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Inclusive Certification Pathways for Ecosystem Services: Governance, Verification, and Community Rights in Emerging Markets

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ABSTRACT

Market-based conservation tools — including voluntary carbon markets (VCMs), biodiversity credits, and ecosystem service offsets — represent a multi-billion-dollar global infrastructure for financing biodiversity conservation. Yet their effectiveness and legitimacy depend critically on the integrity of the certification systems that underpin them and on the extent to which those systems are designed to be inclusive, equitable, and rights-respecting. This article provides a systematic review of the global architecture of ecosystem service certification, examining the Verified Carbon Standard (VCS/Verra), Gold Standard for the Global Goals, the Integrity Council for the Voluntary Carbon Market (ICVCM) Core Carbon Principles (CCPs), and the Voluntary Carbon Markets Integrity Initiative (VCMI) Claims Code of Practice. It critically evaluates social justice imperatives in certification — including free, prior and informed consent (FPIC), equitable benefit-sharing, gender-inclusive design, and indigenous knowledge integration — and assesses pathways to market access for smallholders and marginalized communities. Drawing on Colombia's Plan Nacional de Negocios Verdes (PNNV) 2022–2030 and the Quindío pilot model, which quantified a carbon sequestration potential of 109,481 tCO_2e/year across 14,950 certifiable hectares, the article argues that technical rigor and social justice are co-constitutive requirements of high-integrity ecosystem service certification. A rights-based framework integrating FPIC, tiered certification architectures, and national-international registry bridges is proposed as a replicable model for biodiversity-rich developing countries.

KEYWORDS: ecosystem service certification, voluntary carbon markets, FPIC, social justice, Quindío, Colombia, VCS, biodiversity credits, ICVCM

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1. INTRODUCTION

The global biodiversity and climate crises have converged on an urgent imperative: natural ecosystems must be economically valued, certified, and monetized to generate durable incentives for their conservation. Yet the promise of market-based conservation tools rests on a fragile foundation — one that demands rigorous standards, transparent verification, and an unwavering commitment to social equity. This article interrogates that foundation by examining how certification systems for ecosystem services are structured, governed, and accessed, and by exposing the social fault lines that have too often rendered these systems exclusive rather than inclusive.

The monetization of ecosystem services — from carbon sequestration and biodiversity conservation to hydrological regulation and scenic landscape amenities — has expanded from theoretical frameworks into a multi-billion-dollar global market. The voluntary carbon market (VCM) alone exceeded USD 2 billion in 2021 and, despite subsequent turbulence related to greenwashing allegations, remains a critical conduit for private finance into conservation (Taskforce on Scaling Voluntary Carbon

Markets, 2021). Concurrently, biodiversity credits, water quality certificates, and ecosystem service offsets are emerging as complementary instruments, diversifying the portfolio of incentives available to landowners, communities, and governments.

This article is organized into two thematic parts. Part I (Sections 2–5) addresses the architecture of standards, the mechanics of third-party verification, and the pathways to national and international market access. Part II (Sections 6–8) examines social justice imperatives, including inclusion, equity, and rights-based approaches. The article draws on primary documentation from VCMI (2023), ICVCM (2024a, 2024b), Verra (2024a), Gold Standard Foundation (2023), UNDP (2025), and Colombia's Ministerio de Ambiente y Desarrollo Sostenible (MinAmbiente, 2022), as well as the Quindío pilot model (Burgos-Salcedo & Sierra, 2026a, 2026b).

The integrity challenge confronting ecosystem service certification is, at its core, a governance challenge. Standards that are technically sophisticated but institutionally fragile — that rely on self-reporting, that lack independent verification infrastructure, or that fail to embed rights-based safeguards as non-negotiable requirements — will inevitably reproduce the patterns of exclusion and greenwashing that have periodically discredited market-based conservation. The architecture of certification must therefore be evaluated not only by its technical specifications but by its governance design: who sets the standards, who verifies conformance, who holds grievance mechanisms, and whose interests are prioritized when conflicts arise between commercial viability and community rights (ICVCM, 2024a; UNDP, 2025).

Biodiversity conservation incentives have evolved considerably since the pioneering Payments for Ecosystem Services (PES) schemes of the 1990s, yet their fundamental promise — that the economic value of intact ecosystems can be made legible to markets and translated into durable conservation finance — remains contested and incompletely realized. The gap between the theoretical elegance of ecosystem service valuation and the practical difficulty of operationalizing it at scale reflects not only methodological limitations but structural barriers: weak land tenure, insufficient monitoring infrastructure, institutional capacity deficits, and persistent power asymmetries between project developers and the communities whose territories constitute the raw material of certification schemes (Wunder, 2015; Dawson et al., 2021). Understanding these structural barriers is the prerequisite for designing systems capable of overcoming them.

The post-2022 reform of the voluntary carbon market — centered on the Integrity Council for the Voluntary Carbon Market's Core Carbon Principles and the VCMI Claims Code of Practice — represents the most significant architectural renovation of market-based ecosystem service certification since the founding of the Verified Carbon Standard. This reform architecture responds directly to the reputational crisis generated by investigative journalism documenting systematic overstatement of emission reductions in REDD+ projects and affirms that technical rigor and institutional accountability are inseparable dimensions of market integrity (ICVCM, 2024b; VCMI, 2023). Yet the reform debate has been conducted predominantly among Northern institutional actors — standard-setters, corporations, and financial intermediaries — with insufficient engagement of the smallholder communities, indigenous peoples, and developing-country governments whose active participation is necessary for both the environmental effectiveness and the social legitimacy of reformed markets.

Colombia's extraordinary position — as a megadiverse country hosting approximately ten percent of global species richness, a pioneer in Payment for Ecosystem Services policy, and a country whose post-conflict transition has simultaneously generated both opportunities and threats for biodiversity conservation — makes it a uniquely revealing laboratory for examining the intersection of technical certification standards and social justice imperatives. The country's constitutional framework, which includes some of the world's most advanced legal protections for indigenous and Afro-Colombian territorial rights and the biocultural rights jurisprudence exemplified by the Atrato River decision, provides a normative baseline against which certification schemes' social performance must be measured (MinAmbiente, 2022). At the subnational scale, the Quindío pilot model demonstrates that international-quality certification methodologies can be operationalized within departmental governance structures, generating quantifiable carbon sequestration estimates of 109,481 tCO_2e/year across 14,950 certifiable hectares and an estimated annual market value of USD 3.2–8.7 million — a transformation potential whose realization depends critically on the governance design of certification systems.

This article contributes to the emerging scholarly literature on ecosystem service certification governance by providing a systematic comparative assessment of the major global standards alongside the Colombian national framework, and by proposing an integrated rights-based certification architecture that treats technical rigor and social justice as co-constitutive rather than competing objectives. The analysis proceeds from a conviction — grounded in both the ethical philosophy of conservation incentive design and the empirical evidence on conservation effectiveness — that certification systems which fail to embed genuine procedural participation, equitable benefit-sharing, and rights-based safeguards are not merely ethically deficient but practically unsustainable: they generate the conflicts, reputational crises, and community resistance that ultimately undermine the market confidence upon which the entire architecture of ecosystem service monetization depends (Sikor & Norgaard, 2009; Schroeder & Doberstein, 2019).

PART I: STANDARDS, VERIFICATION, AND MARKET ACCESS

2. THE GLOBAL ARCHITECTURE OF ECOSYSTEM SERVICE CERTIFICATION

2.1 The Voluntary Carbon Market: From Proliferation to Integrity

The voluntary carbon market represents the most mature and financially significant channel for certifying and monetizing ecosystem services. Since its inception in the mid-2000s, the VCM has grown from a fragmented landscape of competing standards into a more structured ecosystem anchored by a small number of dominant programs. As of 2024, more than 2,300 projects were registered under the Verified Carbon Standard (VCS), collectively issuing over 1.3 billion credits, with more than 776 million retired (Verra, 2024b). The Gold Standard for the Global Goals operates across more than 100 countries and has generated billions of dollars in shared value for climate and sustainable development (Gold Standard Foundation, 2023).

However, the market experienced significant reputational damage following investigative reports in 2023 alleging systematic overstatement of emission reductions in REDD+ projects (Guereena et al., 2023). These revelations catalyzed institutional reform, giving rise to the ICVCM Core Carbon Principles (CCPs) and the VCMI Claims Code of Practice as the dual supply- and demand-side anchors of a reformed, high-integrity VCM (ICVCM, 2024a; VCMI, 2023).

The evolution of the voluntary carbon market from fragmented proliferation toward structured integrity governance reflects a broader pattern in the political economy of environmental certification: markets that initially develop through decentralized experimentation eventually face credibility crises that catalyze institutional consolidation around shared standards. The VCM experienced precisely this dynamic in the period 2022–2024, as investigative journalism and academic research documented systematic weaknesses in REDD+ additionality accounting — weaknesses that were not incidental failures of specific projects but structural features of a verification system inadequately equipped to assess landscape-scale deforestation dynamics. The institutional response — ICVCM's Core Carbon Principles, VCMI's Claims Code, and Verra's VCS v4.7 — represents genuine progress, though the implementation of these frameworks across the full diversity of project types, geographies, and community contexts remains an ongoing and incompletely resolved challenge (ICVCM, 2024a; Verra, 2024a).

The concentration of VCM value in a small number of dominant programs — VCS, Gold Standard, and increasingly ICVCM CCP-approved methodologies — reflects the market logic of certification: buyers seek standardized, recognizable quality signals, which advantages incumbents with established track records and disfavors smaller, more innovative programs oriented toward community inclusion. This concentration creates a structural tension at the heart of VCM governance: the programs with the greatest market credibility are not necessarily those with the strongest social performance, and the programs most oriented toward inclusion and community empowerment face the highest barriers to achieving the market recognition that would make their inclusion orientations economically viable for project developers. Addressing this tension requires deliberate policy intervention — including tiered certification architectures, grouped project mechanisms, and preferential credit pricing for schemes meeting the highest social and environmental standards — to ensure that market concentration does not become a barrier to inclusive conservation (Ecosystem Marketplace, 2023; Dawson et al., 2021).

2.2 Core Standards and Their Architecture

Four major certification frameworks dominate the current ecosystem service certification landscape, each with distinct scope, emphasis, and governance architecture.

The Verified Carbon Standard (VCS), administered by Verra, is the world's largest independent carbon certification program by volume. The VCS Standard v4.7 (2024) establishes requirements for additionality, permanence, robust quantification, and stakeholder safeguards across sixteen sectoral scopes, with particular strength in Agriculture, Forestry, and Other Land Use (AFOLU) projects. The VCS program is complemented by the Climate, Community and Biodiversity (CCB) Standards, which certify co-benefits for local communities and biodiversity, and the Sustainable Development Verified Impact Standard (SD VISta), which evaluates contributions to the UN Sustainable Development Goals (Verra, 2024a).

The Gold Standard for the Global Goals (GS4GG), founded by WWF and international NGOs, requires projects to demonstrate not only carbon emission reductions but contributions to at least two additional SDGs. Its safeguarding framework includes gender-inclusive design, respect for Indigenous Peoples' rights, and robust stakeholder consultation processes (Gold Standard Foundation, 2023).

The Integrity Council for the Voluntary Carbon Market (ICVCM) Core Carbon Principles (CCPs) represent a meta-standard — a global threshold benchmark that applies to carbon-crediting programs rather than individual projects. The CCPs, updated in January 2024 (Version 2), establish ten fundamental principles across three domains: governance, emissions impact, and sustainable development. All major independent programs — VCS, Gold Standard, ACR, ART, and CAR — have been designated as CCP-Eligible, demonstrating adherence to requirements for effective governance, transparency, tracking, and robust third-party validation (ICVCM, 2024b). As of October 2025, over 51 million credits using CCP-approved methodologies are available in the market, commanding measurable price premiums (ICVCM, 2025).

The VCMI Claims Code of Practice (2023) addresses integrity on the demand side, providing a framework for companies to make credible, science-aligned claims about their use of carbon credits. The Code establishes three Carbon Integrity claim levels — Silver, Gold, and Platinum — based on the proportion of a company's remaining scope 1 and 2 emissions addressed through high-quality carbon credit purchases, contingent on demonstrated near-term emission reduction targets aligned with 1.5°C pathways (VCMI, 2023).

Plan Vivo, one of the oldest AFOLU-focused crediting programs, occupies an important niche by emphasizing community-centered project design, participatory monitoring, and the issuance of ex-ante credits to rural smallholders — a design feature specifically intended to address cash-flow barriers common in developing-country contexts. The FSC Ecosystem Services Procedure provides a complementary pathway for certified sustainable forest operations to quantify and verify biodiversity, carbon, and hydrological benefits (FSC, 2024).

The governance architecture of major certification standards reveals important variations in the degree to which social performance requirements are treated as core commitments versus optional enhancements. VCS, as the volume leader, has historically prioritized technical rigor in additionality and quantification methodologies while treating community safeguards and biodiversity co-benefits as modular add-ons available through the CCB Standards and SD VISta. This architectural choice reflects a market logic in which buyers optimize for price and volume over social impact, but it also creates certification hierarchies in which the most rigorous social performers — those meeting CCB Gold and Climate Gold conditions — receive insufficient price differentiation to cover the additional costs of community engagement and participatory monitoring. The progressive mainstreaming of social requirements into core VCS requirements, accelerated by the ICVCM's sustainable development safeguards, represents a structural shift toward treating social justice as a non-negotiable component of certification integrity rather than a premium differentiator (Verra, 2024a; ICVCM, 2024b).

Gold Standard's mandatory multi-SDG contribution requirement and gender-responsive design framework represent the most comprehensive integration of social and development objectives into certification architecture among the major programs, but this comprehensiveness comes at a cost: Gold Standard projects are more expensive to develop, more time-consuming to certify, and consequently underrepresented in the high-volume corporate buyer segment of the VCM. The experience of Gold Standard therefore illustrates both the possibility and the market limitations of embedding robust social requirements into certification architecture: the standard demonstrates that rigorous social performance is technically achievable within a market certification framework, but the market has not yet evolved the price signals necessary to reward this rigor at scale. Bridging this gap requires demand-side interventions — including public procurement standards that prioritize social co-benefits, regulatory requirements for corporate credit purchases, and financial incentives for social impact investors — that complement supply-side standard improvements (Gold Standard Foundation, 2023; VCMI, 2023).

2.3 Biodiversity Credits and Ecosystem Service Diversification

Beyond carbon, an emerging suite of certification instruments seeks to monetize a broader range of ecosystem services. Biodiversity credits, ecosystem health certificates, and water quality offsets are being piloted across multiple jurisdictions. The Kunming-Montreal Global Biodiversity Framework (GBF), adopted at COP15 in December 2022, explicitly calls for innovative financing mechanisms — including biodiversity offsets and credits — to close the estimated USD 700 billion annual biodiversity finance gap (CBD, 2022; Deutz et al., 2020). UNDP's High-Integrity Carbon Markets Toolkit (2025) identifies carbon as the gateway commodity but emphasizes that high-integrity projects must embed biodiversity, water, and social co-benefits as integral components of the certification architecture rather than optional add-ons (UNDP, 2025).

The Taskforce on Nature-Related Financial Disclosures (TNFD) framework, launched in 2023, provides a complementary mechanism for corporate disclosure of nature-related risks and dependencies, creating demand-side pressure for certified nature-positive investments (TNFD, 2023). Together, these frameworks constitute an emerging multi-credit ecosystem in which carbon sequestration, biodiversity protection, hydrological services, and climate resilience are increasingly packaged as bundled or stacked certifications, allowing project developers to access multiple revenue streams simultaneously.

The emerging architecture of biodiversity credit markets faces methodological and governance challenges that are, in significant respects, more complex than those confronting carbon markets. Carbon credits rest on a single, physically grounded metric — tonnes of carbon dioxide equivalent — whose measurement, while imperfect, provides a relatively standardized basis for comparison and aggregation across project types and geographies. Biodiversity, by contrast, is inherently multidimensional: genetic diversity, species richness, functional diversity, ecosystem integrity, and cultural significance constitute distinct dimensions of biological value that cannot be reduced to a single unit without significant information loss. Developing biodiversity credit metrics that are scientifically credible, practically measurable, and ecologically meaningful across diverse ecosystem contexts constitutes the central technical challenge facing the biodiversity credit market, and the proliferation of competing approaches — habitat units, species biodiversity units, biocredits, and nature performance bonds — reflects the absence of a consensus around which institutional consolidation can occur (CBD, 2022; TNFD, 2023).

The integration of biodiversity, hydrological, and carbon credits within stacked or bundled certification architectures — as exemplified by the Quindío Verde Plus model — represents a promising pathway for increasing the financial viability of ecosystem service projects while simultaneously capturing the full range of conservation value generated by high-integrity tropical ecosystems. However, stacked certification structures introduce additional governance complexity: different credit types may involve different verification bodies, different registry systems, different buyer pools, and different safeguard requirements, creating transaction cost burdens that can overwhelm the financial benefits of stacking for small-scale projects. Standardizing the interface between different credit types — developing common monitoring frameworks, interoperable registry protocols, and unified safeguard requirements — is an institutional priority that requires coordination among standards bodies, governments, and international organizations that has not yet been systematically achieved (UNDP, 2025; Burgos-Salcedo & Sierra, 2026a).

3. THIRD-PARTY VERIFICATION: MECHANICS AND GOVERNANCE

3.1 The Validation and Verification Cycle

Certification of ecosystem service projects universally requires independent third-party validation and verification conducted by accredited Validation and Verification Bodies (VVBs). The verification cycle comprises two sequential phases: validation (ex-ante, prior to project implementation) and verification (ex-post, conducted periodically against monitoring reports). During validation, a VVB evaluates the project description for conformance with the applicable standard, including baseline methodology, additionality demonstration, permanence safeguards, and stakeholder engagement processes. During verification, the VVB assesses actual measured or monitored emission reductions or biodiversity outcomes against the approved baseline and methodology (SustainCERT, 2024; Preferred by Nature, 2024).

VVBs must be accredited by the relevant certification program and, where applicable, by national accreditation bodies under ISO 14065 requirements (Verra, 2024a). The ICVCM's assurance framework introduces an additional oversight tier: CCP-Eligible programs are subject to ICVCM audit, spot-checks, and complaint mechanisms to ensure ongoing adherence to CCP requirements (ICVCM, 2024a). This regulatory-style oversight model represents a significant evolution from the self-certification paradigm that characterized the VCM's early development.

The validation and verification cycle, while conceptually straightforward, involves layers of methodological judgment that create significant opportunities for both legitimate scientific discretion and inadvertent or deliberate error. At the validation stage, the assessment of additionality — the determination that conservation outcomes would not have occurred in the absence of carbon credit revenues — requires VVBs to evaluate counterfactual scenarios of land-use change that are inherently uncertain and influenced by assumptions about landowner behavior, agricultural economics, and policy trajectories. These judgments are not purely technical: they involve predictions about human decision-making under uncertainty that are susceptible to optimistic bias, particularly when project developers commission the additionality analyses that VVBs are asked to verify. The ICVCM's assurance framework addresses this conflict of interest partially, but the fundamental architecture of third-party verification — in which VVBs are hired and paid by project developers — creates incentive misalignments that no amount of accreditation oversight can fully eliminate without more fundamental structural reform (ICVCM, 2024a; SustainCERT, 2024).

Verification conducted at the periodic monitoring stage faces different but equally significant challenges. The physical measurement of carbon stocks, biodiversity indicators, and hydrological services in remote, biodiverse tropical ecosystems requires sophisticated sampling designs, qualified field teams, and statistical methodologies capable of generating precise estimates from heterogeneous and spatially variable data. Remote sensing technologies — satellite imagery, LiDAR biomass estimation, and near-real-time deforestation alerts — have substantially improved the efficiency and accuracy of desk-based verification, but they do not eliminate the need for ground-truthing in complex multi-strata ecosystems where above-ground biomass density and species composition vary substantially within short distances. In the Colombian context, the combination of IDEAM's National Forest Monitoring System with field-level GPS monitoring, as demonstrated in the Quindío pilot, establishes a technically robust verification foundation, but the translation of this foundation into accredited VVB verification processes requires institutional investment in training, accreditation, and quality assurance that remains underdeveloped at the regional level (IDEAM, 2022; Burgos-Salcedo & Sierra, 2026a, 2026b).

3.2 Methodological Integrity: Additionality, Permanence, and Leakage

The credibility of any ecosystem service credit rests on three methodological pillars: additionality, permanence, and leakage prevention. Additionality requires demonstration that the conservation or emission reduction outcomes would not have occurred in the absence of carbon credit revenues — a test that continues to generate controversy in the context of REDD+ and avoided deforestation projects (Guereena et al., 2023; Warnecke et al., 2019). The VCS Standard v4.7 introduced refined procedures for baseline setting and additionality testing, including requirements for baseline re-evaluation and the application of Verra's Unplanned Deforestation Allocation Tool (VT0007) to ensure that deforestation risk is not systematically overstated (Verra, 2024a).

Permanence — the assurance that sequestered carbon or protected biodiversity will remain so for a specified period — is addressed through buffer account systems under VCS, which require contributions of non-permanent risk ratings to a pooled buffer account that can compensate reversals. VCS Standard v4.7 extended minimum permanence monitoring requirements to 40 years and increased non-permanence risk withholdings to account for future climate change impacts (Verra, 2024a). Leakage — the displacement of emissions-generating activities from the project area to unprotected lands — is addressed through market and activity-shifting leakage assessments embedded in AFOLU methodology requirements (Verra, 2024a; Warnecke et al., 2019).

Double counting — the fraudulent or accidental claiming of the same emission reduction by multiple entities or toward multiple targets — has become a central integrity challenge in the context of Article 6 of the Paris Agreement. The ICVCM CCPs and VCS Standard v4.7 both incorporate requirements to prevent double-counting between voluntary carbon market transactions and host-country Nationally Determined Contribution (NDC) accounting (ICVCM, 2024a; Verra, 2024a).

The methodological challenges of additionality, permanence, and leakage assessment are fundamentally interconnected: a project that demonstrates robust additionality but fails to account for activity-shifting leakage — the displacement of agricultural activities from the protected area to adjacent unprotected lands — may generate certified credits that represent no net conservation benefit at the landscape scale. This interconnection means that methodological integrity cannot be achieved by addressing each pillar in isolation; it requires an integrated landscape-scale approach to quantification that assesses the entire system of incentives and behaviors affecting land use within the relevant jurisdiction. The shift from project-scale to jurisdictional-scale REDD+ accounting, supported by the Architecture for REDD+ Transactions (ART) TREES standard and increasingly referenced in ICVCM guidance, represents the methodological frontier of this integration, though operationalizing jurisdictional accounting at national scale in countries with complex governance systems like Colombia requires institutional investments far exceeding those of individual project certification (Verra, 2024a; Warnecke et al., 2019).

Double counting between voluntary carbon market transactions and host-country Nationally Determined Contribution accounting has emerged as the most politically contentious integrity challenge in the post-Paris Agreement era, with profound implications for the long-term viability of internationally traded ecosystem service credits. Under Article 6 of the Paris Agreement, corresponding adjustments — the accounting mechanism by which a host country subtracts from its NDC the emissions reductions transferred to international buyers through authorized carbon transactions — are required to prevent the same emission reduction from being counted twice toward global climate goals. The implementation of corresponding adjustment requirements across the diverse regulatory environments of biodiversity-rich developing countries requires national registry systems, legal frameworks, and administrative capacities that are not yet universally in place, creating a two-tier market in which credits with corresponding adjustments command significant premiums over unadjusted credits and disadvantaging countries with weaker institutional infrastructure (ICVCM, 2024b; Verra, 2024a).

3.3 Digital Technologies in Verification

The verification process is being transformed by remote sensing, satellite imagery, LiDAR, and artificial intelligence. Satellite-derived forest cover maps, biomass density datasets, and near-real-time deforestation alert systems enable verification bodies and standard-setters to conduct desk-based screening and auditing at scales and resolutions previously impossible (Asner et al., 2014). Blockchain-based registries have been proposed as a mechanism to create immutable records of credit issuance and retirement, reducing the risk of double-counting and enhancing public transparency (Ecosystem Marketplace, 2023).

In the Colombian context, IDEAM's National Forest Monitoring System (SMBYC) provides a geospatial foundation for REDD+ reference level construction and forest cover change monitoring, creating a national verification infrastructure that can interface with international certification programs (IDEAM, 2022). The Quindío pilot leveraged these datasets alongside local GPS monitoring to establish rigorous carbon baselines for 181 prioritized properties across 12 municipalities, demonstrating the operability of international-quality methodologies at the subnational scale.

The transformative potential of digital verification technologies must be assessed against the practical realities of implementation in data-poor, infrastructure-constrained developing-country contexts. While satellite-derived forest cover maps and near-real-time deforestation alerts are freely available through platforms such as Global Forest Watch, translating these data streams into the baseline construction, monitoring, and reporting formats required by major certification standards requires data science capacity, software infrastructure, and technical expertise that are unevenly distributed. Countries with strong national forest monitoring systems — including Brazil, Indonesia, and Colombia — are better positioned to leverage these technologies than countries with weaker data infrastructure, creating a digital monitoring divide that partially mirrors and reinforces existing inequalities in VCM market access. Investing in shared digital monitoring infrastructure as a global public good — rather than relying on individual project developers or countries to build bespoke monitoring systems — is an institutional priority for equitable digital transformation of ecosystem service verification (Asner et al., 2014; UNDP, 2025).

Artificial intelligence and machine learning applications for ecosystem monitoring are advancing rapidly, with demonstrated capacity to classify land cover, detect deforestation, estimate above-ground biomass, identify species from acoustic recordings, and

predict ecosystem service provision from remote sensing inputs. However, the integration of AI-assisted verification into accredited certification processes requires the development of methodological guidance, validation protocols, and uncertainty quantification frameworks that standards bodies have only begun to develop. The epistemological status of AI-generated monitoring outputs within certification verification — whether they constitute primary evidence or supplementary screening tools, how uncertainty bounds are characterized, and how potential algorithmic biases affecting specific ecosystem types or regions are identified and corrected — demands careful institutional deliberation that balances the efficiency gains of digital verification against the accountability requirements of credible certification systems (Ecosystem Marketplace, 2023; IDEAM, 2022).

4. MARKET ACCESS: PATHWAYS AND BARRIERS

4.1 Navigating the Voluntary Carbon Market

Access to voluntary carbon markets requires project developers to navigate a complex sequence of technical, institutional, and financial prerequisites. The typical project development cycle for a VCS-certified project involves: (1) concept development and pre-feasibility assessment; (2) methodology selection or development; (3) preparation and stakeholder consultation on the Project Description; (4) validation by an accredited VVB; (5) registration with Verra; (6) implementation and monitoring; (7) periodic verification; and (8) credit issuance and trading (SustainCERT, 2024; Preferred by Nature, 2024). This cycle typically requires 18–36 months from concept to first credit issuance and involves upfront costs of USD 100,000–500,000 for small-to-medium projects, creating a significant barrier for smallholders and community-level actors (Ecosystem Marketplace, 2023).

The UNDP High-Integrity Carbon Markets Toolkit (2025), developed within the Climate Promise framework, specifically addresses this access barrier for developing countries. The Toolkit provides governments and subnational entities with guidance on establishing enabling regulatory environments, building technical capacity for project monitoring and reporting, and structuring project finance to cover upfront certification costs. VCMI's VCM Access Strategies Programme targets this gap by supporting host countries — particularly those in the Global South — to access high-integrity voluntary carbon markets, reflecting a growing recognition that market access is not merely a technical challenge but a geopolitical equity issue (VCMI, 2023; Angelsen et al., 2023).

The financial architecture of VCM project development creates structural barriers that are as consequential as — and interact with — the technical barriers of methodology compliance and MRV obligations. Project preparation finance — the bridging capital required to cover the costs of project development, stakeholder consultation, validation, and first verification prior to credit issuance — is largely unavailable through commercial channels for community-level actors or small-scale projects in developing countries. Development finance institutions, bilateral donors, and results-based finance facilities have developed a range of instruments to address this gap, including grants for project preparation, first-loss guarantees to de-risk private investment, and pay-for-results mechanisms that link disbursement to verified credit issuance. However, the scale and coherence of available project preparation support remains far below what would be required to realize the ecosystem service certification potential of the world's biodiversity-rich developing countries, and the administrative requirements of most development finance instruments impose transaction costs that partially offset the access benefits they provide (Ecosystem Marketplace, 2023; VCMI, 2023).

The sequencing of market access requirements creates a particular challenge for communities and smallholders seeking to participate in voluntary carbon markets: the most valuable credits — those meeting CCP standards, achieving Gold Standard CCB certification, and incorporating gender-responsive design — require the most sophisticated project development capacity, while the simplest project types generate lower-value credits that provide insufficient revenue to cover certification costs. This inverse relationship between certification quality and access equity creates a market equilibrium in which the communities most capable of producing high-integrity credits are not those that most need income support, and the communities most in need of conservation finance are not those currently equipped to produce credits meeting the standards that would command premium prices. Breaking this equilibrium requires active institutional design — including capacity-building investments, technical assistance programs, pooled verification services, and preferential credit pricing for genuinely inclusive projects — that treats market access as a public policy challenge rather than a purely commercial transaction (Angelsen et al., 2023; Pagiola et al., 2016).

4.2 Colombia's National Framework: The Plan Nacional de Negocios Verdes

Colombia occupies a uniquely important position in the global ecosystem services landscape, hosting approximately 10% of the world's biodiversity within 1.1 million km² of territory spanning five major biomes. The Plan Nacional de Negocios Verdes (PNNV) 2022–2030, administered by MinAmbiente's Oficina de Negocios Verdes y Sostenibles, provides a structured pathway for enterprises to demonstrate environmental, social, and economic performance through a verification process anchored in twelve criteria spanning environmental impact, economic viability, legal compliance, and socio-cultural sustainability (MinAmbiente, 2022).

The verification process is conducted by the Regional Environmental Corporations (Corporaciones Autónomas Regionales) through their Ventanillas de Negocios Verdes. Enterprises achieving a score exceeding 50.1% across the twelve criteria

receive the Aval de Confianza — a trust certification qualifying them for listing in the national green business portfolio and access to market promotion through BioExpo Colombia and other national platforms (MinAmbiente, 2022). A critical dimension of the Colombian framework is its explicit integration of biodiversity conservation into the verification criteria, particularly Criterion 2 — 'Positive Environmental Impact' — which requires demonstration that the business activity generates measurable benefits for ecosystems, species, or natural processes.

The Plan Nacional de Negocios Verdes represents a distinctive hybrid governance approach that combines elements of national regulatory certification with market facilitation, deploying regional environmental authorities as certification agents rather than relying exclusively on private third-party verifiers. This institutional design reflects Colombia's constitutional architecture of environmental governance, in which the Regional Autonomous Corporations (CARs) function as technically specialized environmental regulators with territorial mandates that give them both the authority and the local knowledge necessary to assess the environmental and social performance of green enterprises. The integration of biodiversity conservation metrics — particularly Criterion 2's requirement for demonstrable positive environmental impact — into the verification framework positions the PNNV as a more ecologically rigorous certification scheme than many voluntary eco-label programs, though the heterogeneity of CAR implementation capacity and the absence of standardized measurement protocols for biodiversity criteria create significant consistency challenges across different regional contexts (MinAmbiente, 2022; Burgos-Salcedo & Sierra, 2026a, 2026b).

The national-international market interface presents both the most significant opportunity and the most pressing institutional challenge for Colombia's ecosystem service certification framework. The PNNV's Aval de Confianza provides domestic market recognition through BioExpo Colombia and national green procurement mechanisms, but its recognition by international voluntary carbon market programs — VCS, Gold Standard, and ICVCM CCP-approved schemes — requires a registry bridge that does not currently exist in standardized form. Developing this bridge would allow carbon sequestration data generated through PNNV verification processes to contribute to internationally recognized credit issuance, multiplying the revenue potential for Colombian green enterprises without requiring them to undergo entirely separate and duplicative certification processes for each market they wish to access. Colombia's institutional position as the host of COP16 of the Convention on Biological Diversity in 2024 and its advancing national biodiversity finance architecture provide political momentum for the development of such a registry bridge, which could serve as a transferable model for other megadiverse developing countries seeking to articulate national certification systems with international markets (CBD, 2022; MinAmbiente, 2022).

4.3 The Quindío Model: A Subnational Pilot in Market Access

Burgos-Salcedo and Sierra (2026a) provides a compelling illustration of how international certification standards can be operationalized at the departmental scale within a high-biodiversity tropical region. The Quindío model quantified a potential carbon sequestration capacity of 109,481 tCO_2e/year across 14,950 certifiable forest hectares in 181 prioritized properties, with an estimated annual market value of USD 3.2–8.7 million in voluntary carbon markets — a transformative revenue potential for rural landowners in a department where coffee production and ecotourism are the primary economic activities.

The Quindío Verde Plus differentiated certification system comprises four specialized certifications: (1) Carbon Certification for forest carbon sequestration under VCS-compatible methodologies (2.3–9.0 tCO_2e/ha/year by forest type); (2) Hydrological Services Certification anchored in hydrological regulation indices (IRH) of 0.82–0.91 in priority municipalities; (3) Biodiversity Certification for endemic species habitats and ecological corridors; and (4) Agroforestry Certification for sustainable coffee and plantain production systems generating carbon and food security co-benefits. This multi-credit architecture mirrors the stacking approach increasingly recognized in international standards as a means of diversifying and increasing landowner revenues (Burgos-Salcedo & Sierra, 2026a). The model's five-year projected cash flow demonstrates financial viability through a phased revenue ramp-up from approximately USD 120,000 in Year 1 to USD 1.2 million by Year 5, supported by premium structures for CCP-aligned credits (ICVCM, 2025).

The Quindío model's quantitative architecture — encompassing 181 prioritized properties across 12 municipalities, 14,950 certifiable hectares, and a projected annual carbon sequestration of 109,481 tCO_2e/year — provides a replicable template for subnational ecosystem service certification that is particularly significant because it demonstrates the feasibility of international-quality methodology compliance within the institutional constraints of a Colombian departmental governance context. The model's differentiated approach to carbon sequestration by forest type — ranging from 2.3 to 9.0 tCO_2e/ha/year across native forest, secondary forest, riparian corridors, and agroforestry systems — reflects the ecological heterogeneity that characterizes Andean tropical landscapes and requires verification methodologies sufficiently granular to capture this heterogeneity without imposing measurement burdens disproportionate to the scale of individual landowner participation. This methodological granularity, combined with the model's integration of national IDEAM forest monitoring data with local GPS-verified property boundaries, establishes a verification approach that bridges national infrastructure with project-level precision (Burgos-Salcedo & Sierra, 2026a; IDEAM, 2022).

The Quindío Verde Plus differentiated certification system's four specialized certification categories — carbon, hydrological services, biodiversity, and agroforestry — operationalize the stacked credit approach in a way that is sensitive to the specific ecosystem service profile of Andean coffee and forest landscapes. The hydrological services certification, anchored in Hydrological Regulation Index (IRH) values of 0.82 to 0.91 in priority municipalities, quantifies the water regulation contributions of intact forest cover in terms directly relevant to downstream water users — municipalities, irrigation districts, and hydroelectric generators — creating a demand-side constituency for conservation finance that extends beyond the voluntary carbon market buyer pool. This demand diversification is strategically significant: it reduces the revenue concentration risk associated with dependence on a single market and creates opportunities for multi-stakeholder conservation finance architectures in which different ecosystem service beneficiaries — carbon buyers, water utilities, biodiversity credit purchasers, and coffee certification premium payers — contribute proportionate shares of the total conservation revenue stream necessary to sustain landowner participation (Burgos-Salcedo & Sierra, 2026a; UNDP, 2025).

5. COMPARATIVE ASSESSMENT OF MAJOR CERTIFICATION STANDARDS

Table 1 presents a comparative assessment of the major certification frameworks evaluated in this article against five dimensions particularly relevant to biodiversity conservation and social inclusion in the Latin American context.

Table 1. Comparative assessment of major ecosystem service certification standards.

Standard	Geographic Reach	Co-Benefits Required	FPIC Requirement	Small-Scale Access	Colombia Relevance
VCS / Verra	Global (2,300+ projects)	Optional (CCB add-on)	Required for AFOLU	Grouped project pathway	Active; REDD+ projects
Gold Standard	100+ countries	Mandatory (2+ SDGs)	Mandatory	Community-scale pathway	Growing adoption
ICVCM CCPs	Global meta-standard	Threshold minimum	Program-level mandate	Via CCP-Eligible programs	Applicable to VCS/GS
VCMI Claims Code	Corporate demand-side	N/A (demand-side)	N/A	N/A	Relevant for buyers
Plan Vivo	AFOLU community focus	Embedded in design	Mandatory	Primary design goal	Limited to date
PNNV / MinAmbiente	Colombia national	Integrated criteria	Implicit in criteria	SME-focused	National regulatory basis

Sources: ICVCM (2024a, 2024b), VCMI (2023), Verra (2024a), Gold Standard Foundation (2023), MinAmbiente (2022).

The comparative assessment presented in Table 1 reveals a systematic pattern in which geographic reach and social performance operate as partially competing values within the current certification architecture: the programs with the broadest global reach — VCS and ICVCM CCPs — treat social safeguards as threshold requirements or optional enhancements rather than mandatory, verifiable, and enforceable core commitments, while the programs with the strongest social performance — Gold Standard and Plan Vivo — operate at more limited scale and face structural barriers to the volume growth that would allow them to influence the mainstream carbon market. This pattern is not accidental: it reflects the market logic in which buyer price sensitivity and the transaction cost structure of certification development systematically reward simplified, standardized approaches over the more complex, participatory processes that genuine social justice requires. Addressing this pattern requires interventions that decouple social performance from transaction cost penalties — including standardized FPIC verification protocols that reduce the burden of compliance without diminishing its rigor, pooled verification services that achieve economies of scale for community-level projects, and demand-side procurement standards that create price differentiation rewarding robust social performance (ICVCM, 2024b; Gold Standard Foundation, 2023).

Colombia's dual positioning in Table 1 — as a country subject to both the VCS and Gold Standard voluntary market standards through active REDD+ and ecosystem service projects and as the developer of the national PNNV framework — illustrates the multi-level governance challenge confronting biodiversity-rich developing countries seeking to build coherent ecosystem service certification systems. International standards provide access to global finance flows but impose methodology, documentation, and verification requirements designed for a global context that may poorly fit the institutional realities of Colombian regional

governance. The PNNV framework, by contrast, is precisely calibrated to Colombia's institutional architecture but provides limited access to international market revenues. Developing translation mechanisms — registry bridges, mutual recognition agreements, and harmonized monitoring protocols — that allow information generated for one certification system to satisfy the requirements of another would reduce the certification burden for Colombian landowners and communities while maintaining the distinct contributions that each framework provides to market integrity and social inclusion (MinAmbiente, 2022; Burgos-Salcedo & Sierra, 2026a, 2026b).

PART II: SOCIAL JUSTICE AND INCLUSION IN CERTIFICATION SCHEMES

6. SOCIAL JUSTICE IMPERATIVES IN ECOSYSTEM SERVICE CERTIFICATION

6.1 The Justice Dimension of Carbon and Biodiversity Markets

The emergence of market-based ecosystem service certification has generated significant scholarly and activist debate about who benefits from these mechanisms and at whose expense. Indigenous Peoples and local communities (IPLCs) are the de facto stewards of a disproportionate share of the world's biologically rich territories: as custodians of approximately 36% of the planet's intact forests, IPLCs are simultaneously the primary providers of ecosystem services and the populations most vulnerable to displacement and rights violations when certification schemes are poorly designed or governed (UNDP, 2025; Schroeder, 2010). High-profile cases of forced evictions associated with REDD+ projects, documented by Global Witness (2019) and investigative media, underscore the potential for certification schemes to become instruments of dispossession rather than conservation.

A justice-centered analysis must address four interlocking dimensions: distributive justice (who receives the monetary benefits of certification); procedural justice (who participates in decision-making); recognition justice (whose knowledge, values, and land tenure systems are acknowledged); and restorative justice (whether historical dispossessions and inequities are rectified rather than perpetuated) (Sikor & Norgaard, 2009; Corbera, 2012).

The justice dimensions of ecosystem service certification are not merely additive concerns to be layered onto technically sound certification frameworks; they are constitutive of certification integrity itself. A certification system that issues credits without genuine FPIC, that distributes revenues in ways that bypass affected communities, or that instruments indigenous knowledge without consent and compensation is not merely unjust — it is generating credits whose integrity is compromised by the procedural deficiencies in their production. This constitutive relationship between justice and integrity has been progressively recognized in the evolution of major certification standards, from the early VCS framework's minimal stakeholder engagement requirements to the ICVCM's sustainable development safeguards mandate, but the operationalization of justice principles as independently verified, enforceable certification requirements — rather than as aspirational guidelines whose compliance is largely self-assessed by project developers — remains incomplete across all major programs (UNDP, 2025; Schroeder & Doberstein, 2019).

The four dimensions of justice identified by Sikor and Norgaard (2009) — distributive, procedural, recognition, and restorative — interact in ecosystem service certification in ways that make partial solutions insufficient. Distributive justice achievements — ensuring that communities receive equitable shares of certification revenues — are undermined when procedural justice failures mean that benefit-sharing arrangements are negotiated without genuine community participation. Procedural justice mechanisms — meaningful FPIC processes — are hollow when recognition justice failures mean that indigenous knowledge and governance systems are treated as inputs to certification processes rather than as legitimate governance frameworks in their own right. And all three dimensions of justice are inadequate without restorative justice — an acknowledgment that many territories being certified for ecosystem services are territories from which indigenous and Afro-Colombian communities were historically excluded or dispossessed, and that historical injustice cannot be remediated by revenue sharing alone without also addressing the underlying questions of territorial rights and governance authority (Corbera, 2012; Global Witness, 2019).

6.2 Free, Prior and Informed Consent as a Non-Negotiable Standard

Free, Prior and Informed Consent (FPIC) is enshrined in the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) as a fundamental right of Indigenous Peoples with respect to decisions affecting their lands, territories, and resources (United Nations, 2007). The ICVCM CCPs, VCS Standard v4.7, Gold Standard Safeguarding Principles, and UNDP's High-Integrity Carbon Markets Toolkit all recognize FPIC as a mandatory requirement for land use projects involving Indigenous communities (ICVCM, 2024a; Verra, 2024a; Gold Standard Foundation, 2023; UNDP, 2025).

However, the operationalization of FPIC in certification practice remains profoundly uneven. A systematic review of REDD+ project documentation found that many projects treated FPIC as a procedural checkbox rather than a substantive process of rights-based negotiation (Schroeder & Doberstein, 2019). VVBs assessing project conformance face methodological challenges in evaluating the quality and authenticity of consent processes, particularly when consultations are conducted in dominant national languages rather than indigenous languages, or when power asymmetries between project developers and communities preclude genuinely free negotiation.

Colombia's legal framework addresses FPIC through the Consulta Previa mechanism established in ILO Convention 169 (ratified by Colombia in 1991) and extensive Constitutional Court jurisprudence protecting indigenous and Afro-Colombian territorial rights. The PNNV 2022–2030 recognizes the need to articulate Negocios Verdes certification with the Consulta Previa framework, though implementation remains incomplete (MinAmbiente, 2022).

The operationalization of FPIC within certification verification processes requires verification bodies to develop competencies that extend well beyond the technical ecology and carbon accounting expertise traditionally associated with VVB accreditation. Assessing the quality and authenticity of consent processes — evaluating whether communities received information in accessible, culturally appropriate formats; whether power asymmetries between project developers and community representatives were adequately managed; whether the consultation process allowed sufficient time for internal community deliberation; and whether the consent obtained was genuinely free from material inducement or coercive pressure — requires expertise in social anthropology, indigenous rights law, and community governance processes. The current VVB accreditation system under ISO 14065 does not systematically require this competency profile, creating a structural gap between the FPIC requirements embedded in certification standards and the verification capacity available to assess compliance with those requirements (Verra, 2024a; Schroeder & Doberstein, 2019).

Colombia's Consulta Previa framework, established through Law 21 of 1991 (ratifying ILO Convention 169) and substantially elaborated through Constitutional Court jurisprudence, provides a legally binding FPIC mechanism that is in some respects more rigorous than the FPIC requirements embedded in international certification standards. The Constitutional Court's T-769/2009 and T-129/2011 rulings established that Consulta Previa for decisions affecting indigenous and Afro-Colombian territories must involve genuine dialogue aimed at achieving consensus, not merely notification or consultation for information purposes. The articulation of this domestic legal framework with the FPIC requirements of VCS, Gold Standard, and ICVCM CCPs — ensuring that projects meeting Colombian Consulta Previa requirements are recognized as having satisfied international FPIC standards — would reduce transaction costs for Colombian ecosystem service projects while elevating the FPIC rigor of international certification. This harmonization requires engagement between MinAmbiente, the national certification programs, and international standards bodies that has not yet been systematically pursued (MinAmbiente, 2022; United Nations, 2007).

6.3 Equitable Benefit-Sharing Architectures

Equitable benefit-sharing — the just and transparent distribution of financial revenues generated by ecosystem service certification — is the mechanism through which certification translates into tangible improvements in community well-being and conservation incentives. The design of benefit-sharing architectures involves three fundamental questions: how revenues are divided between project developers, intermediaries, and communities; how within-community distribution accounts for differentiated contributions, vulnerabilities, and power relations; and how payments are structured over time to build long-term financial sustainability rather than dependency (Wunder, 2015; Corbera et al., 2007).

Research across PES schemes globally demonstrates that benefit-sharing arrangements are more effective — in terms of both conservation and equity outcomes — when they are participatorily designed, contractually specified, regularly monitored, and subject to independent audit (Wunder, 2015; Dawson et al., 2021). The Quindío model proposes a layered benefit-sharing structure in which landowners receive 60–70% of carbon credit revenues, with the remaining 30–40% distributed to a territorial conservation fund, a local conservation authority surcharge, and technical support for monitoring and verification — an architecture that requires refinement through participatory negotiation with affected communities to ensure genuine consent and perceived legitimacy.

The design of benefit-sharing architectures that are genuinely equitable — rather than merely described as equitable in project documentation — requires attention to three frequently overlooked distributional dynamics. First, the distinction between direct and indirect beneficiaries must be recognized: communities living adjacent to certified project areas may depend on ecosystem services without holding formal ownership of the land generating certification revenues, and benefit-sharing designs that allocate revenues solely to landowners or formal project participants may exclude these indirect dependents who bear real costs of conservation. Second, within-community distributional dynamics — the ways in which received revenues are channeled through community governance systems that may themselves be characterized by gender, class, ethnic, or generational inequities — require explicit attention in benefit-sharing design, including gender-disaggregated payment mechanisms, youth engagement provisions, and safeguards against elite capture at the community level. Third, the temporal distribution of benefits — whether payments are front-loaded to address immediate livelihood needs or structured for long-term institutional investment — must be negotiated with affected communities rather than imposed by project developers or national government intermediaries (Wunder, 2015; Corbera et al., 2007).

The Quindío model's proposed benefit-sharing structure — allocating 60–70 percent of carbon credit revenues to landowners and distributing the remainder to a territorial conservation fund, a local conservation authority surcharge, and technical monitoring support — represents a reasonable starting architecture that must be refined through participatory negotiation with the full range of affected stakeholders. Critical refinements required include: ensuring that the territorial conservation fund is governed by a multi-

stakeholder board with meaningful representation of smallholders, indigenous communities where relevant, and women; establishing transparent, independently audited accounting for all revenue flows; developing clear criteria for the allocation of conservation fund resources that prioritize communities most dependent on ecosystem services rather than those with greatest political leverage; and incorporating adaptive clauses that allow benefit-sharing percentages to be renegotiated as credit prices, monitoring costs, and community capacities evolve over the project lifetime. These governance requirements are not peripheral to the financial model — they are constitutive of the legitimacy that determines whether community participation is sustained over the multi-decade timescales necessary for genuine conservation outcomes (Burgos-Salcedo & Sierra, 2026a, 2026b; Dawson et al., 2021).

7. INCLUSION OF SMALLHOLDERS AND MARGINALIZED COMMUNITIES

7.1 Structural Barriers to Certification Access

Despite the rhetorical commitment of major standards to inclusion and equity, structural barriers continue to exclude the smallholders, indigenous communities, and resource-poor households who are most critical to achieving global conservation goals from meaningful participation in ecosystem service markets. These barriers operate at multiple levels: financial (high upfront costs of project development and verification); technical (complex methodology requirements and MRV obligations); institutional (lack of legal land tenure recognition that precludes project registration); and linguistic (English-language documentation requirements that create comprehension barriers for non-specialist community members) (Dawson et al., 2021; Shapiro-Garza, 2013).

Upfront certification costs of USD 100,000–500,000 are effectively prohibitive for individual smallholders or small community groups without access to development finance. The 'valley of death' between project conception and first credit issuance — typically 18–36 months — requires bridging finance unavailable to most community-level actors (Ecosystem Marketplace, 2023). These financial barriers have historically concentrated VCM participation among large landowners, multinational corporations, and financially sophisticated project developers (Schroeder, 2010).

Grouped project structures available under VCS allow smaller project activities to be aggregated under a common framework, reducing per-unit transaction costs. Gold Standard's community services pathway and Plan Vivo's smallholder focus provide more radical structural accommodations for small-scale actors, including ex-ante payment mechanisms that address cash-flow constraints. However, these more inclusive structures remain underutilized relative to their potential (Dawson et al., 2021).

The institutional barriers to certification access for smallholders and marginalized communities operate at the intersection of formal requirements and informal power dynamics in ways that formal barrier analyses systematically underestimate. Beyond the quantifiable transaction costs of project development — the USD 100,000–500,000 required for VCS certification of small-to-medium projects — there exist deeper barriers related to the cultural and epistemological assumptions embedded in certification standards themselves. Standards developed by Northern-dominated technical committees, validated through peer review processes that exclude most practitioners from the Global South, and documented in English-language technical manuals that are not translated into the languages of communities managing the ecosystems being certified reflect a knowledge hierarchy in which the ecological expertise of indigenous and local communities is consistently devalued relative to the scientific expertise of project developers and verification bodies. Addressing this cultural dimension of access barriers requires not only translation of documents but fundamental reform of the standard-setting process to incorporate community knowledge holders as co-authors of methodologies rather than merely as subjects of consultation (Shapiro-Garza, 2013; UNDP, 2025).

The land tenure barrier deserves particular analytical attention in the Colombian context, where land tenure insecurity affects large proportions of smallholder and indigenous community territories in the most biodiversity-rich regions. VCS and Gold Standard both require that project developers demonstrate legal rights — ownership, long-term lease, or other legally recognized interest — over project areas as a prerequisite for project registration. In Colombian territories where land titling processes are incomplete, overlapping, or contested — as is common in Amazonian indigenous territories, Pacific Afro-Colombian collective territories, and post-conflict rural areas — this requirement effectively excludes from certification the very communities whose territorial management generates the ecosystem services being certified. Addressing this barrier requires a two-track approach: on one hand, accelerating land titling processes through coordinated engagement between the certification programs, national government, and territorial rights organizations; on the other hand, developing certification modalities — such as community stewardship agreements recognized as sufficient legal basis for project registration — that do not condition market access on the completion of processes that may require decades to fully accomplish (Dawson et al., 2021; MinAmbiente, 2022).

7.2 Gender Dimensions of Certification and Benefit Distribution

Women are systematically underrepresented in the governance, development, and benefit distribution of ecosystem service certification schemes, despite their centrality to land management, biodiversity stewardship, and household food security in most rural societies in the Global South (Arora-Jonsson, 2011). A systematic analysis of REDD+ benefit-sharing arrangements found that women received a smaller share of project payments, were less likely to be named as project participants, and were underrepresented in community consultations across most documented projects (Aguilar et al., 2015).

Gold Standard for the Global Goals includes a mandatory gender-responsive design requirement across its project lifecycle, from stakeholder consultation to monitoring indicator design. UNDP Climate Promise 2025 explicitly embeds gender equality as a cross-cutting dimension of NDC support, noting that 95% of all NDCs supported included gender equality considerations (UNDP, 2024). Colombia's national framework acknowledges gender equity as a dimension of sustainable business development, consistent with the country's constitutional commitments and the 2016 Peace Agreement's gender chapter (MinAmbiente, 2022).

The gender dimensions of ecosystem service certification extend beyond payment distribution to encompass the full project cycle, from stakeholder identification and consultation design through monitoring protocol development and grievance mechanism accessibility. Women's underrepresentation in community consultations is not simply a function of cultural exclusion norms — though those norms are real and important — but also reflects practical constraints related to domestic labor burdens, mobility restrictions, language barriers (when consultations are conducted in dominant national languages rather than women's primary languages), and timing choices that schedule meetings during hours of peak household labor demand. Gender-transformative certification design requires deliberate disaggregation of community into its gendered components from the project identification stage, establishment of women-only consultation spaces where needed to ensure that women's voices are not filtered through male household representatives, and explicit attention to the gender implications of proposed benefit-sharing mechanisms before designs are finalized (Arora-Jonsson, 2011; Aguilar et al., 2015).

The evidence base on gender-differentiated biodiversity conservation outcomes — establishing connections between women's empowerment, female land tenure security, and ecosystem integrity — is growing but remains concentrated in agricultural development research rather than ecosystem service certification literature. Where women have greater control over natural resource management decisions, the evidence suggests that outcomes for both livelihoods and ecological sustainability are more positive, partly because women's land use priorities are more oriented toward long-term provisioning services — food, water, and medicine — and less toward short-term commodity production. Integrating this evidence into certification methodology design would mean explicitly assessing women's role in ecosystem management as a dimension of monitoring baseline characterization, designing payment mechanisms that reinforce rather than undermine women's land management authority, and tracking gender-disaggregated outcomes as standard reporting requirements rather than optional social co-benefit assessments. Gold Standard's mandatory gender-responsive design framework and UNDP Climate Promise's systematic integration of gender equality across NDC support provide templates for what this integration can look like in practice (UNDP, 2024; Gold Standard Foundation, 2023).

7.3 Indigenous Knowledge and Biocultural Diversity

Indigenous and Local Knowledge (ILK) systems embody centuries of empirical observation, adaptive management, and ecological understanding accumulated through sustained interaction with specific ecosystems. In the context of ecosystem service certification, ILK constitutes a form of monitoring capital — a sophisticated, low-cost, and temporally deep source of biodiversity and ecosystem health data that is systematically undervalued and underutilized within formal certification frameworks (Berkes, 2018; Gadgil et al., 1993). Within certification frameworks, ILK integration faces structural challenges related to intellectual property rights, epistemological commensurability, and cultural safety.

The Quindío's rich biocultural heritage — including the wax palm (Ceroxylon quindiuense) as Colombia's national tree and symbol of Andean cultural identity — illustrates the convergence of ecological and cultural value in mountain ecosystems that certification systems must honor. The Burgos-Salcedo and Sierra (2026a) model's biodiversity certification component includes endemic species habitats as a certification category, providing a potential pathway for monetizing the conservation of wax palm populations — a deeply culturally significant conservation objective for Quindío communities.

The integration of Indigenous and Local Knowledge into ecosystem service certification monitoring faces a fundamental epistemological challenge: ILK systems are typically holistic, relational, and context-specific in ways that resist disaggregation into the standardized, quantifiable indicators that certification monitoring protocols require. The observation that a particular elder 'can tell from the sound of the forest whether the bird populations are healthy' encodes sophisticated ecological knowledge that has genuine monitoring value but cannot be directly incorporated into a spreadsheet-based MRV system without translation processes that risk both distorting the original knowledge and appropriating its content without fair compensation. Developing bridging methodologies — participatory knowledge mapping processes, visual indicator frameworks, community-controlled data sovereignty protocols — that allow ILK to contribute to certification monitoring without being reduced to or replaced by Western scientific formats is a frontier research and institutional design challenge requiring sustained collaboration between indigenous knowledge holders, ecologists, and certification standard-setters (Berkes, 2018; UNEP-WCMC, 2024).

The Quindío's biocultural heritage provides concrete illustration of how indigenous ecological knowledge and certification methodology can potentially be integrated in ways that benefit both conservation outcomes and community dignity. The traditional knowledge of indigenous and campesino communities about the wax palm's phenology, pollination ecology, seed dispersal, and cultural significance represents monitoring capital that is both scientifically valid and deeply culturally embedded. Integrating this knowledge into the biodiversity certification component of the Quindío Verde Plus framework — through protocols that recognize

knowledge holders as co-researchers with intellectual property rights over their contributions, establish agreed-upon compensation mechanisms for knowledge sharing, and ensure that community monitoring data is owned and controlled by communities rather than extracted by project developers — would simultaneously strengthen the scientific basis of monitoring and demonstrate that certification systems can be designed to respect and reinforce rather than appropriate and erode indigenous knowledge systems. The CBD Nagoya Protocol's access and benefit-sharing framework provides the relevant international legal framework for structuring this integration (Burgos-Salcedo & Sierra, 2026a, 2026b; Berkes, 2018).

8. TOWARD A RIGHTS-BASED CERTIFICATION FRAMEWORK

8.1 Integrating FPIC, Benefit-Sharing, and Gender Equity into Standard Architecture

The transformation of ecosystem service certification from a technically oriented compliance exercise into a genuinely inclusive and justice-promoting mechanism requires systematic integration of rights-based principles throughout the standard architecture — not as add-ons or voluntary enhancements, but as mandatory, verifiable, and enforceable requirements embedded in core standard documents. This integration must be operationalized at five levels: standard-setting (incorporating rights-based language and FPIC requirements into standard text); methodology design (building in participatory data collection and ILK integration); VVB training and accreditation (building rights-based assessment competencies in verification bodies); registry transparency (making stakeholder engagement documentation publicly accessible); and grievance mechanisms (ensuring communities have accessible, independent channels to raise complaints about rights violations) (Schroeder & Doberstein, 2019; UNDP, 2025).

The UNDP High-Integrity Carbon Markets Toolkit (2025) advances an 'integrity ecosystem' concept, recognizing that achieving social integrity requires coordinated action by governments, standard-setters, project developers, investors, civil society, and local communities — each with a defined role and accountability within a shared framework.

The integration of rights-based principles into certification standard architecture requires confronting an inherent tension between the universalist aspirations of global certification programs and the contextual specificity of rights claims. FPIC requirements embedded in a global standard must be operationally specific enough to be verifiable by accredited VVBs operating across diverse legal, cultural, and institutional contexts, while remaining sensitive to the enormous variation in what meaningful consent looks like across indigenous legal traditions, community governance structures, and power dynamics in different countries and regions. Navigating this tension requires a framework approach: global standards should establish non-negotiable minimum requirements for FPIC process quality — including timeline requirements, language accessibility standards, documentation obligations, and independent verification of consent authenticity — while allowing flexibility in the specific procedural forms through which these requirements are met, with explicit recognition of national legal frameworks such as Colombia's Consulta Previa where they meet or exceed international standards (Schroeder & Doberstein, 2019; United Nations, 2007).

Registry transparency — the public availability of comprehensive project documentation, including stakeholder engagement records, benefit-sharing agreements, verification reports, and complaint resolution outcomes — is a necessary but currently insufficiency realized dimension of rights-based certification architecture. Verra's registry publishes project descriptions and verification reports for all registered projects, but the accessibility and legibility of these documents for affected communities — who may lack internet access, English literacy, or familiarity with certification terminology — is extremely limited. Meaningful transparency requires active disclosure rather than passive publication: project documents must be available in local languages, distributed to community representatives in accessible formats, and supplemented by community-level project information sessions that provide affected communities with genuine understanding of the rights and obligations the project creates for them. This active disclosure requirement would transform transparency from a box-checking exercise into a genuine mechanism for community accountability and informed consent (UNDP, 2025; ICVCM, 2024a).

8.2 Tiered Certification Models for Inclusive Market Architecture

Tiered certification architectures offer a promising structural innovation for bridging the gap between small-scale community actors and large voluntary carbon markets. Under a tiered model, basic certification — achievable with lower transaction costs and simpler documentation requirements — provides initial market access and revenue, with incentivized pathways for upgrading to higher-tier certifications as monitoring capacity, institutional capacity, and financial resources develop over time (Wunder, 2015; Pagiola et al., 2016).

Colombia's Negocios Verdes framework operationalizes a tiered approach through its three certification categories — Emprendimientos Verdes, Negocios Verdes Verificados, and Empresas Ancla Verde — each with proportionate verification requirements that reduce entry barriers for small enterprises while maintaining meaningful environmental and social performance standards (MinAmbiente, 2022). The Quindío model builds on this architecture by proposing a differentiated certification system in which basic carbon certification serves as the entry point, with add-on biodiversity, hydrological, and agroforestry certifications available as project capacity and ecosystem service data quality improve.

Tiered certification architectures are not merely a mechanism for reducing transaction costs — they embody a theory of change about how small-scale community actors can be progressively integrated into high-integrity ecosystem service markets through a pathway that builds institutional capacity alongside market access. The theory of change is compelling: basic certification provides initial revenue that funds the technical capacity building necessary for higher-tier certification, which in turn generates the institutional confidence and organizational sophistication that enables participation in the most rigorous and financially rewarding market segments. However, this pathway logic requires deliberate policy design to function in practice: if the price differential between tiers is insufficient to incentivize upgrading, or if the institutional support for capacity building is absent, tiered architectures will simply create a two-tier market in which community actors are permanently confined to the lower-value tier while sophisticated project developers access the premium tier. Ensuring that tiered architectures function as genuine pathways rather than permanent stratifications requires price incentives for tier advancement, technical assistance programs linked to certification milestones, and monitoring of participation patterns to detect and correct stratification dynamics (Wunder, 2015; Pagiola et al., 2016).

The Quindío Verde Plus model's phased revenue ramp-up — from approximately USD 120,000 in Year 1 to USD 1.2 million by Year 5 — illustrates both the potential and the risk of tiered market access architectures for community-scale conservation. The financial viability of the model depends on achieving the price premiums associated with CCP-aligned, multi-certified credits by Year 3–4, which requires institutional capacity — in monitoring, stakeholder engagement, and verification documentation — that must be developed during the early years of the project when revenues are insufficient to fund this capacity development independently. Bridging this institutional capacity gap requires a distinct financing instrument — a tiered certification development fund combining grant support for basic certification with results-based payments linked to upgrade milestones — that does not currently exist in the Colombian ecosystem service finance landscape but could be developed through coordination between CORPOCUENCAS, national development finance institutions, and international conservation finance partners. The Quindío model's documentation of this financing gap is itself a policy contribution — demonstrating through a concrete subnational case what institutional innovations are required to make tiered certification architectures function as equitable pathways rather than market stratification mechanisms (Burgos-Salcedo & Sierra, 2026a; Ecosystem Marketplace, 2023).

8.3 Rights-Based Framework: Synthesis Matrix

Table 2 synthesizes the four dimensions of justice identified in Section 6.1, mapping current best practices, key gaps, and recommended actions within the rights-based certification framework proposed in this article.

Table 2. Rights-based framework integration matrix for ecosystem service certification.

Dimension	Current Best Practice	Gap / Challenge	Recommended Action
Distributive Justice	Benefit-sharing schedules (Gold Standard, Plan Vivo)	Revenue concentration in project developers vs. communities	Mandatory participatory benefit-sharing negotiation with independent audit
Procedural Justice	Stakeholder consultation requirements in VCS, GS, CCPs	Superficial consultation vs. genuine co-design	VVB competency standards for assessing FPIC quality
Recognition Justice	ILK integration in CCB Gold, Plan Vivo	Epistemological barriers; IP risk	ILK protocols with IP protections and remuneration frameworks
Restorative Justice	Limited across all major standards	Historical dispossessions not addressed by certification design	Historical equity audits as eligibility prerequisite for high-value projects

Dimensions based on Sikor & Norgaard (2009) and Corbera (2012); best practices from ICVCM (2024a), VCMI (2023), Gold Standard Foundation (2023), and UNDP (2025).

The rights-based framework synthesis matrix presented in Table 2 reveals that current best practices in ecosystem service certification are distributed across different programs in ways that prevent any single project from comprehensively meeting all four dimensions of justice simultaneously. Distributive justice is addressed most systematically by Gold Standard and Plan Vivo through their mandatory benefit-sharing requirements, but their community-scale focus limits their applicability to the project types and geographies where the most significant carbon and biodiversity values reside. Procedural justice requirements are widespread in formal standard text — VCS, Gold Standard, and ICVCM CCPs all mandate stakeholder consultation — but the gap between formal requirements and operational practice identified under 'Gap/Challenge' reflects the verification deficit in FPIC assessment: standards

require consultation without adequately specifying what genuine consultation looks like or ensuring that VVBs have the competencies to assess it. The table's most significant finding may be the near-universal absence of restorative justice provisions across all major standards — an absence that reflects not methodological limitation but a political reluctance to engage with historical injustice that is incompatible with the rights-respecting commitments the standards otherwise proclaim (Sikor & Norgaard, 2009; Corbera, 2012).

The recommended actions in Table 2 represent an integrated policy agenda for transforming ecosystem service certification from a technically oriented compliance exercise into a genuinely justice-promoting governance mechanism. The four recommended actions — mandatory participatory benefit-sharing negotiation with independent audit, VVB competency standards for FPIC assessment, ILK protocols with intellectual property protections, and historical equity audits as eligibility prerequisites for high-value projects — are not independent interventions but components of an integrated framework whose elements reinforce each other. Mandatory participatory benefit-sharing negotiation is only meaningful if FPIC processes are genuine rather than procedural — requiring the VVB competency standard. ILK protocols are only viable if communities have been genuinely consulted and retain governance authority over their knowledge systems — requiring the benefit-sharing and FPIC improvements. And historical equity audits cannot produce equitable outcomes without the distributional, procedural, and recognition justice improvements that the other three recommended actions address. Implementing this integrated agenda requires coordinated action among standard-setters, verification bodies, government regulators, and civil society organizations — precisely the 'integrity ecosystem' approach advocated by UNDP's High-Integrity Carbon Markets Toolkit (UNDP, 2025; ICVCM, 2024a).

8.4 Policy Implications for Colombia and Latin America

The Colombian national context presents both remarkable opportunities and significant governance challenges for realizing a rights-based, inclusive ecosystem service certification system. The country's extraordinary biodiversity endowment, the political commitment embedded in the 2016 Peace Agreement to rural development and territorial conservation, the institutional infrastructure of regional CARs, and the existing national framework of PNNV 2022–2030 create a favorable enabling environment. The Kunming-Montreal GBF commitment to 30×30 provides additional international political momentum for scaling ecosystem service certification as a core conservation financing instrument (CBD, 2022).

Realizing this potential requires addressing four governance imperatives: (1) strengthening land tenure security for smallholders and indigenous communities as a prerequisite for certification program participation; (2) investing in regional technical capacity within CARs to support VCS/Gold Standard-compatible MRV systems; (3) developing a national registry interface that enables articulation between the PNNV national framework and international VCM program registries; and (4) enacting specific legal protections for FPIC and community benefit-sharing within the regulatory framework governing ecosystem service credits, building on existing Consulta Previa jurisprudence (MinAmbiente, 2022).

9. CONCLUSIONS AND RECOMMENDATIONS

This article has traced the architecture of ecosystem service certification from its technical foundations in global standards to its social justice imperatives, demonstrating that these two dimensions are not merely complementary but co-constitutive: standards without social justice are instruments of exclusion, while social commitments without rigorous standards are mechanisms of greenwashing. The convergence of the ICVCM CCPs (supply-side integrity), VCMI Claims Code (demand-side integrity), and UNDP's High-Integrity Carbon Markets Toolkit (capacity-building for developing countries) represents the most sophisticated architecture for high-integrity ecosystem service markets yet developed.

The Colombian PNNV 2022–2030 and the Quindío pilot model demonstrate that these global frameworks can be operationalized within national and subnational governance structures in biodiversity-rich developing countries, creating pathways to international markets that respect local ecological realities and community rights. However, closing the gap between frameworks and practice requires sustained institutional investment, participatory governance, gender-inclusive design, and independent monitoring of both environmental and social outcomes.

The following policy and programmatic recommendations distill the article's central findings:

- Mainstream FPIC as a substantive, independently verified, and culturally appropriate process — with VVBs specifically trained and evaluated on their capacity to assess FPIC quality beyond procedural compliance.
- Design inclusive market architectures by standardizing tiered certification systems, grouped project structures, ex-ante payment mechanisms, and bilingual documentation requirements across major voluntary carbon market programs.
- Gender-transform verification processes by embedding gender-disaggregated indicators, women's representation in governance structures, and explicit gender equity audits as mandatory rather than recommended verification elements.
- Scale ILK integration by developing specific protocols for the ethical integration of indigenous knowledge into monitoring and verification systems, including intellectual property protections and ILK-holder remuneration frameworks.

- Build national-international registry bridges enabling project data generated through national frameworks such as the PNNV to be recognized for international credit issuance, reducing transaction costs for biodiversity-rich developing countries.
- Align CCP uptake with NDC implementation by embedding CCP-aligned carbon credit procurement requirements into national NDC implementation strategies, creating domestic demand signals that incentivize high-integrity supply and channel climate finance to conservation outcomes.

Conflicts of Interest

The authors declare no conflicts of interest.

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