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INVITED OPINION

Demystifying the Romanticized Narratives About Carbon Credits From Voluntary Forest Conservation

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ABSTRACT

Carbon offset projects aimed at avoiding deforestation and forest degradation, generally labeled "REDD+," are frequently promoted as a pivotal tool to mitigate climate change, promising to offer additional co-benefits for biodiversity and local communities. Despite this optimism, most positive impacts claimed by these initiatives in the voluntary carbon market (VCM) lack empirical support and are instead based on the hopeful narratives of stakeholders with clear conflicts of interest. We critically examine the scientific theories, concepts, and evidence regarding VCM's REDD+ projects, highlighting limitations on the quantification of their purported benefits that are inherent to the current design of carbon markets. Independent studies consistently point to shortcomings in the rigor and credibility of crediting methodologies and other procedures, which market players have been slow or reluctant to address. There is accumulating evidence that projects' climate and social impacts are often exaggerated due to a range of technical and practical shortcomings. We hope this work clarifies widespread misconceptions associated with REDD+ projects in the VCM and assists organizations and policymakers in their efforts to meaningfully mitigate climate change.

1 | Introduction

Escalating concerns over climate change and corresponding societal pressures to reduce greenhouse gas emissions are fueling the growth of the voluntary carbon market (VCM; Ecosystem Marketplace 2024). Carbon credits (or offsets)—equivalent to one ton of CO_2 removed from or not emitted to the atmosphere due to the voluntary, non-business-as-usual actions of "carbon projects"—are seen by many individuals, organizations, and governments as a cost-effective and scalable way to abate emissions (Blum and Lövbrand 2019; Corbera and Martin 2015). Certification schemes for such projects, allegedly based on

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conservative calculations and independent third-party assessments, were established to guarantee the environmental integrity and legitimacy of the emerging offset industry (Merger and Pistorius 2011). With the new hype and perceived convenience of "carbon offsetting," there was speculation that the burgeoning trend could evolve into a trillion-dollar market (Bloomberg 2023)—at least prior to the recent scrutiny initiated by academics and journalistic exposés. Investigative findings that questioned the environmental integrity of offset claims and the impacts of projects on local communities sparked substantial public skepticism, reshaping market trends and heightening societal awareness (e.g., The Guardian 2024, 2023).

Nearly one-quarter of the VCM consists of credits from avoided deforestation projects (Haya et al. 2023), generally labeled "REDD+" (Reduced Emissions from Deforestation and forest Degradation, with the "plus" including sustainable forest management, conservation, and enhancement of carbon stocks). For that reason, we focus this discussion on avoided deforestation projects, but conclude by briefly addressing two other REDD+ project types: improved forest management and afforestation/reforestation (AR) projects. Credits from avoided deforestation projects are issued based on the comparison of the observable deforestation in a project site to the deforestation expected to take place in the absence of the project, that is, the baseline (or counterfactual) scenario. In general, the more "catastrophic" the baseline, the more credits a project can claim.

One of the main criticisms of baseline scenarios adopted by REDD+ projects lies in the substantial flexibility in modeling decisions embedded within baseline methodologies. This flexibility has historically allowed ample room for manipulation (West et al. 2024)—where the exploitation of such leeway can lead to financial gains, thereby creating perverse incentives for the offset industry (Battocletti et al. 2023; Seyller et al. 2016). While there are exceptions (e.g., Malan et al. 2024), many studies suggest that the climate impacts claimed by a sizeable share of REDD+ projects are exaggerated, implying that very few avoided deforestation credits in the VCM are actually equivalent to one ton of CO_2 (Calyx Global 2023; Takahata et al. 2024; The Guardian 2023; West et al. 2023, 2020).

Recent attention to the lack of environmental integrity associated with many REDD+ projects has had major repercussions for carbon markets, including both new regulations and lawsuits worldwide. Most notably, various legal jurisdictions adopted disclosure requirements aimed at increasing transparency in carbon markets (SEC 2024; California State Assembly 2023; European Union 2022). Courts in various countries recently ruled that businesses claiming their products are carbon-neutral based on the use of offsets violate consumer protection laws (BGH 2024; Rechtbank Amsterdam 2024; Stockholms Tingsrätt 2023). This interpretation was also recently codified into European Union law (European Union 2024a). Greater transparency is now a key methodological requirement of Article 6.4 under the Paris Agreement, emphasizing openness in data sources, calculations, and monitoring methods used to measure offset effectiveness (European Union 2024b). This emphasis is essential for Article 6.4's aim to establish a regulatory framework for international carbon markets, whereby VCM projects may become authorized to participate.

Recent findings casting doubt on the environmental integrity of REDD+ credits in the VCM are hardly surprising. First, the weight of evidence indicates that all types of carbon projects have largely failed to achieve climate change mitigation beyond business-as-usual (Badgley, Freeman, et al. 2022; Calel et al. 2021; Cames et al. 2016; Kollmuss et al. 2015; Macintosh et al. 2024; Probst et al. 2024). Second, in retrospect, the challenge of guaranteeing the environmental integrity of credits from avoided deforestation interventions was one of the main reasons why this project type was excluded from the Clean Development Mechanism of the Kyoto Protocol (Jung 2005) and, more recently, from certification schemes such as the Gold Standard (Gold Standard 2024).

Although REDD+ projects are championed as a vital instrument for climate change mitigation, with promising co-benefits for local communities and biodiversity, there continue to be large gaps between theoretical expectations and the actual impacts of existing interventions. These discrepancies are frequently obscured by romanticized narratives that are not grounded in evidence and that portray the projects as achieving striking success in preventing deforestation, improving local livelihoods, and ensuring lasting climate benefits extending beyond their operational lifetimes, all while conveniently omitting any mention of the inherent conflicts of interest. To bridge this divide and provide a foundation to rectify misconceptions about REDD+ in the VCM, we examine misinterpreted theories, neglected evidence, and the limitations of impact assessment protocols and standard procedures.

2 | Protection of Forests Threatened by Deforestation

Carbon offset projects rely on the principle of additionality: the measurable difference in deforestation between the baseline scenario—the hypothetical future without the intervention—and the actual forest state within the project area. To ensure the integrity of offsets from avoided deforestation, carbon credits must originate from forests demonstrably at risk of deforestation. This stipulation is unlikely to be satisfied for the many projects in remote or otherwise inaccessible areas (Delacote et al. 2022). Location bias is well documented in the conservation literature, particularly in the context of protected areas (e.g., Ferraro and Pattanayak 2006; Joppa and Pfaff 2009). In theory, project baselines would not suffer from location bias if baselines were properly constructed. Unfortunately, nearly all existing project baselines are based on subjective narratives and unreliable deforestation forecasts, often originating from simulation models lacking proper validation (West et al. 2024; Pontius 2018). Compounding the problem is the role of information asymmetries between project developers and certifiers, which create opportunities for adverse selection, where projects are more likely to be established in areas facing little real deforestation risk while still claiming credit for avoided emissions (Delacote, Le Velly, and Simonet 2024; Cordero Salas et al. 2018).

The validity of these ex-ante simulations of land-use/cover change is assessed through model validation exercises. In the context of REDD+ projects, validation scores measure the accuracy of simulation models in replicating historical deforestation patterns and rates, ranging from 0% to 100% (i.e., from no alignment to perfect alignment with historical data). While not all projects conduct validation exercises, many that do report alarmingly low validation scores (Pontius 2018). An examination of nine REDD+ projects found a maximum accuracy of only 11.7%, with three scoring under 1% (West 2016a). Such low values render many baseline scenarios no more reliable than "random guessing" (Pontius 2018). Still, numerous such scenarios are deemed "validated" by VCM standards. Moreover, even with high validation scores, ex-ante simulations are inherently limited for rigorous impact assessments since they fail to account for time-varying confounding factors that can only be observed ex post and that can affect the level and spatial distribution of counterfactual deforestation.

In impact evaluation terminology, confounding factors are those that influence both site selection (or its probability) and outcome regardless of (or in addition to) the intervention itself (e.g., broad changes in governance or the economy), thus leading to incorrect conclusions about the causal relationship between the intervention and its actual outcome (e.g., Ferraro and Hanauer 2014). Identifying and controlling for confounding factors is thus crucial for handling adverse selection and ensuring accurate impact assessments of any intervention, including REDD+ projects. Nevertheless, avoided deforestation baselines often rely on unrealistic assumptions of unchanging historical averages or trends (West et al. 2024). These assumptions are especially problematic given the inherent volatility of deforestation rates, which are sensitive to political, demographic, and economic shifts (Simmons et al. 2018; Busch and Ferretti-Gallon 2017). Consequently, the resulting baselines render carbon crediting unreliable, thereby compromising the integrity of claimed offsets. Further exacerbating this issue, baseline methodologies historically allowed for excessive flexibility (Delacote et al. 2025), creating opportunities to inflate counterfactual deforestation rates through methodological choices.

The inherent difficulty of predicting the future does not absolve project developers and VCM standard-setters from the responsibility to adopt modeling assumptions and frameworks that, at the very least, yield defensible or conservative outcomes, while avoiding elementary errors. Furthermore, contrary to unsubstantiated assertions by the offset industry, project baselines frequently disregard local deforestation contexts. In practice, baseline scenarios are almost always constructed based on information derived from satellite images taken at different points in time (West et al. 2024), with no input from local stakeholders.

A notable exception to the standard practice of baseline construction came from the Suruí REDD+ Project in Brazil, which employed a more robust modeling approach that integrated local indigenous knowledge within a properly validated, dynamic systems modeling framework (Vitel et al. 2013). Notably, it resulted in the only project baseline (of 12 in the Brazilian Amazon) that exhibited a trend consistent with synthetic controls estimated by West et al. (2020). The Suruí case also illustrates the often monumental challenge of effectively curbing illegal deforestation on the ground. Despite a well-designed, participatory initiative (West 2016b), the project ultimately succumbed to the relentless pressures of illegal mining and cattle ranching expanding into the indigenous territory (Verra 2018). The Suruí Project's failure underscores the persistent—and often insurmountable—challenge of safeguarding tropical forests in the context of institutional failures to enforce the law and the impunity of illegal deforestation agents, even with targeted interventions and financial support from the VCM. Furthermore, it exemplifies the well-accepted principle that "silver bullets" in conservation do not exist (Börner et al. 2020) and underscores the need for careful scrutiny of claims that REDD+ projects have drastically—and miraculously—reduced deforestation.

As demonstrated in the literature, ex-post analyses—based on standard methods for causal inference—can be used to more reliably estimate project impacts (Delacote et al. 2022; Takahata et al. 2024; West et al. 2023, 2020). Such assessments could provide the starting point for developing more credible practices, ratcheting up the quality of the analyses underlying carbon credit claims, and restoring the credibility of the VCM (Delacote et al. 2025). Nevertheless, ex-post analyses are limited by data availability and quality (Delacote, L'Horty, et al. 2024), and their outcomes can be sensitive to methodological choices (Probst et al. 2024). Therefore, robustness checks, potentially including both methodological variations and test datasets, are paramount for ensuring fair impact assessments. While ex-post analyses (including dynamic baseline approaches) offer valuable additional evidence for evaluating the credibility of baselines and carbon crediting protocols, there is currently no single ex-post method that should be regarded as the definitive solution.

3 | Leakage

Another key concept related to REDD+ is leakage—the displacement rather than the reduction of deforestation or forest degradation. Leakage often stems from market dynamics, such as shifts in the supply of timber or agricultural products (i.e., market leakage; Hertel 2018), or from the relocation of activities to other areas (i.e., activity-shifting leakage; Fearnside 2009). While leakage is often associated with undesirable outcomes, there can be beneficial spillovers beyond project boundaries (e.g., Yu et al. 2024).

Quantifying leakage is challenging, and experts disagree about the best approaches. For example, while Groom et al. (2022) estimated negligible leakage from Indonesia's moratorium on granting new forest concessions, Leijten et al. (2021) suggested that it potentially exceeded, and thus nullified, the intervention's intended benefits. While there is no consensus around the best ways to estimate or evaluate leakage, it is clear that the simplified, often subjective methods for estimating leakage adopted by REDD+ projects lack scientific rigor (Filewod and McCarney 2023), suffering from similar problems as the project baseline methodologies. As a result, leakage estimates assumed by REDD+ projects are often unrealistic and, more concerningly, tend not to be conservative. Financial incentives directly reward the underestimation of leakage in these projects, which compounds the problem.

A recent review of leakage estimates from 75 avoided deforestation projects reported average deductions of 2.6% for activity-shifting leakage and 4.4% for market leakage (Haya et al. 2022). These values are strikingly lower than the 39.6% average leakage estimate derived by Pan et al. (2020) for the forest sector, which ranged from −10% to 100%. Although more research is needed on this topic, existing studies offer enough evidence to raise concerns about the leakage estimates provided by REDD+ projects.

Leakage may even be exacerbated in cases where REDD+ interventions aim to convert tropical forests slated for logging into strictly protected areas. While such an action might justifiably claim reduced site-level carbon emissions, the well-intentioned intervention could inadvertently lead to an overall increase in net emissions if the wood not harvested is replaced by materials currently with larger carbon footprints (e.g., Oliver et al. 2014), in the form of material-shifting leakage—an issue often overlooked in the VCM.

4 | Non-Permanence

Lasting climate benefits from forest offsets can vanish if deforestation or destructive wildfires occur during or even after the project's lifespan (Lee et al. 2025; Carrilho et al. 2022), which is why forest carbon credits are considered non-permanent (Palmer 2011). This characteristic was at least partially responsible for keeping AR credits from the Clean Development Mechanism (CDM) of the Kyoto Protocol ineligible for trading in the largest carbon market in the world, the European Union Emissions Trading Scheme (European Parliament and the Council 2004).

To address the non-permanence issue, the CDM introduced a rule requiring forest credits to be replaced by other credits once the project they originated from ends (Maréchal and Hecq 2006; Schlamadinger et al. 2005). This straightforward—but arguably inconvenient—solution was not adopted by VCM standard-setters. Instead, certification schemes such as Verra's Verified Carbon Standard implemented an insurance-like approach, where a portion of credits from each project is set aside in a "buffer pool" determined through a risk assessment. However, this buffer pool approach has two key limitations. First, the risk assessments used to determine contributions to the buffer pool are often neither rigorous nor conservative, leading to substantially lower buffer allocations than needed to account fully for potential reversals (Anderegg et al. 2025; Badgley, Chay, et al. 2022). Second, unlike the CDM's replacement approach, this mechanism does not ensure forest offset permanence after projects conclude. In effect, buyers may be essentially "renting" carbon emission reductions, as these reductions may no longer exist in the future (cf. Maréchal and Hecq 2006), with no lasting accountability for the parties involved once the projects end.

While REDD+ projects cannot control government decisions, they can be severely affected by them. For example, the recent decision to construct dams along the Kong Hen and Russei Chrum Rivers in southern Cambodia is expected to undermine the voluntary Southern Cardamom REDD+ Project implemented in the region (Mongabay 2023). Even jurisdictional REDD+ credits issued with government endorsement are not immune to political turmoil. It is not uncommon for governments to shift their priorities regarding development and conservation under new administrations (e.g., Abessa et al. 2019), posing serious risks to the permanence of forest carbon offsets. Additionally, conflicting positions between national and subnational governments can lead to policy clashes, where national decisions may override previous bilateral agreements made at subnational levels. Institutional barriers—e.g., weak property rights, limited enforcement capacity, and corruption—compound the problem, playing a critical role in shaping deforestation and conservation outcomes (Milne et al. 2019). Carbon finance alone is unlikely to produce lasting reductions in deforestation without complementary institutional reforms.

5 | Double-Counting

One of the most debated topics in REDD+ governance is how to prevent double-counting between offsets issued by governments at the jurisdictional level and those claimed independently by voluntary projects operating within jurisdictions (Lee et al. 2018). While double-counting can be straightforwardly managed once—and if—governments establish a "nesting" accounting framework, several political and technical challenges complicate these approaches (Romm 2023).

Governments have little to gain—politically or economically—from legitimizing carbon credits from private REDD+ interventions. As offset policies are relatively new compared to many existing projects, governments retain substantial discretion over how credits originating from within their jurisdictions are regulated and who is authorized to commercialize them. For instance, in May 2023, the Zimbabwean government announced a policy to "take 50% of all revenue from carbon projects, allocate 30% to foreign investors, and dedicate the remaining 20% to local communities" (Reuters 2023). This issue of who has the right to claim emission reductions under greenhouse gas reporting initiatives, including Nationally Determined Contributions under the Paris Agreement, is at the core of the double-counting challenge (Romm 2023). If governments do not recognize REDD+ project claims, all credits sold from projects in their jurisdictions and used for offsetting would be double-counted.

6 | Social and Biodiversity Co-Benefits

A key attraction of REDD+ projects for buyers in the VCM is their potential to deliver co-benefits: funding action that simultaneously mitigates climate change, protects biodiversity, and supports local communities in developing countries (Forest Trends' Ecosystem Marketplace 2023). However, assessing whether these projects have truly delivered co-benefits also requires robust impact evaluations, ideally grounded in counterfactual analyses and longitudinal data that are often lacking. For example, Verra touted its award-winning certified project with pastoralists in northern Kenya as a success story; however, subsequent investigations revealed the project failed to deliver both its claimed climate benefits and promised improvements for local communities, leading to its suspension (Mukpo 2023). While the pursuit of co-benefits is tempting (and certainly marketable), it flies in the face of the Tinbergen Rule, which states that achieving multiple, distinct policy targets—such as carbon emission reduction, biodiversity protection, and community support—requires an equivalent number of well-defined, independent policy instruments (Knudson 2008; cf. Delacote, Le Velly, and Simonet 2024).

6.1 | Social Impacts

Successfully integrating livelihood and avoided deforestation objectives is challenging due to the inherent short-term trade-offs (Delacote, Le Velly, and Simonet 2024; Putz and Romero 2012). A growing body of research emphasizes that REDD+ projects are unlikely to succeed in the long run unless they prioritize improving livelihoods and the welfare of affected populations (Arhin 2014) and secure local legitimacy (Krause and Nielsen 2014). The principles of ethical conduct and rigorous implementation that are central to the vision of REDD+ are laudable but challenging to translate into practice (Milne and Mahanty 2019).

Research demonstrates varied effects of REDD+ on socioeconomic wellbeing. Some research reports positive perceptions among households during project implementation (Carrilho et al. 2022), while other studies report negligible effects (Sunderlin et al. 2017). Many projects lack the systematic collection and counterfactual analysis of longitudinal socioeconomic data needed for rigorous ex post impact assessment (Delacote, L'Horty, et al. 2024). More fundamentally, REDD+ projects too often lack transparency about benefit-sharing mechanisms, and benefits too often are captured by community elites, further exacerbating social inequalities (Howson 2017; Andersson et al. 2018; Chomba et al. 2016). While land tenure clarity is generally considered a prerequisite for REDD+, many projects are implemented in regions where forest governance is historically complex, and land tenure remains unclear or contested (Larson et al. 2013). This uncertainty exacerbates vulnerabilities, particularly for marginalized groups such as smallholders, Indigenous communities, and the landless, whose livelihoods depend on access to forest resources (Duker et al. 2019; Kansanga and Luginaah 2019; Satyal et al. 2020). Similarly, projects that restrict access to forests are likely to disproportionately affect vulnerable communities, which means that they would have to deliver adequate compensation for lost livelihoods in order to maintain socioeconomic wellbeing (Milne et al. 2019; Poudyal et al. 2016).

To mitigate risks of social harm, VCM standards incorporate safeguard policies designed to protect vulnerable communities. However, field studies reveal that safeguards can become performative exercises focused on meeting indicator-based requirements while disregarding local contestation, critique, and demands for justice (Milne and Mahanty 2019). External audits intended to ensure compliance with social safeguard standards are often undermined by structural limitations, including auditor reliance on self-reporting by project staff, inadequate training on safeguard evaluation, and logistical challenges such as limited time on-site, insufficient local expertise, and the difficulty of accessing remote communities. A review of 18 voluntary REDD+ projects found that auditors frequently failed to detect non-compliance, and even when violations were identified, developers' justifications were often accepted without substantive corrective action (Haya et al. 2023). The inadequacy of safeguards and auditing processes has resulted in failure to prevent harm, as evidenced by numerous documented human rights violations linked to the VCM (Hengeveld 2023; Téllez Chávez 2024). Without substantial reforms, REDD+ risks perpetuating the very injustices it claims to address.

6.2 | Biodiversity Impacts

While projects that effectively protect habitat inherently provide some level of biodiversity protection (Drakare et al. 2006), the documented failures of many REDD+ projects to reduce deforestation below business-as-usual suggest they have also failed to provide additional biodiversity benefits (Delacote et al. 2022; Guizar-Coutiño et al. 2022; West et al. 2023, 2020). Importantly, most REDD+ projects occur in the tropics where local biodiversity is not only largely unknown (Hortal et al. 2015), but also where local biotic communities are more variable and less predictable subsets of the regional flora and fauna (Soininen 2010). These facts have long perplexed conservation science in most areas central to REDD+ and underlie a key challenge for adequately evaluating biodiversity impacts. REDD+ projects need biodiversity monitoring programs designed with project objectives in mind that record information at appropriate temporal and spatial scales (Jetz et al. 2019). Technological advances, including camera traps, environmental DNA, acoustic recording devices, and computer vision approaches, could substantially improve biodiversity monitoring in project areas (van Klink et al. 2022).

7 | Conflicts of Interest

Conflicts of interest are arguably among the primary factors responsible for the ongoing issues surrounding REDD+ projects (Haya et al. 2022; Seyller et al. 2016). Increasing the scientific rigor of baseline, leakage, and non-permanence assessments would likely magnify project risk and the uncertainty about expected financial returns, thereby reducing the attractiveness of REDD+ projects as an investment option. Moreover, it would likely harm project revenue, which in many cases is tied to unrealistic baseline scenarios (West et al. 2024, 2023, 2020; Seyller et al. 2016). This shift would also affect the revenue of VCM standards-setters, which typically collect a fee per credit issued, in addition to potentially affecting their reputation. Further, the adoption of better practices could increase project and certification costs due to additional work hours and expert consultations (cf. Malan et al. 2024; Vitel et al. 2013).

Conflicts of interest are often obscured by the lack of transparency (Delacote, L'Horty, et al. 2024). Project descriptions are typically crafted to meet minimum VCM standards and appeal to buyers, often omitting critical details regarding calculation steps or benefit-sharing mechanisms. In most cases, it is virtually impossible to replicate the abatement calculations carried out by project proponents. Similarly, public project documents rarely provide sufficient information to determine how much of the project's revenue actually reaches local stakeholders, a concern that is frequently at the center of media exposés regarding project misconduct (Healy et al. 2023; Sarmiento Barletti and Larson 2017). Although third-party auditing bodies may have access to additional information, they are hired by project developers and may face reputational damage if strict audits lead to certification denial (cf. Duflo et al. 2013; Giles and Coglianese 2025). The same principle applies to project rating agencies remunerated by project developers. Competition among auditing bodies also often leads to cost-cutting measures (e.g., involvement of fewer or less experienced auditors and shorter audits), which can come at the expense of quality and credibility (Foster et al. 2017). Lastly, it is critical to note that external auditors merely verify adherence to VCM standards, not their suitability or effectiveness.

To date, there has been little meaningful action from the VCM to address the well-documented conflicts of interest associated with REDD+ projects. More broadly, even recent initiatives aimed at enhancing integrity in the VCM are not immune to these conflicts. A notable example is the recent controversy surrounding the Science Based Targets initiative (SBTi), where the former CEO and board members of the organization attempted to circumvent the recommendations of their staff and advisers to unilaterally endorse the use of offsets, neglecting the potential consequences of greenwashing (Reuters 2024). Another striking example was the resignation of technical experts from the Integrity Council for the Voluntary Market (ICVCM) following controversial decisions concerning the endorsement of REDD+ methodologies (Bloomberg 2024).

8 | The "Forgotten D+"

8.1 | Improved Forest Management

While actions to avoid deforestation dominate REDD+, reducing forest degradation (the "forgotten D" in REDD+) through improved forest management can be less contentious. It is well established that switching from conventional selective logging practices to reduced-impact logging (RIL) substantially reduces carbon emissions from the forest (Miller et al. 2011; Pinto et al. 2024; Putz et al. 2008). If such a change in harvesting practices does not reduce timber supply (Barreto et al. 1998) or displace logging agents, leakage is negligible. Given that RIL techniques are seldom used in the tropics, regardless of regulations (e.g., Hermudananto et al. 2024), concerns about the additionality of improved practice adoption are usually less pronounced than those associated with avoided deforestation. Thus, by focusing on improving existing forestry systems or management practices rather than halting them, RIL interventions offer a pathway to sustainable development and enduring climate benefits. Furthermore, several studies also indicate that forests harvested with RIL techniques retain more biodiversity and recover faster because they cause less damage than conventional logging (Putz et al. 2012). Revenues from the VCM could play a crucial role in improving the often contested economic viability of tropical forest management, which cannot be remedied by RIL alone (Sist et al. 2021; Richardson and Peres 2016; Fearnside 2003, 1989).

Despite decades of promoting the climate change mitigation potential of RIL and other improvements in tropical forestry (e.g., Putz and Pinard 1993), projects focused on reducing forest degradation have not secured much traction in the VCM. This limited interest likely stems from their comparatively lower credit generation potential on a per-hectare basis compared to avoided deforestation. While RIL interventions in tropical forests are estimated to reduce 25 to 110 Mg of CO_2 emissions per hectare (Putz et al. 2008), avoided deforestation can claim over 500 Mg of CO_2 reductions per hectare (Probst et al. 2024).

8.2 | Afforestation and Reforestation

The enhancement of forest carbon stocks through AR (part of the "plus" in REDD+) has gained substantial traction among major climate change organizations (Google 2024), particularly in light of the recent controversies surrounding avoided deforestation initiatives. However, AR projects are not immune to pitfalls: they may also suffer from leakage (e.g., livestock displacement; Silva and Nunes 2025) and from a lack of additionality.

Additionality becomes a major concern when AR projects aim to establish commercial plantations, often of exotic tree species. These plantations are typically profitable on their own, as they are needed to meet demand for wood products, and would likely exist in the absence of carbon finance. As a result, a German court has recently barred Apple from marketing the Apple Watch as "carbon neutral," ruling that its reliance on offsets from eucalyptus plantations in Paraguay is misleading and violates competition law (Reuters 2025). An oversupply of credits from non-additional tree plantations was a major factor behind the collapse of credit prices on the Chicago Climate Exchange (CCX) decades ago (Sandor and Diperna 2024). Even non-commercial AR projects focused on native trees are vulnerable to credibility challenges, especially those relying on passive regeneration, where human intervention is often unnecessary. Where forests and tree cover can recover naturally and independently of carbon finance, AR projects will likely lack additionality, as evidenced by a recent study on the effectiveness of the Australian Carbon Offset Scheme (Macintosh et al. 2024). Furthermore, while afforestation—the establishment of forests in areas where none previously existed—gained popularity as a climate change mitigation activity under the Kyoto Protocol, critics stress its potential for negative impacts, including the destruction of native, non-forest ecosystems, such as natural grasslands, and the biodiversity they support (Briske et al. 2024; Veldman et al. 2015).

9 | Conclusions

The romanticized narratives surrounding REDD+ projects in the VCM appear to emerge from an unwarranted combination of insufficient understanding of the limitations of current crediting protocols and conflicts of interest—where convenience is prioritized over integrity, thereby fueling the recent scandals highlighted in the media and academic literature. These scandals have consequences that extend far beyond questionable project outcomes and emissions that have not been offset. They expose deep, yet overlooked, systemic flaws in REDD+ at a pivotal moment, as negotiations unfold over its potential inclusion under the Paris Agreement. Widespread problems with the VCM justifiably reinforce skepticism about whether negotiators can develop a robust framework that prevents similar failures in future crediting mechanisms—especially considering that previous schemes such as the CDM, Joint Implementation, and the Australian Carbon Offset Scheme have also suffered from integrity problems (Cames et al. 2016; Kollmuss et al. 2015; Macintosh et al. 2024). These concerns put the future of global efforts to channel climate funding toward genuine tropical conservation at risk, even as forests continue to dwindle and temperatures steadily rise.

Even if endorsed by governments, credits from REDD+ projects will still face additionality and leakage issues because of the fundamental unobservability of baselines and the inevitability of behavioral and market adjustments. Moreover, these credits will likely be based on assumptions that do not align with REDD+ jurisdictional baselines (e.g., Ehara et al. 2021; Atmadja et al. 2022), requiring a complex grandfathering and alignment process to issue corresponding adjustments that prevent double-counting. On the social dimension, a substantial share of revenues from voluntary REDD+ initiatives may never reach local stakeholders, irrespective of government endorsement (Healy et al. 2023; Sarmiento Barletti and Larson 2017), in plain contradiction to the United Nations' REDD+ objective of promoting sustainable development and conservation (UN-REDD Programme 2012).

While REDD+ offers theoretical potential to promote conservation and sustainable development in the tropics, it is crucial to evaluate critically its impacts on the ground. It is well established that there are no "silver bullet" conservation interventions, with impacts depending on intervention design and context (Börner et al. 2020). REDD+ projects are no exception: the impact evaluation literature offers examples of both effective and ineffective REDD+ interventions globally (Simonet et al. 2019; Wunder et al. 2024), including cases where deforestation resumed after the intervention concluded (Demarchi et al. 2023; Carrilho et al. 2022).

Ultimately, REDD+ projects and VCM standard-setters must ensure, with a reasonable degree of conservatism, that carbon emission reductions and other project outcomes are real, positive, lasting, and attributable to the projects themselves (e.g., Malan et al. 2024). To date, compelling evidence remains lacking for most projects. Policymakers and the carbon offset industry must leverage scientific studies that have identified systemic flaws with REDD+ projects to revamp the current system and build the credibility the VCM urgently needs.

Author Contributions

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors have nothing to report.

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