https://doi.org/10.1038/s41893-024-01403-w

Nature-based credit markets at a crossroads

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Continuing to produce nature-based credits using dubious accounting methodologies will yield limited carbon and biodiversity gains. Establishing scientific credibility unlocks the potential of credits to meaningfully contribute to targets of the Paris and Kunming-Montreal agreements.

The Kunming-Montreal agreement outlines humanity's aim to halt and reverse biodiversity loss. A key component is a heavy reliance on private finance to fund the initiative: countries committed to 'mobilizing' at least US$200 billion per year primarily through "leveraging private finance … such as … green bonds, biodiversity offsets and credits"[1]. Carbon credits form an inevitable component of most national and organizational net-zero strategies, and carbon removals are embedded in nearly all Intergovernmental Panel on Climate Change net-zero scenarios. Biodiversity offsets are applied widely around the world[2], and there has been a recent surge of interest in biodiversity credit markets (henceforth, we refer to credits generated through nature-based carbon and biodiversity offsetting and biodiversity credit activities as 'nature-based credits'). Nature-based credits are perceived as the classes of conservation- and restoration-related financial instruments with the greatest capacity to scale up private investments in biodiversity conservation[3], because of regulatory precedent and 'polluter-pays' rationale.

A swathe of recent impact evaluations demonstrating disappointing results suggest that nature-based credits are at a crossroads[4–6]. Nature-based credit markets either continue to implement crediting processes replete with implicit incentives to over-credit, lose investor confidence and constrain one of our most promising tools for drawing private investment into conservation (Fig. 1, upper panel), or fundamentally reform to adopt the latest scientific understanding on additionality, leakage and permanence, as well as environmental and social safeguards, that will rebuild investor confidence and allow them to upscale to meet the ambition of the Kunming-Montreal and Paris agreements (Fig. 1, lower panel). Here we lay out the fundamental problems embedded in conventional nature-based credits and the solutions needed to achieve scientific credibility. We argue that substantial improvement would be achieved by issuing credits only after proven demonstrably additional relative to a statistically derived counterfactual and by conservatively estimating benefits whenever there is uncertainty. These apparently simple changes require major shifts in expectations from market participants but would create markets robust to, rather than resistant to, scientific improvements in impact evaluation.

The fundamental additionality problem

Nature-based credit markets are typically organized around buyers purchasing credits for land management activities ex ante on the assumption that activities will deliver ecological gains that are additional (that is, they would not have happened in the absence of the intervention). However, multiple evaluations of credit markets have found that this assumption is not consistently reliable[4–6]. The economic problem common to all credits — with nature-based credits no exception — is adverse selection[6]. Nature-based credit markets rely on self-selection into the market, but economic theory tells us this implicitly incentivizes landowners most likely to have already been implementing similar measures to enrol, or, in the case of forest protection, enrolling forest that was not under threat.

Crediting processes so far are replete with misaligned incentives that have exacerbated biases. In voluntary carbon markets, a common practice is for project proponents to propose ex ante forecasts of environmental outcomes under the project's business-as-usual scenario against which the observed, credit-financed outcomes are assessed. Landowners, supported by the accreditation industry (methodology designers, consultants, auditors and verifiers), are thus confronted with estimating key parameters for which there is limited current conceptual convergence with large consequences on the number of credits issued. Delegating forecasting responsibility to project proponents within frameworks permitting considerable flexibility unsurprisingly results in exaggerated counterfactuals and thus over-issuance, often close to the top of the feasible range[4], especially when accreditation organizations have business models tied to the number of credits generated. In biodiversity offsetting markets (for example, in Australia), credits are often issued relative to some implicit counterfactual embedded in a government-mandated calculation method, which has historically been exaggerated[7].

Nature-based credit markets currently have limited recourse to correct for errors. One solution, taken by buyers and recommended by the Carbon Offsetting and Reduction Scheme for International Aviation and the European Union Emissions Trading Scheme, is to only buy newer credits. This approach, based on the assumption that unsold, older credits are of low quality, does not work, however, if credible information about quality is not available before credits are sold. Another solution used in biodiversity offsetting markets is habitat banking — implementing conservation measures upfront, then selling credits retrospectively[8]. While this ensures that activities were implemented, it does not ensure that the impact was properly calculated.

Misaligned incentives prevent project proponents, creditors and buyers from evaluating whether credits materialized according to their ex ante schedule: buyers do not want to risk re-exposure to liabilities they were attempting to pass on, and sellers do not want to identify that they have sold an inadequate product. This is especially problematic under adverse selection conditions because it results in a 'market for lemons'[9]. When buyers cannot easily distinguish credit quality, the market becomes dominated by lower-quality credits, with negative impacts on confidence and participation. Following the discovery of likely systematic over-crediting by a key certification body in the voluntary carbon market, confidence plummeted and the price of credits halved from early 2022 to mid-2023 (ref. 10).

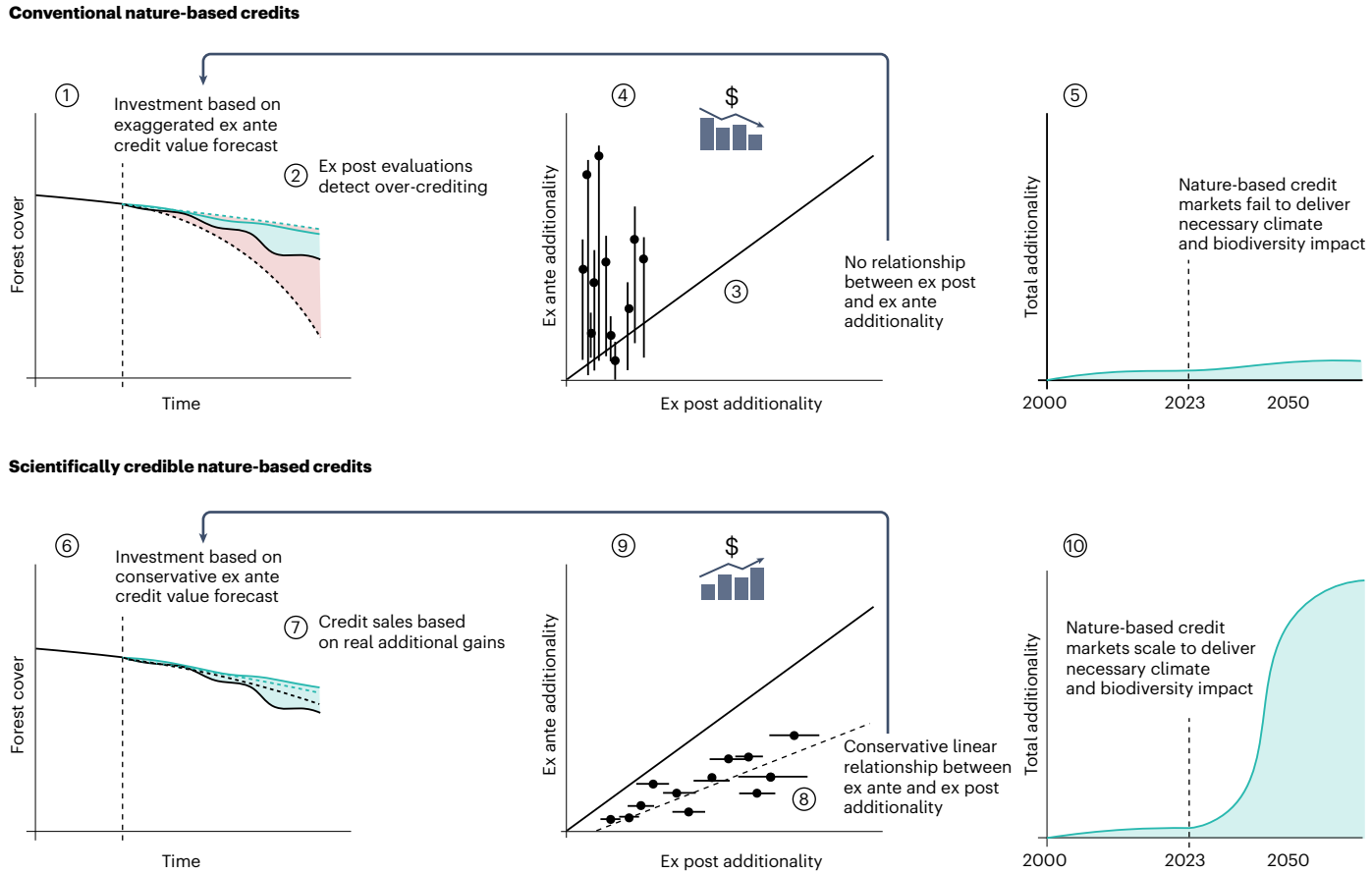

Fig. 1 | The crossroads for nature-based credits. In conventional markets, ex-ante forecasts using flexible or biased methodologies generate credits (1). Impact evaluations identify over-crediting (2, red), including inaccuracies and incoherence (3). Trust in credit markets falls, reducing prices (4) and undermining investment (5). In scientifically credible markets, ex ante projections are conservative (6) with ex-post credit generation using the best available science (7). Consensus across methods confirms conservative relationships between ex ante and ex post estimates (8). Trust in nature-based credits grows (9), increasing investment and unlocking scientifically credible contributions from private finance towards the goals in the Kunming-Montreal and Paris agreements (10).

Making scientifically credible credits work

The theory and statistical tools that demonstrate widespread over-crediting also provide evidence that some credits do work[5,6] and a route towards better accreditation methodologies. Evaluations of the outcomes of nature-based credits in various jurisdictions have identified specific projects that consistently outperform their control sites (derived using statistical methods such as matching or synthetic controls)[4–6]. Emerging initiatives, such as the Integrity Council for Scaling Voluntary Carbon Market's Core Carbon Principles, have created a much-needed framework for progressively integrating more scientifically credible approaches. However, the Core Carbon Principles must ensure that they do not ossify and continue to incorporate advances from well-supported science; for example, the use of ex post evidence from statistically derived counterfactuals for credit issuance. Various fora are also currently working on developing design principles for biodiversity credit markets. Concurrently, scientists are attempting to operationalize the use of robust impact evaluation techniques that measure additionality and leakage using statistically derived controls that are near identical to projects in terms of their exposure to threats and land-use change trajectories before project implementation, selected through peer-reviewed algorithms[11]. Project impact can be tracked dynamically using trusted primary observations (for example, satellite remote sensing) and difference-in-difference methods used to assess outcomes between the project and its controls, in near real time, and only issuing credits once additionality has been observed.

These methods provide by far the most scientifically robust crediting methods proposed to date, yet challenges remain on the specifics of constructing counterfactuals, ensuring leakage mitigation[12] and equivalent permanence[13], and tracking outcomes beyond changes in land cover. To address this, conservative estimates must be made wherever there is uncertainty so that the risks of overestimating the resulting benefit towards our pressing global targets is minimized. This is most important when credits are used as offsets, but even when used for contributory claims it is essential that accounting is rigorous to assure buyers that funds are being used efficiently. Biodiversity offsets face the particular challenge of defining equivalence between biodiversity losses and biodiversity gains. For biodiversity credits, gains

can be produced in very different ecological contexts, and different methods are being developed for operationalizing equivalence[14]. Once the currency of crediting is agreed upon, the scientifically credible approaches for tracking the impacts we describe should be applied. These approaches can already assess outcomes observable using satellite data and although outcomes not directly observable via land cover changes — including certain carbon fluxes and components of biodiversity — can to some extent also be evaluated, they will require complementary data from ground surveys or remotely deployed sensors. Importantly, scientific approaches provide a method for continual improvement that ratchet up quantitative robustness, unlike shifts towards government-mandated standardized methods (including jurisdictional baselines[7]).

Implementing a scientifically credible nature-based accreditation system requires a fundamental shift in expectations. The requirement for ex ante forecasts comes from the need to attract upfront investment. But as demonstrated, this creates huge risks for market integrity once ex post evaluations demonstrate incoherence and bias in additionality claims. While some classes of investors can and do make investments even for uncertain, long-term payoffs, the potential future financial rewards of 'winners' within a portfolio needs to be sufficiently high. Under current credit prices, the potential returns often do not justify the risks. A move towards unbiased, or even precautionarily dampened, ex ante forecasts (to account for uncertainties[15]) would lead to a typical project-level reduction in credit generation from 4 to more than 100 times that of today's methodologies[4], with concerns that considering leakage could increase this estimate further[12]. However, as ex post evaluations confirm that these credits genuinely correspond to real gains, this should have positive effects on market integrity. Such a system would (1) shift incentives away from methodology gaming, intentional or otherwise, and towards identifying where and how to maximize scientifically credible impacts in the search for windfall profits; (2) expand the deployment of low-cost technologies for verifying impacts (that is, digital monitoring and verification); and (3) hasten scientific advances towards methodological consensus to reduce the need for conservatism.

This raises fundamental questions about how to encourage markets to adopt scientifically credible methodologies when they produce fewer credits and what should be done with the large and growing quantity of existing credits. The financial appeal of adopting scientifically credible methodologies would rise if the credits they produced commanded higher prices. Current nature-based carbon credits command lower prices (US$5 per tonne to US$9 per tonne for REDD+ and ARR, respectively, as of 19 November 2023 (ref. 10)) because they are lower quality than credits with near-guaranteed additionality and permanence (for example, direct air capture; one recent trade was valued at US$2,055 per tonne[10]). Nature-based credits that genuinely slow habitat loss, or more ambitiously create new habitat, without leakage, that persist, and that properly compensate local people for opportunity costs, however, are just as innovative as direct air capture. These nature-based credits would be much more expensive to produce than their current price suggests, reflective of their true social value. Ultimately, our proposed scientifically credible nature-based credit system will necessitate that investors develop portfolios of projects rather than assuming a given project will deterministically generate credits. In some circumstances, even well-designed projects will fail to generate credits for reasons outside of the investors' control, but if ex ante projections are unbiased, credits validated ex post will on average align with those projections.

However, addressing integrity issues alone will not cause a sustained rise in prices in a market that remains voluntary. Ultimately, investor confidence will only materialize at scale when there are clear, long-term demand signals, underpinned by regulation, as with regulated carbon markets such as the European Union Emissions Trading Scheme. Therefore, a key role that governments could play would be to introduce regulation that generates mandatory demand for scientifically credible nature-based credits with high standards of social safeguards (that is, by mandating full carbon compensation, or for biodiversity, the achievement of no net loss or net gain). If prices still do not reach levels sufficient to attract private investment due to unresolved uncertainty in additionality, then such investments could be financed through public funding. In a system with mandatory private demand, these mitigation outcomes could be sold by the state to buyers at prices sufficient to, at a minimum, cover the public's costs once additionality has been demonstrated, effectively de-risking credit production for the private sector while minimizing costs to the state.

While finding appropriate financing models will require experimentation, we cannot allow the challenge to stand in the way of fundamental reform of nature-based credit markets. If credits are to play an increasing role in helping achieve the Paris and Kunming-Montreal agreements, it is essential that they begin to reflect real environmental improvements, rather than accounting artefacts based on misaligned incentives and practical convenience.

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Published online: 06 August 2024

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Acknowledgements
We thank A. Balmford for his comments on the manuscript. We acknowledge the Tezos Foundation grant NRAG/719 (to T.S.) and the EU Horizon 2020 project SUPERB grant GA 101036849 (to S.O.S.E.z.E. and J.W.B.).

Competing interests
The authors declare no competing interests.

Additional information
Peer review information *Nature Sustainability* thanks the anonymous reviewers for their contribution to the peer review of this work.