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From Carbon Revenue to Financial Resilience: Rethinking Risk Allocation in REDD+

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forum

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Abstract

REDD+ mobilizes public and private finance for forest conservation, yet community benefits and conservation functions can become vulnerable when they depend on uncertain carbon revenues. This forum paper argues that the central financial problem is not carbon-market participation itself, but how revenue uncertainty is transmitted through REDD+ financing arrangements and how resulting losses are allocated. It develops a framework linking financial exposure, risk transmission and allocation, and financial resilience. Revenue exposure concerns dependence of project income on a financing source, expenditure exposure concerns which functions rely on that income, and liquidity exposure concerns mismatches between revenue timing and expenditure commitments. Market shocks do not automatically become community losses because outcomes depend on reserves, alternative finance, contracts, expenditure priorities, and institutional decisions. The paper extends benefit-sharing analysis from the distribution of gains to the allocation of downside risk and identifies four complementary resilience mechanisms comprising financing diversification, reserves and liquidity management, contractual risk sharing, and transparent financial governance. Financial resilience is distinct from carbon integrity, but can help sustain the community institutions and conservation activities on which durable mitigation outcomes partly depend.

1 Introduction

REDD + has developed into a heterogeneous climate-finance architecture that includes bilateral and multilateral support, results-based payments, jurisdictional programs, and private carbon-market finance (Morita & Matsumoto, 2023). These channels can mobilize resources for forest conservation and community benefits, but differ in payment conditions, timing, governance, and allocation of financial risk.

Carbon finance can become locally important when it supports community payments, livelihood activities, monitoring, patrols, and local institutions. At the same time, revenues are exposed to changes in credit prices, buyer demand, issuance, transaction costs, standards, and perceptions of credit quality (Chesney et al., 2017; Forest Trends, 2024). Financial viability is also context dependent. Koh et al. (2021) estimated that about 80 percent of the tropical forest-carbon sites in their global analysis would fail to break even over the project lifetime under the conditions modelled. This does not imply that REDD+ projects are generally unviable, but shows their sensitivity to prices, costs, and location. Revenue uncertainty does not automatically produce equivalent community or conservation losses. Effects depend on expenditure dependence, alternative finance, reserves, contracts, and institutional allocation of shortfalls. The central issue is therefore which functions become financially exposed and who bears downside risk when expected revenue changes.

Existing research provides important but fragmented insights. REDD+ scholarship has examined market uncertainty, project viability, finance, governance, and benefit sharing (Chesney et al., 2017; Loft et al., 2017; Luttrell et al., 2013; Morita & Matsumoto, 2023). Results-based aid research recognizes that performance-based finance can shift risk toward service providers and that mechanisms can share

those risks (Angelsen, 2017). Less attention has been given to the reverse distributional question. When anticipated revenue is delayed, reduced, or absent, who absorbs the loss and which functions are protected?

This forum paper addresses that gap through a framework linking financial exposure, risk transmission and allocation, and financial resilience. Financial resilience is defined here as the capacity of financing and governance arrangements to maintain essential community benefits, conservation activities, and institutional functions when revenue streams fluctuate, decline, or are delayed. The central argument is that the sustainability of community-oriented REDD+ depends not only on how finance is mobilized, and benefits distributed, but also on how downside risk is allocated and managed.

2 REDD+ financing architectures and financial exposure

REDD+ finance operates through multiple architectures with different sources of capital and conditions for payment. Public and multilateral finance supports readiness, policy development, jurisdictional programs, and results-based payments, while private finance is important for project-level activities and voluntary carbon-market transactions (Morita & Matsumoto, 2023). The Green Climate Fund has established a permanent policy for REDD+ results-based payments, demonstrating the continuing role of multilateral finance alongside carbon markets (GCF, 2024). Broader climate-finance scholarship also considers how public and private finance can be combined where financing constraints limit mitigation investment (Strand, 2023).

The importance of carbon finance should not be inferred from its aggregate share of forest finance. UNEP (2025) estimates that forest investment remains far below required levels and that private finance represents a relatively small share of current flows. Yet aggregate figures reveal little about project-level vulnerability. A project can receive several sources of finance while relying on carbon revenue for community payments, patrols, monitoring, or local institutional costs.

Three dimensions help clarify this relationship. Revenue exposure is the extent to which total project income relies on a financing source. Expenditure exposure concerns which functions depend on that income. Liquidity exposure concerns mismatches between revenue timing and continuing obligations. Carbon projects may incur costs before monitoring, verification, issuance, and sale generate cash flow (Chesney et al., 2017). A project can therefore have diversified aggregate income while a critical function remains highly exposed.

These categories are proposed as analytical distinctions rather than established REDD+ metrics. They replace generalized claims of dependency with measurable questions about income sources, expenditure dependence, and how long priority functions can continue during payment delays.

The distinction strengthens the connection between REDD+ finance and benefit sharing. Benefit-sharing arrangements identify beneficiaries, benefits, and distribution mechanisms (FCPF, 2025; Luttrell et al., 2013). Financial exposure asks whether those arrangements remain viable under changing revenue

conditions. A benefit can be fairly allocated yet remain financially vulnerable if its funding is highly concentrated or poorly matched to recurring obligations.

3 Financial shock transmission and risk allocation

Financial exposure becomes consequential when a shock is transmitted through project finances to expenditure and beneficiaries. Carbon-market shocks can arise from price changes, weaker demand, issuance delays, higher transaction costs, changing standards, or concerns about credit quality (Chesney et al., 2017; Forest Trends, 2024). Forest Trends (2024) reported substantial contraction in the voluntary carbon market in 2023, including sharp declines in REDD+ transaction value and average price. The report also associated the wider pullback with negative media attention and buyers waiting for stronger integrity guidance. This supports a claim of market contraction and demand uncertainty, but not a universal claim that individual REDD+ buyers withdrew.

Project economics can amplify such shocks because viability varies with prices and costs (Koh et al., 2021). A shortfall may be absorbed through lower returns, additional capital, reserves, borrowing, postponed expenditure, or alternative finance, but may instead reduce community payments, monitoring, or institutional budgets. Outcomes therefore depend on the sequence from shock to exposure, transmission, risk allocation, and outcome, summarized in Table 1.

Risk allocation is the critical but underexamined step. REDD+ actors have unequal ability to diversify income, hold reserves, renegotiate contracts, or defer expenditure. Communities may contribute to land-use changes, monitoring, and forest protection while having little control over prices, buyer decisions, verification, issuance, or transactions. Results-based finance can shift performance risk toward service providers, although contractual and institutional mechanisms can share that risk (Angelsen, 2017). Research on REDD-based offsets also shows that risk preferences and benefit-sharing arrangements can affect pricing and contracted volumes (Krasovskii et al., 2016).

This creates a distinction between value and risk allocation. Benefit-sharing research asks who should benefit and on what basis, including contributions, costs, rights, stewardship, and poverty considerations (Luttrell et al., 2013). FCPF programs similarly identify beneficiaries, benefits, and distribution mechanisms (FCPF, 2025), but these arrangements do not necessarily specify what happens when available revenue is smaller or later than anticipated.

Financial resilience therefore extends benefit sharing from allocating gains to allocating losses. It matters whether a shortfall reduces developer returns, intermediary fees, community transfers, livelihood programs, monitoring, or institutional budgets, and whether communities participate in adjustment decisions. This does not imply that communities always bear market losses. It argues that the incidence of loss should be visible rather than assumed.

Longstanding governance problems should also be separated from carbon-market shocks. Unequal distribution, weak participation, tenure disputes, limited financial management capacity, and institutional

fragility are established REDD+ challenges that can exist independently of voluntary carbon-market volatility (Loft et al., 2017; Morita & Matsumoto, 2023). Financial contraction may nevertheless intensify these vulnerabilities if it reduces expected benefits or recurring finance.

REDD+ finance already contains examples of explicit risk management. Chan et al. (2023) discuss insurance, price guarantees, forward commitments, and buffers for jurisdictional REDD+, while Sheng et al. (2019) show how cost-sharing contracts affect incentives and cost distribution. Although these studies address risks different from community revenue shortfalls, they establish an important principle. REDD+ financial risk can be allocated contractually rather than simply passed downstream.

4 Building financial resilience in REDD+

Financial resilience requires reducing concentrated exposure, increasing capacity to absorb temporary shocks, and avoiding automatic transfer of losses to actors with limited capacity to bear them. Four complementary mechanisms are relevant.

First, financing diversification can reduce reliance on a single revenue stream. REDD+ already combines public, multilateral, jurisdictional, results-based, and private finance (Morita & Matsumoto, 2023). GCF results-based payments provide one complementary channel, while climate-finance research examines how finance can be blended with carbon-market transactions where credit or capital-market constraints exist (GCF, 2024; Strand, 2023). Recent evidence finds that blended finance can support renewable-capacity expansion in emerging economies, although this is broader climate-finance evidence rather than direct evidence for REDD+ (Hasebe, 2026).

For REDD+, diversification should be functional. Essential recurrent functions such as monitoring, forest protection, local institutional operations, or minimum community commitments may warrant finance less sensitive to short-term fluctuations, while flexible activities can remain linked to variable carbon revenue.

Second, reserves and liquidity management can protect priority functions during temporary disruptions. The Philippine National REDD-plus Strategy proposed a national reserve or price-stabilization fund to help insulate activities from inconsistent financial inputs and carbon-price fluctuations (UN-REDD, 2010). Building on this precedent, community-oriented REDD+ could establish a financial-resilience reserve where feasible. Unlike carbon-performance buffers, its purpose would be to protect cash flow for essential expenditure. Rules would be needed for contributions, triggers, eligible expenditure, control, replenishment, and disclosure. Because retaining revenue has an opportunity cost, reserves should be agreed transparently rather than created by unilaterally reducing community benefits.

Third, contractual risk sharing can clarify who bears price, delivery, timing, and cost risks. Price guarantees, forward commitments, insurance, and cost-sharing arrangements can redistribute particular risks before shocks occur, although each involves costs and trade-offs (Chan et al., 2023; Sheng et al.,

2019). Their value lies in making risk allocation explicit and specifying how shortfalls affect agreed expenditures.

Fourth, transparent financial governance can make allocation decisions visible. Benefit-sharing systems already emphasize beneficiaries, transparent distribution, and accountability (FCPF, 2025; Luttrell et al., 2013). Financial resilience extends these principles to adverse conditions. Reporting should distinguish gross revenue, material costs and deductions, reserve contributions, and amounts available for community and conservation purposes.

Institutional capacity is equally important. Comparative REDD+ benefit-sharing research identifies weaknesses in financial management planning and capacity, particularly at lower jurisdictional levels (Thuy et al., 2013). Local institutions require adequate authority, skills, and financial information to manage benefits and respond to shortfalls. Together, diversification reduces concentration, reserves address liquidity, contracts allocate risk, and governance shapes how losses are managed. Table 1 links these mechanisms to illustrative shocks.

Table 1
Financial shock transmission, risk allocation, and resilience responses in REDD+

Financial shock	Transmission	Potential risk bearer	Candidate response
Price or demand decline	Lower sales revenue	Developer, investor, beneficiaries, or shared	Diversification and contractual risk sharing
Issuance or payment delay	Cash-flow mismatch	Operator and expenditure recipients	Liquidity reserve or credible bridge finance
Higher transaction costs	Lower net distributable revenue	Depends on contractual allocation	Cost disclosure and contractual clarity
Revenue shortfall	Reduced or reprioritized expenditure	Communities or local institutions if unprotected	Protected priorities and participatory adjustment rules

Note. The incidence of loss depends on contracts, reserves, alternative finance, and governance arrangements. The relationships are therefore not one to one.

5 Implications for carbon integrity and climate-finance policy

Financial resilience should not be equated with carbon integrity. Carbon integrity concerns whether mitigation outcomes are credibly quantified and address issues such as additionality, leakage, and permanence. Financial resilience concerns the capacity to sustain essential functions during financing shocks. Strong finance cannot compensate for weak carbon accounting, and credible accounting cannot by itself sustain local institutions.

These dimensions can interact because REDD+ requires continuing expenditure on monitoring, forest protection, institutional coordination, and community engagement (Novick et al., 2023). Repeated

shortfalls can disrupt highly exposed functions. Financial resilience is therefore a potential enabling condition for continuity, not a sufficient cause of high-integrity mitigation (Chan et al., 2023; Morita & Matsumoto, 2023).

A plausible pathway is that resilient financing supports priority community and conservation functions, thereby strengthening institutional continuity and sustained implementation. This may reduce vulnerability to implementation failure, although governance quality, tenure, ecological conditions, project design, and carbon-accounting quality can alter each link.

This framing also connects REDD+ with wider climate-finance scholarship examining how climate risks are transmitted through financial systems and mediated by institutions and financial instruments (Iyke, 2026). The scale and actors differ, but the analytical principle is relevant. Exposure alone does not determine loss because transmission channels, institutional capacity, and risk-management arrangements shape outcomes.

For environmental-development policy and due diligence, REDD+ finance should therefore be assessed beyond expected credit volumes, prices, and benefit-sharing percentages. Assessment should also consider revenue concentration, exposure of essential expenditure, liquidity capacity, reserves, and contractual allocation of downside risk. These considerations complement safeguards, transparent benefit sharing, monitoring, verification, and credible carbon accounting.

6 Research priorities and conclusion

Three research priorities follow. First, empirical studies should measure revenue, expenditure, and liquidity exposure by tracing financing sources to specific community and conservation functions and assessing how long priority activities can continue during payment delays. Second, research should identify who bears downside risk through analysis of contracts, budgets, benefit-sharing rules, reserve policies, fees, and intermediary arrangements. This extends benefit-sharing analysis from gains to losses and responds to the wider REDD+ concern that costs and benefits should be assessed across stakeholders (Rakatama et al., 2017).

Third, resilience mechanisms require comparative testing. Diversification, reserves, insurance, forward commitments, cost-sharing arrangements, and protected expenditure rules involve trade-offs. Research should examine whose risks they reduce, what they cost, and under what institutional conditions they work. REDD+ performance insurance and contractual cost sharing provide useful starting points, but community-level financial protection remains insufficiently tested (Chan et al., 2023; Sheng et al., 2019).

Carbon finance can provide important resources for forest conservation and community benefits, but its durability depends partly on how uncertainty is managed. Revenue shocks do not automatically become community losses because their consequences depend on exposure, liquidity, contracts, alternative finance, and institutional decisions. REDD+ finance should therefore be evaluated not only by how much

capital it mobilizes and how benefits are distributed, but also by how downside risk is allocated when expected revenues do not materialize.

This argument neither attributes longstanding REDD+ governance problems to carbon markets nor advocates replacing them with public finance. Instead, transparent exposure assessment and explicit risk sharing can help protect essential community and conservation functions while retaining carbon-finance opportunities. Financial resilience should therefore become a more explicit component of REDD+ design, research, and environmental-development policy.

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Declaration of interest

statement

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Author Contribution

Chaly Y. was solely responsible for the conceptualisation, investigation, analysis, and writing of this manuscript. The author developed the central argument, prepared the manuscript, and reviewed and approved the final version for submission.

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