agadir Commitment for Mediterranean countries. The declaration of 2021-2030 as the United

Nations Decade on Ecosystem Restoration (UNDER) has further enhanced the global recognition of ecosystem restoration as an environmental imperative.

2. Forest Landscape Restoration

Restoration is required across all ecosystems, e.g., freshwater systems, mountains, peatlands, and oceans, but forest landscape restoration (FLR) in particular could be the most promising avenue of all because of its scale and scope. The Global Partnership for Forest and Landscape Restoration (GPFLR) defines FLR as "*an active process that brings people together to identify, negotiate and implement practices that restore an agreed* ***optimal balance of the ecological, social and economic benefits of forests and trees*** *within a broader pattern of land uses*." FLR, thus, is a stakeholder-centric process that is sensitive to the local context and stakeholders' multiple needs. "The optimal balance" is a noteworthy element of FLR: while it gives agency to stakeholders, it can also give rise to disagreements. For example, some may consider reforestation and plantation as parts of restoration, others may exclude them and instead hold a purist view that restoration only means restoring a degraded ecosystem to their original states. As we discuss in a later section, both views prevail even though we should quickly foreshadow here that reforestation and plantations are part of restoration.

Previous literature shows that FLR can help in stemming biodiversity loss, eradicating poverty and hunger, and improving the resilience and adaptation of local communities and farmers to the impacts of climate change (Sabogal et al., 2015). FLR, especially reforestation and plantations, can also be a key mechanism to meet growing demand for forest-based products as more and more governments and private sector organizations seek to enhance their utilization in their efforts to decarbonize industrial value-chains in sectors such as housing, packaging, and food. This way, FLR could be an effective approach to tackle climate change (through mitigation, resilience, and adaptation), stem biodiversity loss, and protect the livelihoods of local communities and farmers.

3. The private sector and ecosystem restoration

Restoring degraded ecosystems at global scale is a monumental task requiring colossal investment. According to the State of Finance for Nature report (UNEP, 2021), USD 8.1 trillion

is needed by 2050 to restore degraded ecosystems and halt biodiversity loss – this requires tripling the current level of annual available finance by 2030 and quadrupling thereafter until 2050. Given the limited availability of public finance, channeling private sector investments toward ecosystem restoration is an absolute necessity. National, international, and intergovernmental policy frameworks therefore increasingly encourage and incentivize private sector participation in ecosystem restoration. And, the private sector has been responsive primarily through reforestation and tree plantation initiatives. Corporations such as Amazon, Bank of America, HP, Mastercard, Microsoft, Pepsico, LinkedIn, REI, UPS, Verizon, among many others, have pledged to support the Trillion Trees initiative – a reforestation project jointly launched in 2016 by three of the world's largest conservation organizations – BirdLife International, Wildlife Conservation Society and WWF. More than 80 global companies have pledged to conserve, restore and grow more than 7 billion trees in over 65 countries under this program. Amazon's $10 billion Earth Fund, with restoration as one of its key priorities, has funded numerous reforestation projects. L'Oréal has created a Euro 50 million Fund for Nature Regeneration which also has a strong focus on reforestation. Nestle has launched a dedicated program on reforestation to grow 20 million trees by 2030, and McDonald's has initiated a regenerative agriculture program with the aim of planting 230,000 trees by 2030. This list is only illustrative: companies across a range of industry sectors – from tech to finance – are engaging in restoration efforts primarily through the reforestation avenue.

In early 2022, FAO's Advisory Committee on Sustainable Forest-based Industries (ACSFI) initiated conversations about understanding the engagement of forest-based industries in ecosystem restoration. The underlying rationale for these conversations was that whilst reforestation and FLR were core to the business model of forest sector companies – after all they plant, grow, sustainably harvest and replant trees – they were not partaking in global restoration initiatives and as such were absent from prominent forums on restoration. Some expressed a view that forest sector companies were "shying away" from what could be truly a strategic opportunity to position the sector as a leader in FLR for possessing unique scientific, technical, and social-ecological knowledge required for effective restoration, sustainable natural resource management, and community involvement.

This is indeed an intriguing situation. While multinational banks without experience working with land and ecosystems venture to be seen as leaders in restoration, the forest sector – comprising large forest companies, small and medium enterprises, individual and family landowners, collectives, associations, and others – with considerable hands-on experience are relatively silent. It is indeed this latter group which possesses knowledge about how best to plant trees, how to grow them and keep them from dying, and perhaps even more critically, how to integrate these efforts with community well-being. This general tendency among forest sector entities for greenhushing – i.e., under-communicating their sustainability activities – is ironic because there are numerous exemplary restoration initiatives that they are carrying out in different parts of the world.

Recognizing this ironic situation, the Advisory Committee on Sustainable Forest-based Industries (ACSFI) in collaboration with The Forests Dialogue (TFD) convened a roundtable on understanding ways to enhance the forest sector's engagement in ecosystem restoration. More specifically, the roundtable aimed to support initiatives to mobilize ambitious actions, foster collaboration, and raise the visibility of forest-based industries in ecosystem restoration and related initiatives. Twenty participants, including representatives of forest industry associations, forest sector companies, intergovernmental organizations, and civil society, sought to explore how forest sector companies can contribute to ecosystem restoration efforts in a way that also creates value for them so they can sustain it over time. Through a day long deliberation, participants identified the following six priority areas to move forward:

- Build unity within the forest sector through a shared ecosystem restoration vision, simple key messages, and identifying champions to motivate and share learnings.
- Develop good metrics to facilitate goal setting and measurement of outcomes from restoration.
- Collaborate with other stakeholder groups in restoration activities to build understanding and to enhance impact.
- Understand how degraded land and forest sector capacity aligns.
- Establish new business cases for ecosystem restoration based on research and practice.
- Identify and build understanding about business and financial models that enhance shared value and deliver multiple outcomes.

These priority areas are overlapping and mutually reinforcing. In the following, we briefly describe them with a particular focus on pointing out the uncertainties and disagreements within each.

(I) Shared vision and unity

The notion of shared vision and unity in the forest sector can be viewed from the lens of collective action. As illustrated through two examples, many forestry companies are engaged in restoration work including reforestation, wetland restoration, grassland restoration, and watershed restoration. In fact, it would not be an exaggeration to state that most forestry companies – in most parts of the world – are engaged in restoration activities of sorts even if they do not explicitly brand them as restoration. But, why? One possible reason could simply be that forestry companies *do* understand scientific nuances and *do* recognize that restoration may mean different things to different people in different contexts. So, they might perhaps be eschewing giving a label which they know could be contested by some groups. In contrast, non-forestry companies seem to either not be aware of semantic nuances or they deliberately choose to ignore them. When they plant trees, they – in all good faith – simply state that they are involved in restoration.

It is important to note here that ecosystem restoration is an essentially contested field. Disagreements abound about its definition, scope, and approaches. In fact, the definition of restoration has over time been evolving (Holl, 2020). The Society for Ecological Restoration (SER) defines restoration as "the **process of assisting the recovery** of an ecosystem that has been degraded, damaged, or destroyed." According to this definition, the aim of restoration is not to achieve a precisely determined static endpoint, but rather it is to set a degraded ecosystem on a trajectory to recovery. While some scholars believe that the aim of restoration should strictly be achieving a pre-disturbance historical state, a more contemporary understanding is that restoring the characteristics – not composition or functions – of original state is a more realistic target considering that even minimally disturbed ecosystems would have anyway undergone some changes over time (Hobbs et al., 2009).

The division in defining and conceptualizing restoration is not limited to the academic realm. Intergovernmental organizations, too, vary in terms of how they conceptualize the term. FAO's definition of restoration, for example, is more similar in intent to the SER definition. It views restoration as a means to "assist the recovery" within the overall context of current conditions. In contrast, the underlying spirit of the definitions provided by IUCN, UNEP and UNDER is to regain the lost functionality. Suding et al. (2015) take a more comprehensive and integrated view of restoration. They propose that restoration should aim to increase ecological integrity, should be able to be sustained in the long term without continual external support, should be based on past and future, and should involve communities and be beneficial for them. This view closely aligns with the spirit of FLR wherein community needs and involvement are inseparably interwoven with restoration and restoration is not viewed as a purely ecological activity devoid of human needs and social context. Placing human well-being at the center of restoration efforts is a paradigm change in restoration domain because as Holl (2020) says, "at the site scale, it might mean selecting nonnative tree species that are valued by local communities for fruit or timber as part of the planting palette for tropical reforestation rather than only using native tree species (p. 14)."

Similar to the disagreement about the definition, debates persist about the extent of desired level of human intervention in restoration. Some (e.g., Chazdon & Guariguata, 2016) advocate for what is known as **natural generation** or **passive restoration**. This approach involves only removing the degrading factor (e.g., crop production or livestock grazing) while letting the ecosystem recover on its own without reintroducing any species that may have been lost through previous disturbances. In contrast, others (e.g., Bastin et al., 2019) favor what is known as **active restoration** or **reconstruction** which involves introducing new plant species or reintroducing the ones which may have previously been present on a site. This approach can include planting a variety of species or extensive planting of the same species when the conditions of the site do not allow for growing diverse species. Further, plantations may take the form of agroforestry, large-scale reforestation, commercial reforestation with safeguards, or nucleation sites in which only small patches of shrubs and trees are planted for reproduction purposes (Corbin & Holl, 2012, Holl & Aide, 2011, Chazdon et al. 2017). In between the two extremes of natural regeneration and active restoration, an intermediate approach called **assisted natural regeneration** is a third

possible approach. It involves removing pest organisms or reintroducing ecological regimes (e.g., fires) in locations with some signs of success for natural regeneration (Aide et al., 1996; Guariguata & Dupuy, 1997; Gann et al., 2019). Assisted natural regeneration is a step up from natural regeneration in terms of the level of intervention but a step short of active restoration. Notably, none of these choices is considered to be generally better than others; the decision is dependent on the recovery rate of the system and the specific goals that a restoration activity seeks to achieve (Holl & Aide, 2011; Gann et al., 2019).

It is evident from the foregoing explanation that the entire field of ecological restoration is context dependent and, as a result, attempts to generalize goals, activities, and outcomes leads to considerable disagreements. Neither there is one right way to carry out restoration, nor is there an approach which is decidedly wrong. It is because of such a mixed verdict that some industry sectors – e.g., food, finance – may rightfully take a narrow stance on restoration and move ahead with what others would characterize as reforestation projects. This is indeed an issue that forest sector entities need to consider in order to develop a shared understanding of restoration – should they define it in its strictest, narrowest sense or a broader sense that may allow to advance well-intentioned actions, imperfect they may be. In this context, the non-legally binding instrument on all types of forests[1], legally binding biodiversity offsetting initiatives (e.g., in the UK, United States, Peru, Colombia, South Africa), the impending European Union Nature Restoration law[2], and the FSC's recently adopted motion 37[3] deserve a mention because they provide a legal and quasi-legal (market-based) architecture to reduce ambiguity and disagreements around

[1] The United Nations non legally binding instrument seeks to strengthen political commitment and action at all levels to implement effectively sustainable management of all types of forests and to achieve the shared global objectives on forests, to enhance the contribution of forests to the achievement of the internationally agreed development goals, including the Millennium Development Goals, in particular with respect to poverty eradication and environmental sustainability; and to provide a framework for national action and international cooperation.

[2] The European Commission's proposal for a Nature Restoration Law is the first continent-wide, comprehensive law of its kind. It is a key element of the EU Biodiversity Strategy, which calls for binding targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters. More here: https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-law_en

[3] This motion will provide a route by which millions of hectares of forests can be restored and then become FSC certified and managed in a responsible manner. More here: https://fsc.org/en/newscentre/motion-passed-fsc-principles-and-criteria-will-enable-the-policy-to-address-conversion

restoration efforts in the forest sector. A separate restoration- focused certification or a commonly accepted standard could also be possible avenues for structured, collective actions.

Considering the multitude of aforementioned ambiguities, forest sector entities ought to consider the following questions – i.e., possible fracture lines – as they might seek to develop a shared vision of restoration:

FL 1: *How to articulate the relationship between plantation/ reforestation and restoration especially given that other sectors consider them essentially the same?*

FL 2: *How to reconcile between the purist (restore to a static end state) and the pragmatic view (set restoration targets given current conditions) of restoration?*

FL 3: *How – and to what extent – to balance ecological and social needs through restoration activities?*

(II) Stakeholder collaboration

Ecological restoration is essentially a value-driven social process (Millard et al., 2022) and hence stakeholder engagement is at the core of ecosystem restoration. In this regard, the foremost question is who is a stakeholder. Business management literature defines stakeholders as those groups which can affect or be affected by an organization's actions (Freeman, 2010). Some scholars address this question from a strategy perspective, others from an ethical perspective. The strategist's view is that any powerful entity whose claims are legitimate and urgent qualifies as a stakeholder (Mitchell et al., 1997). According to this view, identification of stakeholders is a time and context dependent phenomenon because the power of a group can change over time and place. In contrast, the ethicist's view is that stakeholder identification should not be based on the strategist's utilitarian criterion but on moral appropriateness. In practice, most organizations blend the two perspectives together. In the restoration ecology literature, stakeholders are defined as those "individuals, groups, or organizations that have a vested interest in a restoration activity, usually because they have something to gain or lose from it (Holl, 2020, p 18)." So, natural resource managers, forest sector business entities, Indigenous and local communities, landowners, farmers, relevant government agencies, academia, NGOs, multilateral organizations

could be considered as stakeholders although, again, relevant stakeholders would vary from project to project.

Stakeholder engagement is critical at the goal setting stage because motivations for restoration can widely vary among stakeholders. Clewell and Aronson (2006) show that stakeholders motivations can be *biotic*, *technocratic*, *pragmatic*, *heuristic*, and *idealistic*. Biotic motivations include such targets as biodiversity conservation and habitat enhancement. Technocratic motivations refer to legal and policy compliance, e.g., mitigating or offsetting habitat loss from development and mining. Pragmatic or socioeconomic motivations are often related to the provision of ecosystem services and the reversal of land degradation that could be used for human needs. The heuristic motivations are meant to generate scientific data through experimental studies. Finally, idealistic reasons involve reparation and atonement for environmental degradation or simply reconnection with nature. A national level survey (Hagger et al., 2017) of restoration stakeholders conducted in Australia shows that 95% of respondents favored ecological restoration for the biotic reasons (biodiversity enhancement), followed by water quality improvements (*pragmatic* motivation) and social reasons (*idealistic* motivation) (both 55%). About 41% of respondents undertook restoration for the *technocratic* motivation of biodiversity offsetting, but only 22% of respondents were motivated by carbon sequestration (*pragmatic* motivation).

Differences among stakeholders in their motivations for restoration could lead to conflicting objectives and ultimately project failure. Careful stakeholder analysis (Ianni et al., 2010) which starts with stakeholder identification is therefore important before launching restoration activities and setting goals for them. One of the approaches to minimize conflicts is to make the goals as specific as possible rather than keeping them broad. Holl (2020) provides an excellent example, "a stated goal to *restore native grasslands* could be interpreted in in several different ways, such as restoring grassland to (1) increase the cover of native plant species, (2) enhance the population of an endangered native grassland insect, (3) reduce plant biomass to minimize fire risk, (4) increase carbon content of soils, (5) enhance the cover of native grassland plants that are food source for Indigenous people, (6) some combinations of options 1 through 5, or (7) a different goal entirely." Needless to say, the difference among these possible interpretations is not trivial and can lead to significant stakeholder friction.

While ecological restoration is a social process, a mistaken common belief is that it is more about ecology than social dynamics and for that reason perhaps social understanding of restoration lags ecological understanding (Millard et al., 2022). That said, basic social knowledge does exist which can inform restoration planning and designing. Metcalf et al. (2015), for example, identify that the most critical element for stakeholder collaboration is trust and that widely prevalent mistrust must be dispelled for effective collaboration. One way to do so, these authors argue, is to recognize that trust requires accepting vulnerability, and that perceived vulnerability affects stakeholders' perceptions of the risks and benefits of a restoration project. Gornish et al. (2021) offer three suggestions for effective stakeholder collaboration– (1) Stakeholder identification should attempt to be as broad as possible, (2) collaboration with those who have developed networks with key stakeholders can be useful and (3) and providing information back to stakeholders builds trust. Elias et al. (2021) provides a comprehensive set of prescriptions for stakeholder collaboration through their "ten people-centered rules" for restoration, which are captured in Figure 1. Ultimately, it is crucial to internalize that the success of restoration efforts hinge on effective navigation and integration of stakeholder perspectives (Millard et al., 2022; Walker et al., 2006) while recognizing and respecting human rights and community ownership rights.

Fig 1: Ten people-centered rules for sustainable ecosystem restoration (Source: Elias et al., 2021)

Considering aforementioned complexities, forest sector entities ought to consider the following question – i.e., a possible fracture line – as they might seek to develop a framework for stakeholder engagement:

FL 4: *Which are relevant stakeholders and which principles should govern stakeholder relationships?*

(III) Metrics to measure success of restoration projects

Tracing the progress and success of restoration activities carried out in different ecological and social contexts is crucial for the success of global efforts to ecological restoration (Gann et al., 2022). One way to accomplish this is by developing and identifying reliable and generalizable indices/indicators that could enable meeting local, national, regional, and international targets. This implies that different metrics are needed to ensure that projects successfully comply with what is agreed upon at different scales. Ideally, these indicators should be cost-effective, monitorable in a short period of time, should provide relevant information about the state of the restoration, and should require minimal expertise to assess them (Galatowisch, 2012). These indices will allow us to answer a key question, *Are we making progress towards the initial goals?*. When the expected changes are not happening, then incorporating an adaptive management approach that identifies unanticipated outcomes and allows to modify the strategies implemented can help to put on track the restoration of the project (Holl, 2020).

The barriers in data availability and ambiguity around restoration metrics incentivized that UNDER compiled a set of global indicators which allow multiple stakeholders to keep track of the progress of restoration activities in terms of different ecological, social, and economic aspects. In 2022, SER, Climate focus, the Global Restoration Observatory network, and the UN Decade on Ecosystem Restoration Monitoring Task Force made available a sector-wide Restoration Project Information Sharing Framework that contains a list of restoration indicators. The list was based on more than 50 multilateral frameworks, project databases, published standards, academic papers, and interactive tools. The final framework includes 17 headline indicators, and 44 additional core and secondary indicators that projects can measure (Table 1). The proposed indicators are directly linked to the 10 principles of the UNDER. The data collected from the indicators can be reported on the Framework for Ecosystem Restoration Monitoring (FERM) platform, enabling integration of these metrics at local, national, regional,

and global scales. The use of the variables proposed is expected to facilitate data collection and enable projects to select most relevant indices according to their particular ecological and social needs (Gann et al., 2019).

The Restoration Project Information Sharing Framework allows users to link indicators that research institutions and consulting firms have recently developed (e.g., German Centre for Integrative Biodiversity Research (iDiv), Nature serve, Science Based Targets Network) for different stakeholders needs. For example, iDiv group designed the Global ecosystem restoration index (GERI), and index that integrates structural and functional aspects of the ecosystem restoration process allowing projects to keep track of the indicators that are under the UNDER **Principle 4** "Ecosystem restoration aims to achieve the highest level of recovery for biodiversity, ecosystem health and integrity, and human well-being." This proposed framework goes beyond basic ecological indicators, it allows the inclusion of forest certifications and verifications (e.g. Forestry Stewardship Council, VERRA, PEFC) as monitoring indicators. Even though the FERM can be easily adapted, selection of indicators from myriad available options requires weighing many factors including cost effectiveness (Bodin et al., 2022).

Considering aforementioned complexities, forest sector entities ought to consider the following question – i.e., a possible fracture line – as they might seek to identify metrics to keep track of restoration initiatives:

FL 5: *How to determine adequate metrics that can be used for both restoration monitoring and certification initiatives on a given site?*

Table 1. Core and secondary indicators modified from the Restoration Project Information Sharing Framework.

Principles	Core Indicator	Secondary Indicator
1: contributes to the UN sustainable development goals and the goals of the Rio Conventions.		Certifications or verifications that projects have achieved (e.g., Forestry Stewardship Council, VERRA) that contribute to the SDGs or other global goals.
2: promotes inclusive and participatory governance, social fairness and equity from the start and throughout the process and outcomes.	Change in stakeholder and community engagement in restoration	Change in stakeholder and community awareness of value of restoration
	Underrepresented groups represented within project decision-making structure	
	Whether stakeholder Free, Prior and Informed Consent was practiced during the planning stages in relation to land tenure, land rights, and project benefits	
	Primary technical guidance used in restoration planning	Review process carried out during the project planning or design phase.
3: includes a continuum of restorative activities.	Types of project activities implemented	Species used in projects
	Types of aftercare or maintenance for seeds/plants/biota that are or were provided.	
	Percent survival of installed plants or other biota	
4: Achieves the highest level of recovery for biodiversity, ecosystem health and integrity, and human well-being.	Change in richness of desirable native species	Recovery progress from pre-project baseline toward a reference model
	Changes in native species abundance or relative abundance	Change in presence of contaminants, pollutants, or excess nutrients
	Change in invasive species abundance or relative abundance.	Change in number of human-wildlife conflicts affecting indicator species
	Changes in beneficial connectivity between native ecosystems.	Changes in beneficial reproduction and dispersal
		Changes in ecosystem productivity
		Reestablishment of characteristic ecological disturbance regimes
	Changes in food, water, and fuel security	Change in local community restoration-based livelihoods, including employment

	Changes in other social benefits	Financial benefits from restoration other than employment
	Timeframe during which benefits are expected to be produced or available	Changes in owner or other occupant capacity for security and self-sufficiency
	Contributions to climate change mitigation and disaster risk reduction	
	Changes in land cover or marine structured habitat	
5: addresses the direct and indirect causes of ecosystem degradation.	Direct and indirect causes of ecosystem degradation addressed by the restoration project, including reducing risk	Direct and indirect causes of ecosystem degradation not addressed by the restoration project
		Trends in ecosystem degradation processes from pre-project baseline toward measurable project goals
6: incorporates all types of knowledge and promotes their exchange and integration throughout the process.		
7: is based on well-defined short-, medium- and long-term ecological, cultural and socio-economic objectives	Components of project baseline assessed.	If and how a reference model was constructed.
8: is tailored to the local ecological, cultural and socio-economic contexts, while considering the larger landscape or seascape.	Changes in exchanges with external ecological, cultural, and social-economic systems	
9: includes monitoring, evaluation and adaptive management throughout and beyond the lifetime of the project or programme.	Intended or completed monitoring duration	Main sources of monitoring funding.
	How often monitoring is or was performed and how the data are shared	Publication of project monitoring results.
	Identification of those responsible for monitoring and the monitoring method employed.	
10: is enabled by policies and measures that promote its long-term progress, fostering replication and scaling-up.	Long-term funding or other resourcing strategies to maintain or manage the restoration process	Participation of stakeholders in creation of ecosystem restoration policies and rules.

(IV) Capacity alignment

Global commitments aim to restore more than 2 billion hectares of degraded and deforested areas across the globe (UN, 2019). The first step to accomplish these goals is to identify suitable areas where restoration initiatives can be implemented. To do so, efforts should be focused on identifying degraded areas that can still be recovered and that can provide ecosystem services to the neighboring local communities. During this process it is also key to determine for how long the target area has been degraded and who was responsible for the degradation. These elements will allow a better selection of the restoration strategies that should be implemented and will enable more accurate cost estimates of the restoration interventions. Therefore, detailed fine scale information that allows different stakeholders including the forest sector to assess landscape levels of degradation and potential benefits of different restoration strategies to local communities is critical. Most available land-cover maps (e.g., WRI, Integrated biodiversity areas, Global Forest Watch, World cover map European Space Agency) allow only to access coarse-scale strategies (Gibbs & Salmon, 2015), and most restoration specific resources (e.g. Areas of global significance for restoration, Regeneration Hotspots) lack information about local communities' needs (Kirui et al., 2020). Therefore, to successfully identify suitable areas for restoration and the right practices to implement, country and regional scale maps where the presence of local communities can be identified are needed. Brazil has been a pioneer in this realm. The country created the Brazilian Restoration and Reforestation Observatory, a platform that allows stakeholders to easily track changes in land use across the country at a fine scale. Additionally, the extensive research that has been conducted in several biomes across the country including the Brazilian Atlantic Forest allowed stakeholders to identify where there is natural regeneration potential and how much carbon can be sequestered in those areas (Crouzielles et al., 2019).

It is evident that most degraded areas need active restoration interventions (Bastin et al., 2019). Therefore, millions of high-quality seeds and seedlings need to be gathered and produced in the next decade to meet active intervention demands (Broadhurst et al., 2016; Vitt et al., 2022). To accomplish this, large-scale mass production of seeds and seedlings is required. The expertise of the forest sector and the knowledge of local communities selecting, and propagating high-quality material is key for scaling this process up (Bloomfield et al., 2018; Urzedo et al., 2021,

Mansourian et al., 2022). Additionally, the progress made by the forest sector in improving management practices (Griscom et al., 2017) can also contribute to making restoration practices and seedling production more sustainable. Their experience in planning road networks, developing responsible logging practices, and implementing sustainable incentives can offer seven to nine times more mitigation potential at ≤US$20 tCO2e−1 (Busch et al., 2019). Finally, the expertise of the sector can help train a highly qualified workforce that can support active restoration strategies. This will increase job opportunities and strengthen local economies (UNEP, 2021).

Another essential aspect where the forest sector can contribute is in the understanding of the costs and benefits of different restoration strategies (Ghazoul & Chazdon, 2017; Holl, 2017). Even though initiatives like the natural climate solutions (NCS) World Atlas is a good starting point to quantify the cost/benefits of restoration practices, the variability of costs across projects requires small scale assessments. The expertise of the forest sector implementing (seed purchasing, seedling production, site preparation, and tree planting), managing (i.e. irrigation, fertilization, fencing, insecticide application, and weed and invasive species control), and monitoring a spectrum of restoration strategies (Brancalion et al., 2020) is key for determining the cost-effectiveness of fine-scale interventions across the globe. Their knowledge can broadly benefit other sectors interested in investing in restoration initiatives. Finally, the strong and well-established partnerships that the forest sector has with multiple stakeholders can help channel funding and bring together donors that can help financing restoration activities. In Vietnam, for example between 2000 and 2015, the Forest Sector Support Program and Partnership (FSSP) brought together 25 international donors (Mansourian et al., 2022). The Vietnamese success model can be replicated in other countries.

The following fracture lines emerge from the complexity to establish cost-effective large-scale restoration initiatives:

FL 6: *How to make restoration strategies cost-effective?*

FL 7: *How to translate large-scale degradation maps that do not consider local communities needs into fine-scale inclusive maps where restoration initiatives can be implemented?*

(V) Business case and financing

Whether the private sector can commit to a long-term participation in a project ultimately depends on the financial payoff – whether accrued directly (e.g., through new revenue or investment streams) or indirectly (e.g., through improved reputation, alliance formations). The question of central significance in the context of this background paper then becomes whether there is a business case for the forest sector companies to engage in ecosystem restoration. In other words, is there a reasonable likelihood that forest sector companies can materially gain from vigorously participating and becoming more visible in ecosystem restoration?

In today's investment climate where climate and nature finance are key growth areas, and where considerable innovative instruments have emerged in recent years, the answer to the above question appears to be a yes! Restoration activities can help forest-based industries to tap into emerging capital market investment opportunities through such measures as impact funds, green bonds, social bonds, sustainability bonds (SBs), sustainability-linked bonds (SLBs), green loans or sustainability-linked loans (SLLs). In addition, restoration activities can help companies gain access to novel finance opportunities through payment for ecosystem services, impact funds, debt for nature swaps, biocredits, natural capital funds, and funds tied to CSR commitments. Figure 2 captures main currently available (or emerging) financing options.

Fig 2: Possible instruments to attract investment through ecosystem restoration.

A Bloomberg report Figure (3) shows that sales of all major green assets have fast been rising and all reliable estimates suggest that these trends will only accelerate as investors interest in Environmental Social and Governance (ESG) and climate responsible portfolios further increases.

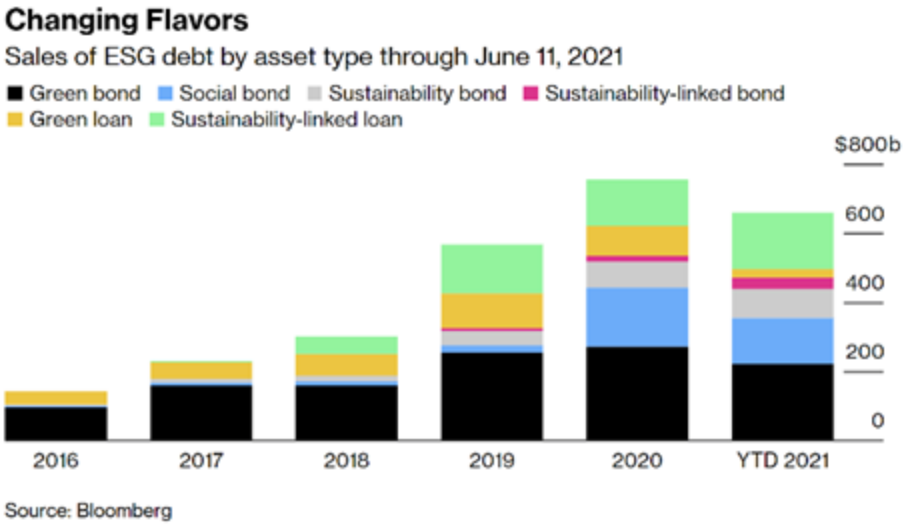

Fig 3: Upward trajectory of ESG assets

That said, how much of the green finance market can be realistically tapped into through restoration initiatives remains unclear although nature and biodiversity are bound to become increasingly important. The impending launch of the Taskforce on Nature-related Financial Disclosures (TNFD) framework is likely to provide further boost to the field as common understanding and standardized practices to measure and report on nature emerge. As the field becomes further structured and investors' scrutiny increases, quality of restoration will become a core priority. Quality, in turn, would be assessed on both ecological and social criteria and hence the sector's potential to attract nature-related finance is tied to stakeholder engagement, development of reliable measures, and indeed, concerted efforts to reposition the sector as a model of restoration which, by virtue of its scientific expertise and community relationship, is ahead of others. Concerted efforts and shared vision perhaps are pivotal to capitalizing upon the

business case simply because the sector has to proudly embrace its own story before it can set out to share it with others.

Visibility in the restoration realm could also help the sector to reorient its sustainability messaging that has long suffered from a reputational crisis. Specifically, restoration can facilitate anchoring the sustainability messaging of the forest-industry in the *regenerative economy* or *nature-positive economy* narratives, both of which are becoming mainstream in broader sustainability conversations.
As such, there is a strong possibility that ecosystem restoration is underpinned by a multifaceted business case waiting to be explored and shaped. Its foundations will have to be built collaboratively but, needless to say, companies will need to develop strategies to benefit from the business case individually.

Here, the following question emerges as a possible fracture line:

FL 8: *How best to tie the forest industry's restoration expertise with emerging investment opportunities?*

4. Conclusion

Enhancing the overall profile of forest industries in global ecosystem restoration could be a real strategic opportunity. This is the only industry which has core competence in ecosystem restoration. It has much to offer to other industry sectors that are just beginning to scratch the surface of restoration and can thus significantly augment private sector efforts to ecological restoration globally.

Notwithstanding its triple footholds, namely, scientific expertise, community relationships, and a vast land ownership, which very well position the forest industry to vigorously participate in prominent ecosystem restoration initiatives, the industry needs clarity on unresolved issues – fracture lines – before it can take decisive actions.

In summary, the paper's core contention is that a full engagement of the forest sector in ecosystem restoration is an imperative to achieve global aspirations to restore our degraded

landscapes. By being at the forefront of restoration efforts initiatives, the forest sector companies can contribute both by knowledge sharing with other sectors and by implementing its own high quality restoration projects attracting nature-aligned investments. Shedding light on the eight fracture lines which we identify above can help in unleashing the sector's potential to restore ecosystems, protect biodiversity, and provide employment and income opportunities to local communities world over.

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