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Conceptual Model for Payment for Ecosystem Services Incentive Design

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Abstract

Payment for Ecosystem Services (PES) has emerged as a central mechanism to incentivize the protection, restoration, and sustainable management of ecosystems. However, the effectiveness of PES programs depends heavily on the design of incentive structures that align ecological objectives with the preferences, behaviors, and constraints of diverse stakeholders. This study develops a Conceptual Model for Payment for Ecosystem Services Incentive Design, integrating economic, ecological, and behavioral perspectives. The model recognizes that PES is not merely a financial transaction but a complex arrangement shaped by ecological priorities, institutional frameworks, and socio-cultural contexts. It outlines four interconnected components: (1) Ecosystem service valuation, establishing measurable ecological outcomes and their relative importance; (2) Stakeholder analysis, identifying service providers, beneficiaries, and intermediaries while capturing heterogeneity in land tenure, resource dependence, and local knowledge; (3) Incentive mechanism design, encompassing direct payments, in-kind transfers, tiered schemes, or performance-based rewards that account for opportunity costs and risk-sharing; and (4) Enabling conditions, including legal frameworks, monitoring systems, transparency, and trust-building processes that sustain long-term participation. Importantly, the model incorporates behavioral economics by highlighting how fairness perceptions, social norms, and framing of incentives influence compliance and participation beyond pure monetary value. It also addresses trade-offs between efficiency, equity, and ecological effectiveness, proposing pathways to balance these dimensions. Policy implications suggest that PES programs must move beyond "one-size-fits-all" approaches and instead adopt flexible, context-specific designs that foster inclusivity, resilience, and adaptive learning. Practical applications include using the model as a decision-support tool for policymakers, conservation agencies, and development partners when tailoring incentive schemes to local conditions. By synthesizing multiple perspectives, the conceptual model advances theoretical understanding of PES incentive structures and provides a foundation for empirical testing. Ultimately, it seeks to enhance the durability and legitimacy of PES programs, ensuring that conservation incentives not only secure ecosystem services but also strengthen social-ecological systems in the face of environmental change.

Keywords: Payment for Ecosystem Services, Incentive Design, Ecosystem Valuation, Stakeholder Analysis, Behavioral Economics, Equity, Ecological Effectiveness, Conservation Policy, Adaptive Management, Sustainability

1. Introduction

Ecosystem services are the life-support systems of the planet, providing clean air, water purification, soil fertility, climate regulation, pollination, and cultural benefits that underpin human well-being and economic development. Yet these services are often undervalued in conventional markets and subject to degradation due to overexploitation, land-use change, and insufficient governance. Recognizing their global importance has led to increasing efforts to design mechanisms that create incentives for their protection. Payment for Ecosystem Services (PES) has emerged as a prominent policy instrument to address this gap by linking those who provide ecosystem services with those who benefit from them. The idea is to reward landholders, farmers, or communities for managing land and resources in ways that sustain ecosystem functions, thereby aligning private incentives with public environmental goals (Eyinade, Ezeilo & Ogundeji, 2020, Ofodile, *et al*., 2020).

The rationale for PES rests on its potential to create a direct connection between conservation actions and economic benefits,

offering a flexible, market-based complement to regulatory approaches. By compensating individuals or groups for ecosystem stewardship, PES aims to overcome the problem of externalities that has long hindered sustainable resource management. It can also promote co-benefits, including rural livelihoods, biodiversity protection, and climate resilience. However, traditional PES designs have often struggled to achieve these outcomes consistently. Programs may face limited participation when payments do not match opportunity costs, or when institutional trust is weak (Abass, Balogun & Didi, 2020, Balogun, Abass & Didi, 2020). Equity concerns also arise when benefits accrue disproportionately to wealthier landholders while marginalized groups are excluded. Furthermore, sustainability is undermined when PES schemes focus on short-term transactions without embedding conservation behavior into long-term practices or broader socio-ecological systems (Addison, *et al*., 2013, Von Schomberg, 2019).

Against this backdrop, there is a pressing need for a conceptual model that guides the design of PES incentives in ways that are more equitable, effective, and durable. The model proposed in this work emphasizes integrating ecological priorities, stakeholder heterogeneity, and behavioral insights into incentive structures. It seeks to move beyond narrow financial approaches by considering social norms, perceptions of fairness, and enabling institutional conditions (Adger, 2010, Van Rijn, Bulte & Adekunle, 2012). In doing so, it provides a framework for crafting PES programs that are context-specific, inclusive, and capable of balancing ecological effectiveness with economic efficiency and social legitimacy. This conceptual model contributes not only to theoretical debates but also offers practical pathways for policymakers, conservation agencies, and communities seeking to secure ecosystem services for present and future generations (Eyinade, Ezeilo & Ogundeji, 2022, Omowole, *et al*., 2022).

2.1 Methodology

The study adopts a design-science and participatory modeling approach to build a conceptual model for Payment for Ecosystem Services (PES) incentive design that is behaviorally precise, equity-aware, and operationally tractable. We begin with context scoping to align ecological goals with policy priorities and landscape constraints while embedding model credibility and decision usefulness from the outset through iterative engagement with implementers and rightsholders. We map stakeholders and social capital structures to identify bridging actors and collective-action capacities that condition enrolment, monitoring, and compliance. We establish a biophysical and socioeconomic baseline of priority ecosystem services and opportunity costs, then construct a farmer typology using behavioral segmentation and analytics to capture heterogeneity in risk preferences, norms, liquidity constraints, and channel access. This segmentation borrows targeting, churn-risk, and messaging insights from CRM/AI literature to anticipate adoption frictions and tailor incentive menus. Co-design workshops translate these insights into incentive options and choice architecture e.g., fixed vs. performance-based payments, upfront vs. staggered disbursements, non-monetary rewards, and community bonuses explicitly testing for motivation crowding, fairness perceptions, and transaction costs. Contract prototypes specify eligibility, practices, MRV metrics, and payment schedules, with grievance pathways and adaptive clauses to mitigate uncertainty. A lightweight data infrastructure integrates field MRV (including remote sensing/IoT where feasible) with beneficiary registries and a dashboard for real-time feedback, transparency, and A/B testing of incentive variants. Pilots are executed using multi-arm, adaptive designs; interim analyses update priors on uptake, additionality, leakage, and permanence, while diagnosing equity effects by gender and tenure. Governance mechanisms, including bridging institutions and dispute resolution, are operationalized to support trust and reduce enforcement costs. Payments are released contingent on verified outcomes using clear MRV protocols and affordable audit rules. Impact evaluation combines quasi-experimental comparisons and behavioral diagnostics to quantify ecosystem outcomes, welfare effects, and any intrinsic motivation crowding; qualitative sense-making sessions reconcile model outputs with lived experience and mental models. Learning loops update incentive parameters, targeting rules, and communication scripts; successful configurations scale through cross-market replication while preserving participatory design, responsible-innovation principles, and safeguards for vulnerable groups. Throughout, the process integrates lessons on making models indispensable to decisions, PES effectiveness and political economy, responsible innovation, farmer decision drivers, and social-capital-enabled cooperation, ensuring both ecological additionality and durable participation.

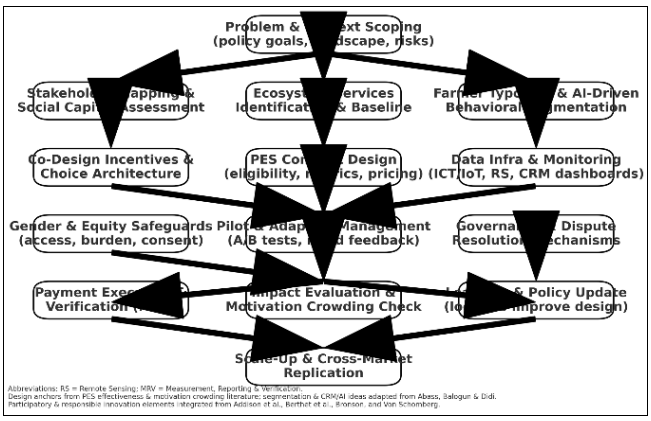

Fig 1: Flowchart of the study methodology

2.2 Theoretical Foundations

The theoretical foundations of a conceptual model for Payment for Ecosystem Services (PES) incentive design rest upon an integration of economic reasoning, ecological science, and behavioral and social insights. These foundations provide the intellectual scaffolding for understanding why PES schemes are necessary, how they should be structured, and what factors determine their long-term success or failure. PES emerged from a recognition that ecosystem services, though fundamental to human well-being, are typically treated as externalities in market systems. They are rarely priced, often undervalued, and as a result, prone to degradation and overuse (Avolio, 2017, Venkateswaran, *et al*., 2018). Designing effective PES programs requires frameworks that acknowledge not only the economic logic of aligning incentives but also the ecological realities of service provision and the behavioral and social dynamics that shape participation, fairness, and

trust. Together, these foundations create a holistic model for incentive design that bridges technical efficiency with social legitimacy (Lawrencea, *et al*., 2021, Umoren, *et al*., 2021).

The economic principles underlying PES are critical to understanding its rationale and mechanics. At its core, PES is designed to improve efficiency by internalizing the externalities associated with ecosystem services. When ecosystems provide services such as carbon sequestration, watershed regulation, or biodiversity protection, these benefits extend to society at large but are not captured in individual land-use decisions. Without intervention, farmers or landholders may prioritize short-term profits from deforestation or intensive agriculture over long-term ecosystem health. PES corrects this by creating financial flows from beneficiaries to providers, aligning private incentives with public goods (Umoren, *et al*., 2022). Opportunity costs represent another key principle in economic theory that informs PES design. For landholders to participate, payments must at least cover the foregone benefits of alternative land uses, such as farming or logging. If payments are too low, participation will be limited; if too high, they may lead to inefficiency by overcompensating providers. Opportunity cost analysis therefore provides a baseline for setting payment levels that are both attractive and cost-effective. Additionality further sharpens the economic foundation by ensuring that PES schemes deliver conservation benefits that would not have occurred in the absence of payments. A PES program that pays for practices already in place creates no net environmental gain and risks wasting resources (Awuor & Otanga, 2019, Vignola, *et al*., 2010). The concept of additionality thus requires careful baselines and monitoring to ensure that payments drive real change rather than simply rewarding existing behavior. Efficiency, opportunity costs, and additionality together provide the economic logic that underpins PES and guides decisions on payment size, targeting, and conditionality (Bailey & Ngwenyama, 2010, Von Schomberg, 2013).

While economic principles establish the rationale for PES, ecological foundations determine which services should be prioritized and how schemes can achieve genuine environmental outcomes. Ecosystem services are broadly categorized into provisioning, regulating, cultural, and supporting services, each with its own ecological dynamics and challenges for PES design. Provisioning services include tangible outputs such as timber, water, or genetic resources. These services are often already embedded in markets, but PES can still play a role in ensuring their sustainable supply, such as through certification programs that reward sustainable timber harvesting (Didi, Abass & Balogun, 2021, Umoren, *et al*., 2021). Regulating services, such as climate regulation through carbon sequestration or flood control through wetlands, are particularly well-suited for PES because their benefits extend broadly to society but are rarely valued in conventional markets. For example, carbon markets represent large-scale PES mechanisms where payments incentivize landholders to conserve forests or restore degraded lands. Cultural services, including spiritual, aesthetic, and recreational values, present unique challenges for PES design because they are less tangible, harder to measure, and often deeply tied to local identities. Nonetheless, ecotourism schemes or community-based conservation initiatives demonstrate that PES can be structured to reward communities for preserving landscapes with cultural and recreational value (Berthet, *et al*., 2016, Van Hecken & Bastiaensen, 2010). Supporting services, such as nutrient cycling, soil formation, and pollination, underpin all other services but are often indirect and difficult to monetize. Nonetheless, PES schemes that incentivize habitat conservation for pollinators or practices that improve soil health can be designed to protect these vital functions (Balogun, Abass & Didi, 2023, Didi, Abass & Balogun, 2023). Recognizing the ecological basis of PES ensures that incentive design is grounded in ecological science, with clear links between land-use practices, service provision, and measurable environmental outcomes. Without this ecological grounding, PES risks becoming an abstract financial exercise disconnected from its ultimate goal of sustaining ecosystems. Figure 2 shows figure of payments for ecosystem services: an instrument to balance the environmental and human welfares of farm household systems presented by Li, *et al*., 2018.

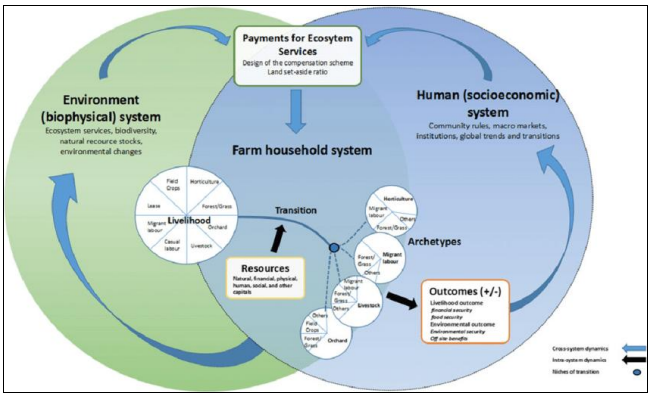

Fig 2: Payments for ecosystem services: an instrument to balance the environmental and human welfares of farm household systems (Li, *et al*., 2018)

In addition to economic and ecological principles, behavioral economics and social science insights form a crucial pillar of PES theory. Traditional models assume that landholders are rational actors who respond predictably to financial incentives. However, research shows that decisions are shaped by perceptions of fairness, trust in institutions, and social norms. These behavioral and social factors can significantly affect participation and compliance in PES schemes. Fairness perceptions influence whether payments are viewed as legitimate and acceptable. For example, if wealthier landowners receive the bulk of payments while marginalized groups are excluded, communities may perceive the scheme as unjust, undermining its credibility and long-term viability (Obadimu, *et al*., 2021, Umoren, *et al*., 2021). Designing PES with attention to distributive fairness ensuring that benefits are equitably shared and procedural fairness ensuring that decision-making processes are transparent and inclusive can therefore enhance legitimacy and participation (Börner, *et al*., 2017, Tsolakis, Bechtsis & Bochtis, 2019).

Trust is another key behavioral element. Landholders must trust that payments will be delivered reliably, that monitoring will be fair, and that institutional frameworks will remain stable. In contexts where governments or organizations have a history of broken promises, mistrust can deter participation even if financial incentives are attractive. Building trust requires consistent delivery, transparency, and meaningful engagement with local communities. Social norms also play a powerful role. In

many rural contexts, decisions are not made solely by individuals but are embedded within collective practices and community expectations. If conservation is viewed as aligned with community values, participation in PES may be high, even with modest payments (Umoren, *et al*., 2023). Conversely, if conservation is perceived as imposed by outsiders, it may generate resistance. Leveraging positive social norms by highlighting role models, fostering peer-to-peer learning, and framing conservation as a collective responsibility can strengthen adoption and compliance. Behavioral economics also highlights cognitive biases that shape responses to PES. Loss aversion may make landholders reluctant to give up familiar practices, even when payments compensate for losses. Time discounting may cause individuals to undervalue long-term ecosystem benefits relative to immediate returns (Botha, *et al*., 2014, Thapa & Shrestha, 2019). Ambiguity aversion may deter participation if outcomes are uncertain. Recognizing these tendencies allows for the design of interventions that nudge behavior in positive directions, such as framing payments as risk-reduction strategies rather than uncertain gains. Figure 3 shows models for payments for ecosystem services (PES), including their explicit and implicit distribution of responsibilities proposed by Chan, *et al*., 2017.

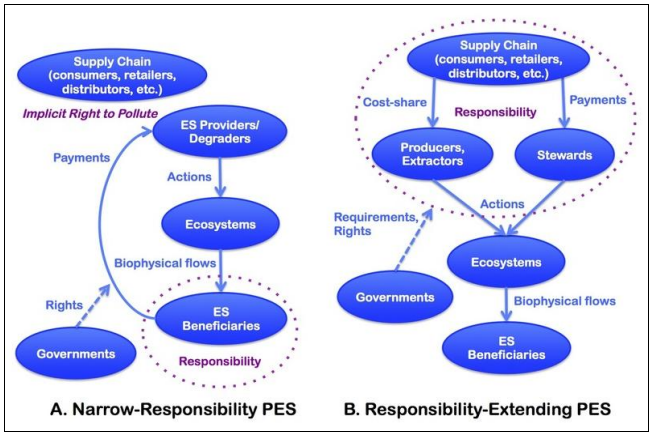

Fig 3: Models for payments for ecosystem services (PES), including their explicit and implicit distribution of responsibilities (Chan, *et al*., 2017)

Integrating these three theoretical foundations economic principles, ecological science, and behavioral and social insights creates a robust conceptual model for PES incentive design. Economics provides the rationale and criteria for efficiency, opportunity cost coverage, and additionality. Ecology ensures that incentives are linked to real and measurable environmental outcomes across provisioning, regulating, cultural, and supporting services. Behavioral and social science grounds the model in human realities, emphasizing fairness, trust, and norms as key determinants of participation (Eyinade, Ezeilo & Ogundeji, 2021, Ogundeji, *et al*., 2021). Together, these foundations move PES beyond simplistic financial mechanisms toward holistic, context-specific designs that balance efficiency, equity, and sustainability.

This integration also highlights the interdependence of these foundations. For instance, a program that is economically efficient but fails to account for fairness may face resistance and collapse. Similarly, a scheme that is ecologically sound but disregards behavioral dynamics may struggle with participation and compliance (Braito, *et al*., 2019, Taptiklis, 2011). Conversely, programs that blend economic efficiency with ecological validity and social legitimacy are more likely to succeed in delivering sustained conservation outcomes. The conceptual model therefore contributes not only to academic debates but also to practical policymaking, offering a comprehensive framework for designing PES programs that are effective, inclusive, and resilient (Abass, Balogun & Didi, 2020, Eyinade, Ezeilo & Ogundeji, 2020).

In conclusion, the theoretical foundations of PES incentive design rest on a triad of principles that together provide a holistic understanding of how to link conservation with economic incentives. Economic principles ensure efficiency and accountability, ecological science ensures that incentives translate into real environmental benefits, and behavioral and social insights ensure that programs resonate with human realities. By integrating these dimensions, the conceptual model provides a pathway for designing PES schemes that not only protect ecosystems but also enhance social equity and trust, thereby securing the long-term sustainability of conservation efforts (Balogun, Abass & Didi, 2021, Omokhoa, *et al*., 2021).

2.3 Core Components of the Conceptual Model

The core components of a conceptual model for Payment for Ecosystem Services (PES) incentive design reflect the integration of ecological science, economic reasoning, and social legitimacy into a coherent framework that ensures sustainability, effectiveness, and fairness. For PES to achieve its dual goals of conserving ecosystems and improving human well-being, it must move beyond narrow transactional perspectives and embrace a systems-oriented design (Bronson, 2018, Tambo & Wünscher, 2018). This involves valuing ecosystem services appropriately, conducting thorough stakeholder analysis, carefully structuring incentive mechanisms, and creating enabling conditions that ensure long-term viability. Each component is indispensable and interdependent, providing the scaffolding that allows PES programs to align ecological priorities with social needs and institutional realities (Ewim, *et al*., 2021, Umoren, *et al*., 2021).

At the foundation of any PES scheme lies ecosystem service valuation. Without identifying and quantifying services, it is impossible to create incentives that reflect their true value. Valuation requires a mix of ecological, economic, and social methodologies. Ecological assessments identify services such as watershed regulation, biodiversity conservation, or carbon sequestration, and measure their outputs through biophysical indicators like water quality, forest cover, or soil fertility. Economic valuation translates these services into monetary terms using approaches such as contingent valuation, avoided cost, or willingness-to-pay surveys (Balogun, Abass & Didi, 2023). Social valuation adds further nuance by recognizing non-monetary values, such as cultural and spiritual connections to landscapes. Together, these methods ensure that PES programs are grounded in accurate, context-specific assessments of service provision. The challenge, however, is balancing ecological priorities with stakeholder needs. Conservation science may highlight carbon storage as the most critical priority at a global scale, but local communities may prioritize clean water or fertile soils. A strong PES model therefore requires participatory valuation processes where stakeholders articulate their priorities and negotiate trade-offs. By aligning global ecological imperatives with local livelihood concerns,

valuation becomes a tool not only for measuring services but also for ensuring legitimacy and inclusivity in incentive design (Call & Sellers, 2019, Steede, 2018).

Stakeholder analysis represents the second critical component of the model. Ecosystem services involve multiple actors, including service providers, beneficiaries, and intermediaries. Service providers are often landholders, farmers, or indigenous communities whose land-use decisions directly affect ecosystem functions. Beneficiaries include local communities relying on water quality, downstream users such as cities or industries, or global actors benefiting from carbon sequestration. Intermediaries such as NGOs, governments, and development agencies play facilitative roles, channeling funds, designing contracts, and building institutional trust. A robust PES scheme requires mapping these actors, clarifying their roles, and addressing their interests. Importantly, stakeholder analysis must account for heterogeneity in land tenure, dependence on resources, and cultural values (Ojurongbe, 2017, Didi, Abass & Balogun, 2019). Land tenure insecurity, for instance, can prevent smallholders from participating, as they may lack formal rights to enter into contracts. Dependence on resources also varies: wealthier landowners may have the capacity to adopt conservation practices without significant hardship, while marginalized groups may face greater opportunity costs (Carroll & Groarke, 2019, Six, *et al*., 2015). Cultural values further shape engagement; practices that resonate with traditions of stewardship may be more readily adopted than those perceived as externally imposed. Recognizing this heterogeneity ensures that PES does not exacerbate inequalities but instead creates inclusive pathways for diverse stakeholders to participate and benefit. Figure 4 shows the conceptual framework of incentives and disincentives for ecosystem services presented by Wainaina, *et al*., 2021.

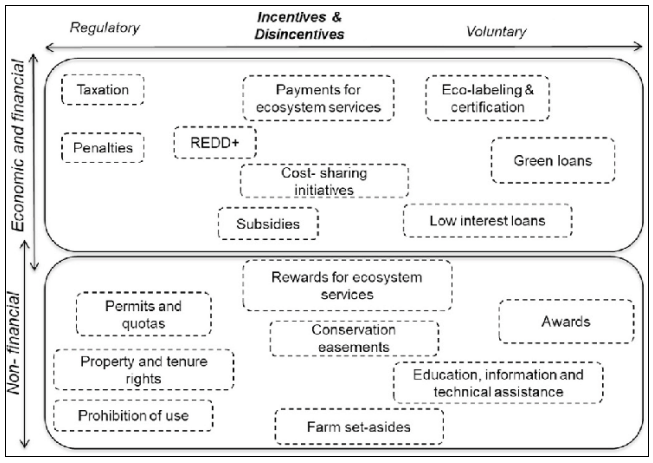

Fig 4: Conceptual framework of incentives and disincentives for ecosystem services (Wainaina, *et al*., 2021)

The third component of the model is incentive mechanism design. The central premise of PES is to create incentives that make conservation an attractive option relative to unsustainable land use. Mechanisms can take various forms. Direct payments provide financial compensation for specific conservation actions, such as maintaining forest cover or restoring wetlands. In-kind benefits include providing agricultural inputs, infrastructure, or technical support in exchange for conservation commitments (Umoren, *et al*., 2022). Tiered or performance-based incentives reward higher levels of service provision, aligning payments with ecological outcomes rather than merely prescribed actions. This design acknowledges that not all conservation activities generate equal benefits and that differentiation can improve efficiency. Effective incentive design must also account for opportunity costs, risks, and trade-offs. Payments must at least cover the benefits foregone from alternative land uses, such as farming or logging, or they risk failing to attract participation. At the same time, overcompensation can create inefficiency or dependency. Risks such as crop failure during conservation transitions or fluctuating market demand for ecosystem service credits must also be addressed through mechanisms like insurance or price stabilization (Cawley, 2018, Sebuliba-Mutumba, Kibwika & Kyazze, 2017). Trade-offs are inevitable, as prioritizing one ecosystem service may reduce another; for example, promoting tree planting for carbon storage might reduce water availability downstream. By incorporating flexible and context-specific incentive structures, PES models can mitigate these risks while ensuring that conservation remains both economically viable and ecologically sound.

The fourth component, enabling conditions, underpins the effectiveness and sustainability of PES programs. Even well-designed incentives will falter without strong institutional frameworks, legal support, and governance structures. Institutions are required to administer contracts, enforce compliance, and resolve disputes. Legal frameworks clarify property rights, establish enforceable obligations, and provide legitimacy to agreements. Governance structures ensure that power is balanced among stakeholders and that marginalized groups are not excluded. Monitoring, reporting, and verification (MRV) systems are equally vital (Elumilade, *et al*., 2022, Ogundeji, *et al*., 2022). They ensure that payments are conditional on actual service provision rather than promises or assumptions. MRV systems rely on ecological indicators, remote sensing technologies, and participatory monitoring to provide credible evidence of conservation outcomes. Without such systems, PES risks devolving into rent-seeking arrangements that deliver little environmental benefit. Transparency, accountability, and trust-building mechanisms further reinforce enabling conditions (Chilemba & Ragasa, 2018, Schut, *et al*., 2016). Transparent decision-making processes, clear communication of rules, and equitable distribution of benefits create legitimacy and encourage compliance. Trust-building is particularly important in contexts where communities have experienced exploitation or neglect by institutions. When stakeholders trust that payments will be delivered reliably and that commitments will be respected, participation increases and PES becomes embedded within local governance systems.

These four components ecosystem service valuation, stakeholder analysis, incentive mechanism design, and enabling conditions are interdependent and mutually reinforcing. A PES program that values services accurately but neglects stakeholder heterogeneity risks excluding marginalized groups. A program that designs sophisticated incentive mechanisms but lacks institutional credibility may fail in practice (Eyinade, Ezeilo & Ogundeji, 2022, Ogundeji, *et al*., 2022). Conversely, enabling conditions without proper valuation or incentive design may result in inefficient or inequitable outcomes. The conceptual model therefore emphasizes that success depends on integrating all components into a coherent whole. For instance, accurate

valuation informs the scale of payments, while stakeholder analysis ensures inclusivity in their distribution. Incentive design aligns economic and ecological goals, and enabling conditions provide the institutional support to sustain commitments over time.

The strength of this model lies in its adaptability. Different ecosystems and communities face unique challenges, and PES must be flexible enough to address them. In some cases, direct payments may be the most appropriate mechanism, while in others, in-kind benefits or performance-based tiers may work better. In regions with insecure land tenure, policies may need to prioritize legal reforms before PES can function effectively. Where trust in institutions is low, community-based governance structures may be more appropriate than centralized systems (Umoren, *et al*., 2023). By treating the four components as guiding principles rather than rigid prescriptions, the conceptual model allows PES to be tailored to diverse contexts while maintaining coherence and integrity.

In conclusion, the core components of a conceptual model for PES incentive design highlight the multifaceted nature of linking conservation with human livelihoods. Valuing ecosystem services ensures that incentives are grounded in ecological and economic realities. Stakeholder analysis ensures inclusivity and addresses heterogeneity in land, resources, and cultural values. Incentive mechanism design creates pathways for conservation to become economically attractive and socially legitimate, while enabling conditions ensure that programs are credible, transparent, and sustainable. Together, these components provide a comprehensive framework for designing PES programs that are effective, equitable, and durable (Abass, Balogun & Didi, 2023, Ogundeji, *et al*., 2023). They move PES beyond isolated transactions toward integrated systems of governance that recognize the interdependence of ecological health, economic viability, and social justice. By building on these components, PES can fulfill its promise as a powerful tool for protecting ecosystems and enhancing human well-being in the face of growing global environmental challenges (Clement, *et al*., 2019, Rutherford, *et al*., 2016).

2.4 Behavioral and Social Dimensions

The behavioral and social dimensions of a conceptual model for Payment for Ecosystem Services (PES) incentive design are fundamental for understanding why such programs succeed in some contexts but falter in others. While economic logic and ecological science provide strong justification for PES, they cannot by themselves explain the complexities of human participation, compliance, and long-term commitment. Farmers, landholders, and communities do not act solely as rational agents maximizing financial returns; their decisions are influenced by perceptions of fairness, expectations of reciprocity, social norms, networks, and the way incentives are framed and communicated. Recognizing these behavioral and social dimensions is therefore crucial to developing PES programs that are not only technically efficient but also socially legitimate and resilient over time (Didi, Abass & Balogun, 2019).

Fairness perceptions and reciprocity play a central role in shaping attitudes toward PES schemes. People care not only about the size of payments but also about how benefits and responsibilities are distributed. If payments are perceived as inequitable for instance, if wealthier landowners receive larger compensation while poorer smallholders receive little or none then communities may resist participation, even when aggregate conservation goals are met. Fairness is both distributive, concerning the actual allocation of benefits, and procedural, concerning the transparency and inclusiveness of decision-making. Programs that consult local communities, allow input into rules, and ensure representation of marginalized groups are more likely to be perceived as legitimate (Umoren, *et al*., 2022). Reciprocity is closely tied to fairness, as many communities have deeply ingrained cultural expectations that benefits should be shared and obligations respected. In PES, reciprocity might manifest as an expectation that if landholders comply with conservation requirements, institutions must reliably deliver payments and support. When reciprocity breaks down such as when payments are delayed or conservation outcomes are questioned without evidence trust erodes, leading to withdrawal or non-compliance. Designing PES to align with fairness and reciprocity, therefore, is not only ethically important but also instrumental in sustaining participation (Cranford, 2014, Rose & Chilvers, 2018).

Social norms, networks, and collective action represent another vital dimension. PES programs are rarely experienced in isolation by individuals; they are embedded in communities where social learning, peer influence, and collective values shape decisions. Social norms define what behaviors are considered acceptable, desirable, or legitimate. If conserving forests is widely viewed as a community responsibility, individuals may adopt practices even with modest incentives, because compliance reinforces belonging and social approval. Conversely, if conservation is seen as an externally imposed burden, social norms may discourage participation, regardless of payments (Didi, Abass & Balogun, 2022, Eyinade, Ezeilo & Ogundeji, 2022). Networks also matter because information about PES its benefits, risks, and requirements often travels through social ties rather than formal channels. Trusted peers, respected leaders, and community organizations can validate information and reduce uncertainty, encouraging participation. Collective action extends this dynamic further, as ecosystem services are often shared resources requiring coordination. For example, watershed protection may only be effective if multiple upstream farmers participate. PES schemes that recognize and foster collective action, such as through group contracts or community-level rewards, can create synergies that individual payments alone might not achieve. In this sense, the social dimension of PES highlights that adoption and compliance are not purely individual choices but are shaped by the dynamics of community trust, cohesion, and cooperation (Daloğlu, *et al*., 2014, Rossing, *et al*., 2010).

The framing of incentives is equally significant in encouraging compliance and long-term adoption. Behavioral economics shows that how information is presented can influence decisions as much as the content itself. Farmers may respond differently depending on whether conservation practices are framed as risk-reduction strategies, opportunities for future generations, or obligations to external authorities. Framing payments as a means of protecting livelihoods against climate shocks, for example, may resonate more strongly than presenting them as mere financial compensation (Eyinade, Ezeilo & Ogundeji, 2021, Umoren, *et al*., 2021). Similarly, emphasizing co-benefits such as improved water quality, healthier soils, or diversified incomes can create a more compelling narrative

for adoption. Framing can also reduce cognitive barriers by simplifying complex requirements into clear and relatable messages. Long-term adoption depends not only on initial compliance but also on embedding conservation practices into everyday routines and identities. If incentives are framed in ways that connect to cultural values, traditions of stewardship, or intergenerational responsibilities, they are more likely to foster enduring behavioral change. Conversely, if PES is framed solely as a transactional exchange, participants may abandon conservation once payments cease, undermining sustainability (Davis, *et al*., 2010, Rose, Keating & Morris, 2018).

These behavioral and social dimensions also interact in complex ways. Perceptions of fairness influence how incentives are interpreted, which in turn affects whether social norms support or undermine compliance. If community members perceive that only a few benefit from PES, social cohesion may weaken, discouraging collective action. Conversely, when programs are transparent and inclusive, fairness reinforces positive norms and reciprocity, building trust and collective ownership (Ogundeji, *et al*., 2023, Omowole, *et al*., 2023). Networks amplify these dynamics by spreading information and validating experiences. Framing strategies can either enhance or damage these relationships depending on whether they resonate with community values or appear manipulative. The conceptual model thus emphasizes that behavioral and social dimensions are not peripheral but integral to how PES functions in practice.

For policy and program design, these insights highlight several implications. First, fairness must be embedded into the structure of payments and processes. This requires participatory approaches to define eligibility, set payment levels, and design monitoring mechanisms. Inclusive governance, where marginalized groups such as women or indigenous communities are represented, ensures procedural fairness. Second, reciprocity must be reinforced through consistent delivery of payments and transparent accountability from both institutions and participants. Mechanisms for grievance redress and conflict resolution are essential to sustaining trust (Eyinade, Ezeilo & Ogundeji, 2022, Omowole, *et al*., 2022). Third, leveraging social norms and networks means identifying and empowering community leaders, promoting peer-to-peer learning, and fostering group contracts where collective responsibility strengthens outcomes. Fourth, careful framing of incentives should emphasize risk reduction, co-benefits, and cultural resonance rather than narrow financial exchanges. Communication should avoid technical jargon and instead use locally meaningful narratives that connect with farmers' priorities and values (De Hoop, Pols & Romijn, 2016, Vuillot, *et al*., 2016).

In the long run, the integration of behavioral and social dimensions into PES incentive design enhances both legitimacy and durability. Programs that fail to address fairness, trust, and norms may achieve short-term compliance but collapse when payments end or when participants lose confidence. Programs that succeed embed conservation into community values and practices, ensuring continuity even if incentives change. For example, a community that sees watershed protection not only as a paid service but as a collective responsibility reinforced by norms of reciprocity is more likely to sustain conservation practices. Behavioral and social considerations therefore provide the bridge between economic efficiency and ecological sustainability, ensuring that PES programs achieve their intended outcomes while empowering communities (Eyinade, Ezeilo & Ogundeji, 2025, Ogundeji, *et al*., 2023).

In conclusion, the behavioral and social dimensions of PES incentive design highlight the critical role of fairness, reciprocity, social norms, networks, collective action, and framing in shaping participation and compliance. These dimensions move PES beyond a narrow financial instrument toward a holistic approach that aligns incentives with human values and community dynamics. Fairness ensures legitimacy, reciprocity sustains trust, social norms and networks foster collective responsibility, and framing strategies embed conservation into cultural and livelihood priorities. Together, they create conditions for compliance that is not only voluntary but also enduring, making PES a more powerful and sustainable tool for safeguarding ecosystems and human well-being (Umoren, *et al*., 2022).

2.5 Balancing Key Trade-offs

Balancing key trade-offs is one of the most challenging yet essential aspects of designing a conceptual model for Payment for Ecosystem Services (PES). While the logic of PES rests on creating incentives for conservation, the actual implementation requires navigating tensions between efficiency and equity, reconciling short-term outcomes with long-term sustainability, and managing the delicate balance between local autonomy and centralized control. These trade-offs are not simply technical challenges but deeply social and political choices that determine whether PES programs can gain legitimacy, attract participation, and endure over time (Didi, Abass & Balogun, 2022, Eyinade, Ezeilo & Ogundeji, 2022).

The first major trade-off lies between efficiency and equity in incentive distribution. From a purely economic perspective, efficiency suggests that resources should be allocated in ways that maximize environmental outcomes per unit of investment. This often translates into targeting areas with the greatest ecosystem service potential or engaging actors who can deliver services at the lowest cost. However, such efficiency-driven targeting may inadvertently exclude marginalized groups, particularly smallholders, indigenous communities, or those with insecure land tenure. Equity considerations demand that benefits be distributed fairly, ensuring that vulnerable groups are not excluded and that participation is inclusive (Balogun, Abass & Didi, 2020, Didi, Abass & Balogun, 2020). Balancing these objectives requires acknowledging that a purely efficient allocation may generate ecological gains but undermine social legitimacy, while an equity-focused allocation may secure broad participation but deliver fewer immediate environmental outcomes (McKune, *et al*., 2015, Meinzen-Dick, *et al*., 2011). The model suggests that the best designs recognize this tension and strive for a middle ground for instance, by blending targeted interventions in high-priority ecological areas with broader programs that ensure inclusivity and fairness. This balance enhances not only legitimacy but also long-term effectiveness, as equity fosters trust and cooperation, which in turn sustain conservation practices (de Krom, 2017, Rocha, 2017, Ziervogel, *et al*., 2014).

The second trade-off involves short-term conservation outcomes versus long-term sustainability. Many PES

programs are designed to deliver rapid ecological gains, such as halting deforestation, improving water quality, or sequestering carbon within a fixed timeframe. Such short-term focus is attractive to donors, policymakers, and beneficiaries who seek measurable impacts. Yet conservation is inherently a long-term endeavor, and incentives that focus only on immediate outcomes risk creating dependency or encouraging temporary compliance. Once payments end, participants may revert to unsustainable practices if deeper behavioral and institutional changes have not taken root (Eyinade, Ezeilo & Ogundeji, 2021, Umoren, *et al*., 2021). Long-term sustainability requires embedding conservation practices into local livelihoods, cultural norms, and governance structures, so that they persist beyond the life of financial incentives. The conceptual model emphasizes designing incentives that not only reward current actions but also build capacity, knowledge, and local ownership that promote continuity. For example, tiered payments that reward incremental ecological improvements over time or investments in community institutions that support ongoing stewardship can help reconcile the tension. By linking short-term payments to long-term strategies such as livelihood diversification or ecosystem restoration, PES can achieve both immediate impact and enduring sustainability (Denison, *et al*., 2015, Rivera, *et al*., 2019).

The third trade-off concerns local autonomy versus centralized control. Effective PES programs require governance mechanisms that ensure accountability, monitoring, and enforcement, which often leads to centralized structures controlled by governments, NGOs, or international agencies. Centralized control can bring consistency, credibility, and the resources necessary for large-scale implementation. Yet over-centralization risks alienating local communities, undermining their autonomy, and creating perceptions of external imposition. Local autonomy, on the other hand, empowers communities to design and manage PES schemes that reflect their priorities, knowledge, and cultural values (Balogun, Abass & Didi, 2022, Eyinade, Ezeilo & Ogundeji, 2022). Locally driven programs are often more legitimate and better adapted to context-specific realities, but they may face challenges in mobilizing resources, ensuring transparency, or delivering services at scale. Balancing these two poles requires hybrid governance arrangements where central institutions provide oversight, resources, and coordination, while local actors retain meaningful decision-making power. Such arrangements foster trust, enhance cultural legitimacy, and ensure that PES programs are both accountable and context-sensitive (Diakosavvas & Frezal, 2019, Reimer, *et al*., 2014).

These three trade-offs are deeply interconnected. Efficiency without equity may lead to rapid ecological gains but undermine social legitimacy, which ultimately compromises long-term sustainability. Similarly, programs that prioritize short-term outcomes without building local autonomy risk collapse once payments cease. Conversely, excessive emphasis on local autonomy without centralized coordination may produce equity but lose efficiency and accountability. The conceptual model recognizes these interdependencies and argues for integrated solutions that balance competing priorities rather than privileging one dimension at the expense of others (Balogun, Abass & Didi, 2022, Elumilade, *et al*., 2022).

In practice, balancing these trade-offs requires adaptive and participatory approaches. Efficiency and equity can be aligned by adopting differentiated payment schemes, where high-priority ecological areas receive larger incentives while marginalized groups are guaranteed access to baseline benefits. Short-term and long-term goals can be reconciled by linking immediate payments with investments in capacity building, education, and livelihood diversification. Local autonomy and centralized control can be balanced by developing multi-level governance systems that assign clear roles and responsibilities, with accountability mechanisms that prevent elite capture while respecting community decision-making (Balogun, Abass & Didi, 2021, Didi, Abass & Balogun, 2021).

Ultimately, the capacity of PES programs to deliver meaningful outcomes rests on how well they navigate these trade-offs. No design can eliminate tensions completely, but by acknowledging them and integrating mechanisms to balance competing goals, PES can move beyond short-term projects toward enduring systems of ecosystem governance (Duckett, *et al*., 2018, Reddy, *et al*., 2017). The conceptual model thus contributes not only to theory but also to practice by offering a roadmap for designing PES schemes that are efficient, equitable, sustainable, and legitimate. In doing so, it underscores that the success of PES is not determined solely by ecological science or financial design but by the social and political choices that mediate these trade-offs and shape how conservation is experienced by communities and institutions alike (Didi, Abass & Balogun, 2020).

2.6 Policy and Practice Implications

The policy and practice implications of a conceptual model for Payment for Ecosystem Services (PES) incentive design are far-reaching, reflecting the need to bridge theory with implementation in ways that are context-specific, adaptive, and inclusive. While PES has demonstrated strong potential to link ecological conservation with economic incentives, its real impact depends on how well it is tailored to local realities, how effectively it incorporates adaptive learning and feedback, and how different actors governments, NGOs, and the private sector collaborate to sustain it. Policies that embrace these dimensions are better positioned to overcome the limitations of earlier PES designs and establish systems that are ecologically effective, socially legitimate, and economically viable over the long term (Umoren, *et al*., 2021).

A critical policy implication of the model is the need for guidelines that tailor PES schemes to local contexts rather than relying on standardized, one-size-fits-all designs. Ecosystems, cultures, and economies vary dramatically across regions, and incentive mechanisms must reflect these differences if they are to gain legitimacy and encourage participation (Eastwood, Klerkx & Nettle, 2017, Rao, *et al*., 2019). Tailoring requires participatory processes that engage local stakeholders in defining ecosystem priorities, identifying service providers and beneficiaries, and designing payment structures. For instance, in communities where land tenure is insecure, PES schemes that rely on individual contracts may fail, whereas community-level agreements might prove more inclusive and effective (Adefila, *et al*., 2023, Eyinade, Ezeilo & Ogundeji, 2023). Similarly, in contexts where monetary incentives carry risks of dependency or social division, in-kind benefits such as agricultural inputs, infrastructure, or capacity building may resonate more strongly. Policymakers must therefore move

beyond narrow financial approaches and integrate local knowledge, values, and cultural traditions into PES design. This also means aligning global environmental priorities, such as carbon sequestration or biodiversity protection, with local needs such as water security, soil fertility, or livelihood stability. When PES schemes are locally grounded, they are more likely to secure buy-in, reduce resistance, and achieve both conservation and social objectives (Didi, Abass & Balogun, 2019, Umoren, *et al*., 2019).

Another implication lies in the integration of adaptive management and feedback mechanisms into PES policies and practices. Ecosystem services and human behaviors are dynamic, shaped by changing environmental conditions, economic pressures, and institutional contexts. PES schemes designed without flexibility risk becoming obsolete or ineffective over time. Adaptive management requires embedding monitoring and evaluation systems that track both ecological outcomes and social impacts, providing timely feedback for adjustments. For example, if a watershed PES program shows that payments are reducing deforestation but creating unintended inequities between landholders, adaptive mechanisms allow for recalibration of incentives to correct imbalances (Eastwood, *et al*., 2019, Ranjan, *et al*., 2019). Similarly, feedback loops that capture farmer experiences and perceptions can reveal behavioral barriers that might otherwise go unnoticed in purely ecological assessments. Adaptive PES design also means building in learning processes where programs evolve iteratively, incorporating lessons from both successes and failures. Policies should mandate regular reviews, encourage experimentation with different incentive mechanisms, and provide channels for stakeholder feedback. This adaptive approach reflects the complexity of socio-ecological systems and ensures that PES schemes remain relevant, effective, and resilient in the face of uncertainty and change (Martin-Ortega, Ojea & Roux, 2013, Yimeng, 2016).

The role of governments, NGOs, and private sector actors is another central policy and practice implication of the model. Governments are critical in establishing enabling frameworks for PES by clarifying land and resource rights, setting legal and regulatory standards, and providing long-term financial and institutional support. Without secure tenure and legal recognition of rights, landholders and communities cannot reliably engage in PES contracts (Li, *et al*., 2019, Mekonnen, *et al*., 2013). Governments also play a role in scaling PES beyond localized initiatives by integrating it into national policies for climate change mitigation, biodiversity conservation, or water management. NGOs, meanwhile, act as vital intermediaries, facilitating trust between communities and institutions, providing technical expertise, and ensuring that marginalized voices are included in decision-making (Ezzine-de-Blas, Corbera & Lapeyre, 2019, Zakaras, *et al*., 2017). Their role in building capacity, designing participatory processes, and delivering transparent communication is indispensable to PES legitimacy. Private sector actors are increasingly central, particularly in carbon markets, sustainable supply chains, and corporate social responsibility initiatives. They can provide funding, create demand for ecosystem services, and integrate PES into business models that align profitability with sustainability. However, private sector involvement must be carefully regulated to prevent elite capture or exploitative practices, ensuring that benefits are equitably shared. The interplay among governments, NGOs, and private sector actors is therefore essential: governments provide enabling conditions, NGOs ensure inclusivity and trust, and private actors bring innovation and financial resources (Lampkin, *et al*., 2015, Minh, *et al*., 2014).

These roles are not static but require collaboration and coordination. For instance, governments may set up national frameworks for carbon PES, NGOs may mobilize communities to participate, and private companies may purchase credits or provide payments. Such partnerships require clarity of responsibilities, transparency in transactions, and mechanisms for accountability. Policies should encourage multi-stakeholder platforms where actors collaborate in design, monitoring, and evaluation. These platforms foster dialogue, build trust, and allow for the negotiation of trade-offs among ecological, economic, and social priorities (Fankhauser & Schmidt-Traub, 2011, Wunder, 2015).

Taken together, these policy and practice implications highlight the importance of designing PES as more than just a financial transaction. Effective PES programs are embedded in social and institutional contexts, responsive to ecological and behavioral dynamics, and supported by multi-actor governance. Policies must recognize that conservation is not only about paying for services but about creating conditions where sustainable practices become attractive, legitimate, and enduring. This requires a combination of context-sensitive tailoring, adaptive learning, and cross-sectoral collaboration (Froehlich, 2019, Puzyreva & Roy, 2018).

In conclusion, the conceptual model for PES incentive design points to several critical policy and practice implications. First, PES must be tailored to local contexts, aligning ecological priorities with cultural values and livelihood needs, while ensuring inclusivity and fairness. Second, adaptive management and feedback mechanisms are essential for keeping PES schemes responsive to dynamic socio-ecological realities, allowing for iterative learning and recalibration (Lalani, *et al*., 2016, Mnimbo, *et al*., 2017). Third, the effective implementation of PES depends on coordinated roles for governments, NGOs, and private sector actors, each contributing unique strengths but working collaboratively within transparent and accountable frameworks. By embracing these implications, PES can move beyond isolated projects toward becoming a robust tool for sustainable ecosystem governance, capable of balancing ecological effectiveness with social legitimacy and economic viability (Gibbs, *et al*., 2012, Prokopy, *et al*., 2019).

2.7 Applications and Case Illustrations

Applications and case illustrations of a conceptual model for Payment for Ecosystem Services (PES) incentive design provide a practical lens through which theoretical components can be tested and refined. Both hypothetical and real-world examples highlight how valuation of ecosystem services, stakeholder analysis, incentive mechanisms, and enabling conditions interact to produce outcomes that vary across contexts. These applications also reveal lessons for scaling and replication in diverse ecosystems, demonstrating that while PES holds universal promise, its success depends on careful tailoring to social, ecological, and institutional realities (Gómez-Baggethun, *et al*., 2010, Willy & Holm-Müller, 2013).

One of the most frequently cited real-world applications is Costa Rica's pioneering national PES program. Initiated in the mid-1990s, this scheme compensated landowners for reforestation, forest conservation, and sustainable forest management, financed primarily through a fuel tax and later through international carbon markets. The program reflects the conceptual model by grounding incentives in ecosystem service valuation: forests were recognized as providing carbon sequestration, watershed protection, biodiversity habitat, and scenic beauty (Koutsou, Partalidou & Ragkos, 2014, Xin & Zazueta, 2016). Stakeholder analysis identified private landowners as service providers and national and international actors as beneficiaries. Incentive mechanisms were primarily direct payments, conditional on compliance with conservation contracts, while enabling conditions included strong institutional frameworks through the National Forestry Financing Fund (FONAFIFO). However, Costa Rica's case also revealed trade-offs. While the program successfully reduced deforestation and contributed to forest recovery, equity issues emerged because wealthier landowners with secure tenure were more likely to participate (Gremmen, Blok & Bovenkerk, 2019, Wilson, Lewis & Ackroyd, 2014). The lesson for scaling is that equity considerations must be integrated alongside efficiency, particularly in contexts where smallholders and indigenous groups are vulnerable.

Another instructive example is Mexico's national PES program, which placed stronger emphasis on equity and community-level engagement. Designed in the early 2000s, it targeted watersheds critical for urban water supplies and prioritized communities with high poverty levels. Payments were directed not only to individuals but also to ejidos, communal land-holding groups. This design reflected sensitivity to heterogeneity in land tenure and cultural values, creating stronger legitimacy and broader participation. Yet the program faced challenges in monitoring outcomes, raising questions about additionality. The Mexican case underscores the importance of balancing fairness with robust monitoring and verification systems, reminding practitioners that equity without ecological accountability risks undermining long-term credibility (Hellin, 2012, Pound & Conroy, 2017).

China's Sloping Land Conversion Program (SLCP) represents another large-scale real-world PES application. It paid farmers to retire steeply sloping cropland and plant trees or grasses, with the goal of reducing soil erosion and improving watershed protection. The program reached tens of millions of households, making it one of the largest PES efforts globally. Incentives were primarily in-kind (grain subsidies) and later direct cash payments, complemented by institutional support from central and local governments. The SLCP illustrates the power of centralized governance in scaling PES but also highlights risks of over-centralization (Hoeberling, 2016, Poteete, 2010). Farmers often participated out of obligation rather than voluntary choice, and when subsidies declined, many reverted to farming. This case shows the importance of ensuring local autonomy and embedding conservation in long-term livelihood strategies to avoid dependency and ensure sustainability beyond the life of payments.

Hypothetical applications of the conceptual model also reveal how PES might be adapted to emerging challenges. Consider a scenario in sub-Saharan Africa where upstream farmers are incentivized to adopt agroforestry practices to protect downstream water supplies for urban areas. Ecosystem service valuation would identify improved water quality, reduced sedimentation, and enhanced carbon sequestration as key benefits. Stakeholder analysis would reveal upstream farmers as service providers, urban water utilities and residents as beneficiaries, and NGOs as intermediaries facilitating contracts (James, *et al*., 2018, Pacifico Silva, *et al*., 2018). Incentive mechanisms might include direct payments funded through water tariffs, alongside in-kind support such as seedlings and training. Enabling conditions would require clear land tenure arrangements, transparent monitoring of water quality, and trust-building between rural and urban stakeholders. The hypothetical scenario shows how the conceptual model can guide design by integrating ecological priorities with stakeholder needs, while also addressing opportunity costs and risks (Kourgialas, *et al*., 2018, Muradian, 2013).

Another hypothetical example could involve coastal communities in Southeast Asia incentivized to protect mangrove forests that provide storm protection, fisheries habitat, and carbon sequestration. Here, valuation highlights both local and global benefits: coastal protection for local villages, fishery productivity for regional markets, and carbon sequestration for international climate commitments. Stakeholders include local fishers as service providers, downstream urban populations as beneficiaries, and international climate funds as intermediaries. Incentives might combine direct payments with investments in alternative livelihoods such as aquaculture or eco-tourism (Jirli, 2013, Owen, Swaisgood & Blumstein, 2017). Enabling conditions would require robust governance to prevent elite capture of benefits, as well as participatory monitoring that empowers local communities to track ecological outcomes. The case illustrates how PES can be designed to protect vulnerable ecosystems while addressing local livelihood needs, but also highlights the challenge of coordinating multiple beneficiaries across scales (Klerkx, Van Mierlo & Leeuwis, 2012, Wossen, Berger & Di Falco, 2015).

From these real and hypothetical examples, several lessons emerge for scaling and replication in diverse ecosystems. First, context matters profoundly. Costa Rica's success was enabled by secure land tenure, strong institutions, and sustained funding, conditions that may not exist elsewhere. Replication requires adapting to local property rights, governance capacity, and cultural values. Second, scaling requires balancing efficiency and equity. Programs that maximize ecological outcomes at low cost may overlook vulnerable groups, while those that prioritize inclusivity must ensure that ecological impacts are not diluted (Kabeer, 2018, Oreszczyn, Lane & Carr, 2010). Blending these objectives through differentiated payments, group contracts, or tiered incentive structures can enhance both effectiveness and legitimacy.

Third, sustainability depends on embedding PES within broader socio-ecological systems. Programs overly reliant on external funding or temporary subsidies risk collapse when payments end. Long-term success requires integrating PES with livelihood diversification, local governance institutions, and cultural norms of stewardship. The Mexican experience with community-based PES, as well as hypothetical scenarios emphasizing alternative livelihoods, show how this integration can strengthen resilience (Kemkes, Farley & Koliba, 2010, Wauters, *et al*., 2010).

Fourth, replication across ecosystems requires innovation in financing. While carbon markets and government budgets have been central in some cases, other contexts may benefit from hybrid funding sources, including water tariffs, corporate sustainability investments, or philanthropic contributions. Diversified financing ensures that PES programs are not overly vulnerable to the fluctuations of a single funding stream.

Fifth, monitoring and verification remain crucial. Without credible evidence of additionality, PES risks losing legitimacy and support. Advances in remote sensing, participatory monitoring, and digital technologies offer new opportunities to strengthen monitoring while involving communities. However, the costs of monitoring must be balanced against available resources, especially in contexts with limited capacity (Keshavarz & Karami, 2016, Nielson, *et al*., 2018). Finally, scaling PES requires multi-actor collaboration. Governments provide legal frameworks and stability, NGOs build trust and facilitate participation, and the private sector brings innovation and resources. The interplay of these actors is essential for replication, as no single institution can manage the complexities of PES alone.

In conclusion, applications and case illustrations of PES incentive design show that while the conceptual model provides a strong foundation, its success depends on sensitive adaptation to local contexts, careful balancing of competing priorities, and robust institutional support. Real-world cases from Costa Rica, Mexico, and China demonstrate both achievements and challenges, while hypothetical scenarios in Africa and Southeast Asia highlight the potential for innovative applications (Klerkx, *et al*., 2012, Muradian, *et al*., 2010). Lessons for scaling emphasize the importance of equity, sustainability, financing, monitoring, and multi-actor collaboration. By drawing on these insights, policymakers, practitioners, and researchers can design PES programs that are not only effective in protecting ecosystems but also legitimate, resilient, and replicable across diverse ecological and social landscapes (Kiptot & Franzel, 2014, Nederlof, *et al*., 2011).

2.8 Conclusion

The conceptual model for Payment for Ecosystem Services (PES) incentive design makes several key contributions to both theory and practice. By integrating economic efficiency, ecological priorities, and behavioral and social insights, it offers a comprehensive framework for designing incentive schemes that go beyond narrow financial transactions. The model highlights the importance of valuing ecosystem services in ways that reflect both ecological realities and local livelihood needs, analyzing stakeholders to ensure inclusivity and fairness, designing incentive mechanisms that balance opportunity costs and risks, and establishing enabling conditions that provide institutional credibility and sustainability. Importantly, it demonstrates that PES cannot succeed through economic logic alone; fairness, trust, reciprocity, and cultural legitimacy are equally central to encouraging participation and long-term compliance. In doing so, the model bridges gaps in earlier PES frameworks, providing guidance for building systems that are ecologically effective, socially legitimate, and economically viable.

Future research should prioritize empirical validation of the model through comparative case studies, behavioral field experiments, and participatory monitoring. Rigorous testing is needed to examine how different combinations of incentive mechanisms and enabling conditions perform across ecological and cultural contexts, as well as how behavioral factors such as fairness perceptions, risk aversion, and social norms shape participation. Interdisciplinary collaboration will be critical to this endeavor, drawing insights from economics, ecology, psychology, sociology, law, and political science. Such collaboration can help refine valuation methods, develop innovative financing models, and strengthen governance systems. Moreover, researchers should focus on the dynamic nature of PES, exploring how feedback loops, adaptive management, and learning processes influence outcomes over time. Understanding how programs evolve, adapt, and persist in the face of environmental change and shifting political landscapes is central to making PES both scalable and sustainable.

The broader implication of this conceptual model lies in its potential to strengthen social-ecological resilience. By aligning conservation incentives with human motivations and institutional realities, PES can embed stewardship within everyday practices rather than treating it as an externally imposed transaction. Programs that integrate fairness, reciprocity, and cultural values not only protect ecosystems but also enhance trust, cooperation, and adaptive capacity within communities. In this way, PES becomes more than a tool for financing conservation it becomes a mechanism for fostering resilience, equity, and long-term sustainability. By adopting the principles of this model, policymakers, practitioners, and researchers can help ensure that PES contributes not only to conserving ecosystems but also to building more just and resilient societies in the face of global environmental challenges.

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