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Situating the "human" in forest landscape restoration

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Globally, forest landscape restoration (FLR) is gaining ground, alongside other forms of restoration under the UN Decade on Ecosystem Restoration. In most cases, projects and initiatives fail to consider human dimensions that influence the processes and outcomes of the restoration effort. These dimensions refer to how and why humans value natural resources; how humans want resources to be managed; and how humans affect or are affected by natural resource management decisions. Using the model of the forest transition curve that shows the trajectory from loss of forests to restored forests, we discuss how FLR intersects in different ways with this transition curve. We conclude that: 1) definitions and their implications are a fundamental challenge for FLR; 2) there is an intrinsic interdependence between people and forests that varies across spatial and temporal scales and that is mediated by institutions; 3) power differentials among stakeholders create imbalances in restoration; 4) conflicts around restoration result from differing interests, power and values. Equitable and durable restoration requires a much greater inclusion of human dimensions along all steps of the process.

1 Introduction

Consideration of human dimensions in forest landscape restoration (FLR) or other restoration undertakings is critical as people are an intricate part of restoration processes (Höhl et al., 2020; Fleischman et al., 2020; Löfqvist et al., 2023). This is particularly relevant in large scale restoration, such as FLR, that involves multiple stakeholders with multiple interests, and has broader socio-economic and environmental repercussions than site-based restoration.

There are many definitions of FLR (Mansourian, 2018) and it can include diverse activities. For example Sabogal et al. (2015), identify the following FLR intervention options: planted forests and woodlots; natural regeneration; silviculture enhancement of existing forests and woodlands and stocking; agroforestry; improved fallow; mangrove restoration; and watershed protection and erosion control. Essentially, FLR aims to balance both human wellbeing and ecological integrity of forested landscapes (Mansourian et al., 2021). These aims are echoed in multiple international agendas, including the UN Decade on Ecosystem Restoration which emphasizes that restoration "needs to be carried out in ways that balance

social, economic and environmental objectives and with the engagement of relevant stakeholders, including indigenous peoples and local communities" (UNGA, Res/73/284: 4). The UN Decade further acknowledges that ecosystem restoration is a process to halt and reverse degradation, improving ecosystem services for people and supporting biodiversity recovery (Nelson et al., 2024). Yet, in practice, restoration has given limited attention to human dimensions emphasizing instead climate mitigation or ecological priorities (Elias et al., 2022).

Human dimensions in relation to natural resources refer to: 1) how and why humans value natural resources; 2) how humans want resources to be managed; and 3) how humans affect or are affected by natural resource management decisions (Decker et al., 2012). Firstly, humans may value natural resources for their intrinsic, relational, or instrumental values (Himes et al., 2024). Such values are shaped by diverse cosmovisions or worldviews, perspectives, and knowledge systems not limited to Western knowledge (Pascual et al., 2023). For example, both Traditional (the Kitcisakik Algonquin community) and Western knowledge were applied in the restoration of mixed eastern white pine (*Pinus strobus* L.) forests in western Quebec (Lake et al., 2018). Understanding the different values held and assigned over the resources to restore in each context is crucial.

Secondly, humans can also have different objectives and needs that, together with their values, shape how they want the resources deemed degraded to be restored (Djenontin et al., 2020; Mansourian, 2021). This calls for understanding restoration motivations, prioritizing the needs of local communities living in the landscapes to be restored. Reaching an acceptable and shared vision for the future landscape may require negotiations among stakeholders to seek consensus. For example, in the context of Habitat 141˚ - a diverse alliance seeking to protect and restore a highly fragmented landscape in Australia - negotiations led to a common 50-year vision: "To work with communities to conserve, restore and connect habitats for plants and wildlife on a landscape-scale from the outback to the ocean" (Bixler et al., 2018). In contrast, in India Rai et al. (2018), highlight the top-down approach taken to restoration through the 2016 Compensatory Afforestation Fund Act, which has led in many instances to restrictions imposed on rural communities for grazing, cultivation and collection of non-timber forest products in areas slated for restoration. Negotiation, reconciliation of interests situated at multiple scales, management of trade-offs among ecological and social dimensions, and minimization of power imbalances are, therefore critical challenges for large scale forest restoration (Guariguata and Brancalion, 2014).

Thirdly, humans shape natural resource management and use by setting rules, building mechanisms to frame these rules, and incentivizing or penalizing compliance. Sabogal et al. (2015) identified "key areas of intervention" in FLR that include understanding the institutional setting and governance context, echoing other studies that pointed to various governance and institutional issues to consider in restoration implementation, such as local participation in decision making (Elias et al., 2022), incentives and broader equitable distribution of costs and benefits (de Groot et al., 2013), cross-scale and cross-sectoral institutional arrangements (Wiegant et al., 2022; Djenontin and Zulu, 2021) and tenure security (McLain et al., 2021). These governance and

institutional factors and conditions mediate the management outcomes, including the benefits people can draw from the resources.
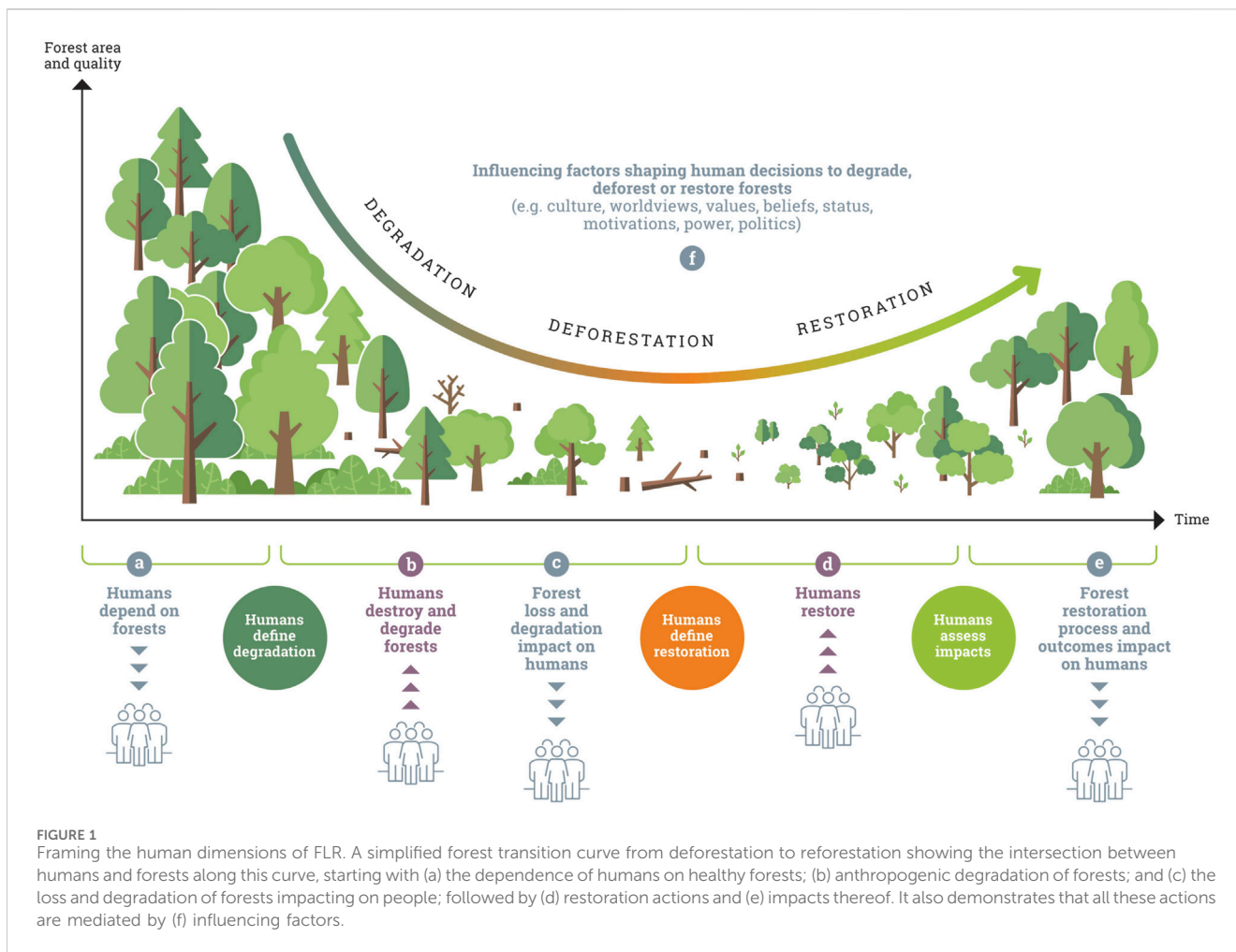
We use the model of a forest transition (Mather, 1992), which sets out a country or region's temporal trajectory from net forest loss to net forest gain, to map and better understand the extent of human dimensions in forest landscape restoration and determine potential leverage points for policy and practice. Human dimensions associated with FLR intersect in different ways with this transition curve (Figure 1).

2 Human dimensions in a forest transition

Extensions to forest transition theory have mapped multiple potential pathways from forest loss to gain (Meyfroidt and Lambin, 2011). As restoration researchers, we recognize that although FLR represents one pathway along the forest transition curve, it is by no means the only one. Furthermore, the lack of agreed definitions (e.g., on forest degradation and restoration) generates challenges to identify broadly acceptable restoration objectives (e.g., Hobbs, 2016; Chazdon et al., 2016). Nonetheless, it is also widely acknowledged that land degradation and its cascade of impacts, are jeopardizing the lives of millions of people around the globe (IPBES, 2018). As such, while Figure 1 is clearly a simplification (realities in different times and places are more complex: Cochard et al., 2023), we believe it presents a useful framework to better understand the intersections between human dimensions and forest restoration.

Human dimensions operate at the intersection of the social and the ecological systems. Many people depend directly on forests for their livelihoods (point a in Figure 1), and even more depend indirectly on forests for the multiple contributions that they provide (Diaz et al., 2018). Yet, people also degrade forests, as shown in Figure 1 (point b). Critically, the people who most depend on forests directly, are often not the ones degrading them, although this will depend on specific locations. For example, in Brazil's Xingu Indigenous reserve, Indigenous communities that depend on the Amazon forest have been conserving and restoring it, while non-Indigenous migrants moving to the area have been responsible for exploiting the forest around the Indigenous reserve (Sanches et al., 2021). In other examples, multinational mining companies with poor management practices have been directly responsible for degrading and deforesting forest areas (Sonter et al., 2017). Other compounded socio-economic and institutional factors, such as poverty and insecure tenure, condition environmental degradation behaviors. For instance, in southern Burkina Faso, relatively wealthy migrants who lack secure land tenure engage less with assisted natural regeneration practices than local farmers with more secure land rights (Etongo et al., 2016).

Moving along the forest transition curve (to point c), the loss and degradation of forests have a direct impact on humans. These impacts may be local (e.g., the loss of material and non-material benefits previously provided by forests, such as provisioning and cultural services), national (e.g., loss of revenue from economic streams linked to such natural capital) or global (e.g., loss of biodiversity such as unique species) and will affect different

FIGURE 1
Framing the human dimensions of FLR. A simplified forest transition curve from deforestation to reforestation showing the intersection between humans and forests along this curve, starting with (a) the dependence of humans on healthy forests; (b) anthropogenic degradation of forests; and (c) the loss and degradation of forests impacting on people; followed by (d) restoration actions and (e) impacts thereof. It also demonstrates that all these actions are mediated by (f) influencing factors.

people. Then, moving along the forest transition curve, it is also humans who are responsible for restoration (point d, Figure 1). Even when natural regeneration is favored as an approach to restoration, human activities may be required to protect new growth by, for example, excluding herbivores or securing rights to the land and forests. Restoration processes and outcomes impact people in many ways (point e), with again differences depending on the actor and stakeholder. For example, local people may benefit (through job opportunities or secure rights) from restoration, but they may also be excluded from certain forest areas, and thereby bear the costs of the restoration process.

Several factors (point f in Figure 1) influence and mediate these interactions between people and the forest restoration process. They include worldviews, power dynamics and culture that influence people's relationships with each other and with the land, trees, and forests. Along the transition curve, humans also shape discourses and understandings of forests and restoration. The concept of degradation is a subjective one and humans are responsible for defining and interpreting it in diverse ways (Hobbs, 2016; Ghazoul and Chazdon, 2017). Likewise, the concept of restoration is defined by humans, and there are a multitude of terms, framings (see, e.g., Mansourian, 2018; Gerwing et al., 2023), and different interpretations associated with the term (Reinecke and Blum, 2018).

3 Discussion

Four key points stand out from our assessment of the linkages between the forest transition and human dimensions in FLR. Firstly, the power of definitions and their implications emerges as a fundamental challenge in restoration (Reinecke and Blum, 2018). Current large scale restoration efforts have been criticized for their limited attention to biodiversity (e.g., Parr et al., 2024), reflecting divergent understandings of what restoration entails (Zerbe, 2023). The concepts of degradation and restoration are central to the model of the transition curve, and defining these concepts is a socio-political process that carries with it significant implications (Hobbs, 2016; Chazdon et al., 2016). If a national government considers an area degraded but not the local community, government-imposed restoration measures are likely to go against the community's interests (e.g., from Viet Nam, McElwee, 2009). Respect for diverse values and knowledge systems as they relate to forests and landscapes provides space for negotiating restoration objectives that are acceptable to all.

Secondly, there is an intrinsic interdependence between people and forests that varies across spatial and temporal scales–with those most proximate typically relying more heavily on forests than those more distant, and being more impacted by degradation as well as restoration. Responsibilities for degrading or restoring also differ,

with people who depend most on forests not necessarily being most directly responsible for forest degradation. Institutions, such as tenure rights, mediate the ways in which people relate to forests along the whole transition curve (Hecht et al., 2019; McLain et al., 2021).

At the same time, and this is our third point, power differentials among stakeholders create significant imbalances in the restoration processes being implemented around the globe (Elias et al., 2021). These power differentials occur at different scales. They may relate to knowledge and data, access to resources, or may be situated in historical processes. For example, many large scale carbon sequestration projects funded by powerful multinational companies skew benefits stemming from land use in favour of actors based in faraway cities (Mansourian and Vallauri, 2023; Schubert et al., 2024). Also, the knowledge used to implement restoration can reflect power imbalances when local knowledge systems and practices are disregarded (Robinson et al., 2021). In addition, the forest transition itself creates power imbalances as different stakeholders benefit more or less at different stages of the transition (Kull et al., 2024).

Fourthly, and as a result of the previous point, conflicts stemming from both degradation and restoration are the result of differing interests, power and values. For example, the creation of value through restoration may lead to conflict (Barr and Sayer, 2012). Various conflict resolution mechanisms can help to address such conflicts in restoration, including, for example, strategy games (Garcia et al., 2022), emphasizing negotiation and mediation (Mansourian et al., 2024).

Despite its limitations in portraying the often uneven evolution of the transition (Kull, 2017; Kull et al., 2024), the forest transition model can help conceptualize the intersections between forests (and tree-based systems more generally) and people along a trajectory from loss to recovery. It provides an opportunity to identify leverage points at different stages in the restoration process.

Improving forest landscape restoration outcomes for people and nature requires more than passive stakeholder engagement, as proposed by some principles on restoration (e.g., Besseau et al., 2018; FAO et al., 2021; Bartholomew et al., 2024), or tokenism (Robinson et al., 2021). Instead, equitable and durable restoration needs to fully engage with human dimensions throughout the entire process, acknowledging that there can be no restoration without people.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

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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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