



DESIGN STUDY

A Nature-Positive and Socially Inclusive Transition Bond Design

A Mangrove Restoration Outcomes Bond for the Aquaculture Sector

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UKPACT

ZSL Zoological
Society
of London

 **SAL FOREST**

About this document

Here, we propose a Mangrove Restoration Outcomes Bond to mobilise private capital for mangrove restoration and protection in Thailand.

Our proposed financial instrument is a performance-based outcomes bond, with a highly rated public or quasi-public issuer, principal-protected private investor capital, and outcome payments from public or philanthropic funders linked to independently verified mangrove indicators (e.g., hectares restored or protected and survival rates over an agreed verification period). Only mangrove outcomes trigger payments; secondary or proxy outcomes are not monetised. Aquaculture-related enabling measures, such as buffer zones or hydrological improvements, may be supported where they protect mangrove durability, drawing on the same supply-chain concerns flagged by FAO and APRACA (2023) and DOL (2024). Gender-disaggregated indicators, including women's participation in restoration planning, representation in co-management, and share of benefit-sharing, could also be tracked alongside ecological indicators.

NAVIGATION

How to read this document

Section one sets out why the aquaculture sector needs climate-transition finance, and where Thailand's mangroves stand today.

Section two is the instrument itself: the bond design, the theory of change, the prototype structures the SEC discussed, the fifteen-indicator KPI framework, and who is legally liable for what.

Section three reports what stakeholders said when the prototype was put to them, grouped by theme.

Figures 1 and 2 are reproduced from Global Forest Watch. Figures 3, 4 and 5 have been redrawn for this edition; the structures and indicators they show are unchanged.

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Executive summary

Here, we propose a Mangrove Restoration Outcomes Bond to mobilise private capital for mangrove restoration and protection in Thailand.

3

payment-linked indicators trigger the success payment

15

indicators across four levels, aligned with ICMA's SLB Principles

24months

survival and establishment window for the headline metric

Financing the transition of coastal aquaculture toward climate-resilient and nature-positive production can involve activities such as the protection and restoration of mangrove ecosystems; this intervention reduces environmental and climate risks to coastal aquaculture by improving the management of water and effluents, maintaining coastal ecosystem functions, and allowing aquaculture to transition toward higher-productivity production without further conversion of natural mangrove habitats. Thailand has made significant strides in restoring its mangrove cover, but ongoing investment is essential to enhance the quality, connectivity, and long-term resilience of mangrove ecosystems.

The outcome framework focuses on three payment-linked indicators: hectares restored, survival and establishment of restored mangroves, and durable protection of existing mangroves. Additionally, ecological quality, coastal resilience, community livelihoods, inclusive governance, and gender outcomes will be monitored to ensure the sustainability of the restoration efforts.

While mangrove restoration is the primary objective of this instrument, the bond also has important implications for coastal aquaculture. Actions such as restoring abandoned aquaculture ponds, improving hydrology, establishing buffer zones, and implementing sustainable aquaculture practices can support the long-term protection of restored mangroves.

CLOSING

Next steps

The next steps involve identifying suitable pilot sites with Thai partners, establishing baselines and restoration targets, confirming the issuer and potential outcome funders, and refining the key performance indicators, verification arrangements, and payment structure before moving on to detailed transaction design.



SECTION 01

Introduction

Why the aquaculture sector needs climate-transition finance, and where Thailand's mangroves stand today.

Introduction

The aquaculture sector is vulnerable to a range of climate-related risks, including rising sea levels, saline intrusion, erratic rainfall patterns, and more frequent and severe droughts and floods (SEI, 2025). These risks directly affect aquaculture productivity, species viability, and ecosystem stability, particularly in areas with insufficient infrastructure or limited adaptive capacity. According to the Stockholm Environment Institute (SEI), these climate impacts are expected to intensify, potentially leading to devastating effects on aquaculture production and food security (SEI, 2025). Therefore, there is an urgent need for climate-transition finance mechanisms in aquaculture to address its unique vulnerabilities.

In addition to climate-related risks, the aquaculture sector in Thailand faces ongoing social challenges related to labour exploitation and illegal fishing (DOL, 2024). These social issues hinder the implementation of sustainable practices in aquaculture and undermine efforts to establish a resilient, ethical supply chain. Additionally, illegal, unreported, and unregulated (IUU) fishing remains a pervasive issue, contributing to overfishing, environmental degradation, and resource depletion (DOL, 2024), further compromising the integrity of Thailand's aquaculture sector and complicating efforts to maintain sustainability standards and manage resources effectively (FAO & APRACA, 2023).

These climate-related and social barriers underscore the need for novel financial instruments that address both environmental and social challenges in aquaculture. Despite the critical role of aquaculture in Thailand's economy, the allocation of climate finance directed specifically at aquaculture has been limited. While global climate finance directed to agrifood systems has increased, only a small proportion has been allocated to aquaculture-specific initiatives (FAO, 2025). According to the FAO, 23 percent of global climate finance in 2022 was directed to agrifood systems, including aquaculture, yet aquaculture-specific funding remains minimal (FAO, 2025). This funding gap highlights the need for more targeted financial instruments that address the unique challenges of aquaculture, which are distinct from those faced by the broader agrifood systems. Both sectors, however, share common institutional barriers, such as limited access to finance, inadequate infrastructure, and a lack of aggregation mechanisms for smaller-scale producers (CPI & IFAD, 2021).

1.1 State of climate-transition financing for the aquaculture sector

A recent instance of private sector financing in aquaculture is Thai Union Group, which secured a USD 150 million blue loan from the Asian Development Bank (ADB) and a consortium of commercial banks in 2025 (TU, 2025). This financing supports Thai Union's SeaChange 2030 strategy, which aims to promote sustainable shrimp production through

certified sourcing, traceability, and enhanced environmental and labour standards (ADB, 2025). While this is a noteworthy instance of climate-aligned finance, it primarily benefits large corporations that possess the necessary creditworthiness and scale to access such funding. Smaller-scale aquaculture producers, however, continue to face significant barriers, including limited access to concessional loans, lack of secure land tenure, and insufficient technical support, which restrict their participation in climate-transition finance (CPI & IFAD, 2021)

150_m USD

blue loan to Thai Union from ADB and commercial banks, 2025

23%

of global climate finance went to agrifood systems in 2022

12.9%

growth in Thailand's mangrove area, 1984–2023

Financing the transition of coastal aquaculture toward climate-resilient and nature-positive production can involve activities such as the protection and restoration of mangrove ecosystems; this intervention reduces environmental and climate risks to coastal aquaculture by improving the management of water and effluents, maintaining coastal ecosystem functions, and allowing aquaculture to transition toward higher-productivity production without further conversion of natural mangrove habitats. As grant-based approaches have struggled to scale or sustain outcomes, generating blue carbon credits from mangroves offers promise as a potential funding mechanism (Montenegro et al. 2025). However, key barriers to financing mangrove conservation include a limited pipeline of projects, a long-time horizon, ecological performance risk, and revenue uncertainty. Many potential mangrove sites for blue carbon credits never progress beyond early concepts due to fragmented data, unclear tenure, and limited project preparation support.

1.2 Status of mangroves in Thailand

Thailand's mangroves appear to be on a relatively positive long-term trajectory in terms of total area, although this should not be interpreted as meaning that all mangrove ecosystems are healthy or secure. The Global Mangrove Watch provides a consistent remote-sensing platform for tracking mangrove extent and change at national and sub-national scales (Figure 1).

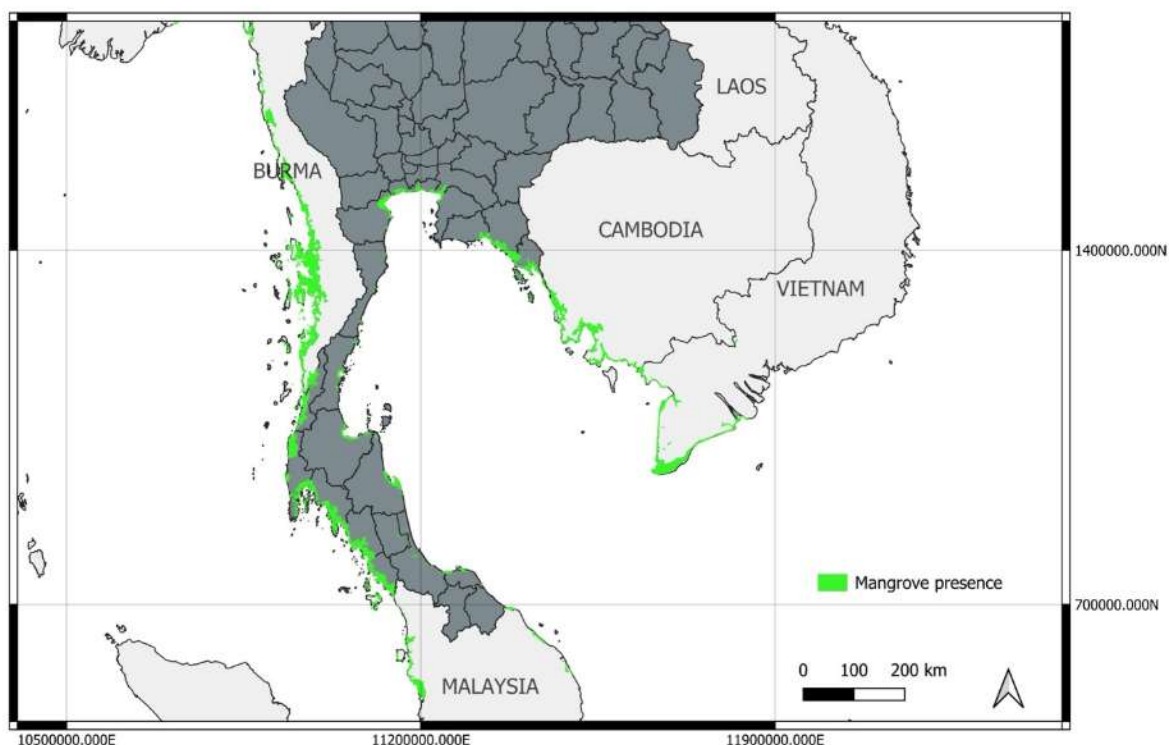
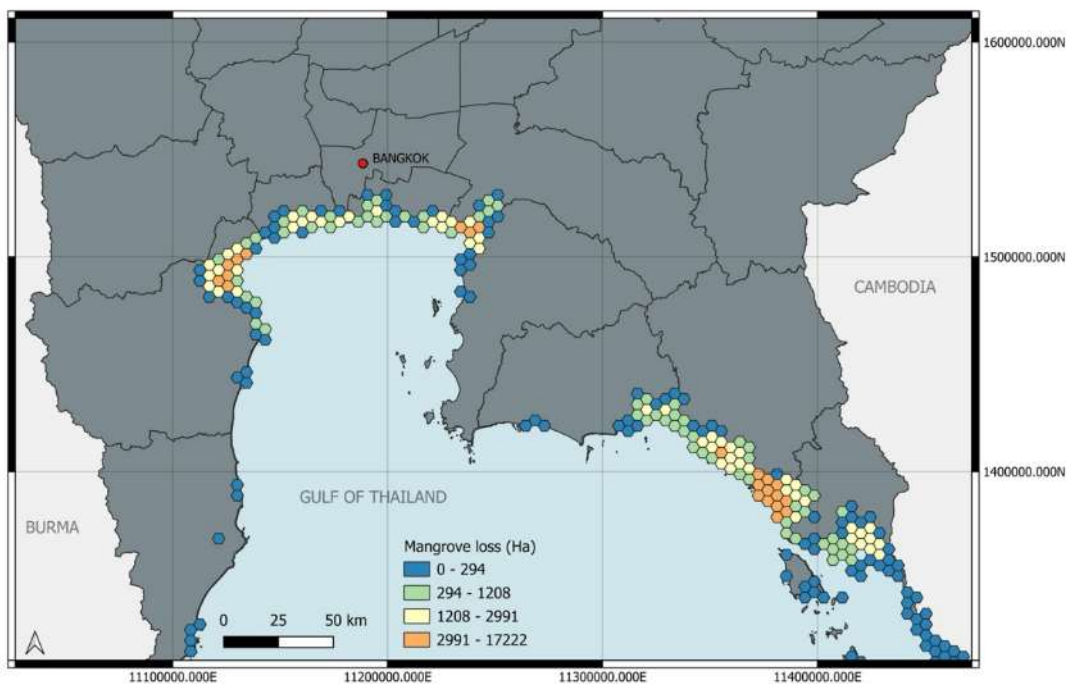


Figure 1 Extent of mangroves in Thailand (shaded dark grey) according to Global Forest Watch.

Consistent with this, Chaiyana et al. (2025), using Landsat-based analysis from 1984–2023, found that Thailand’s mangrove area increased by approximately 12.9%, in contrast to substantial declines in neighbouring Cambodia and Myanmar. This recovery reflects decades of mangrove protection, rehabilitation and improved management, but continued conservation remains important because area gains do not necessarily indicate recovery in ecological condition, forest maturity or biodiversity, and mangroves remain exposed to pressures including coastal development, aquaculture, pollution and climate change. Thus, Thailand represents a relatively successful case of mangrove recovery in the high loss areas (Figure 2), but continued protection and investment in the quality, connectivity and resilience of mangrove forests remain necessary – this still requires substantial financing.

Here, we propose a Mangrove Outcomes Bond to catalyse the financing of mangrove protection and restoration efforts in Thailand. An outcomes bond structure (versus conventional bond instruments) enables upfront private capital to be mobilised for mangrove restoration, with investor returns linked to independently verified ecological outcomes; this shifts performance risk away from communities and implementing organisations, while maintaining strong accountability for results.

Western extent



Eastern extent

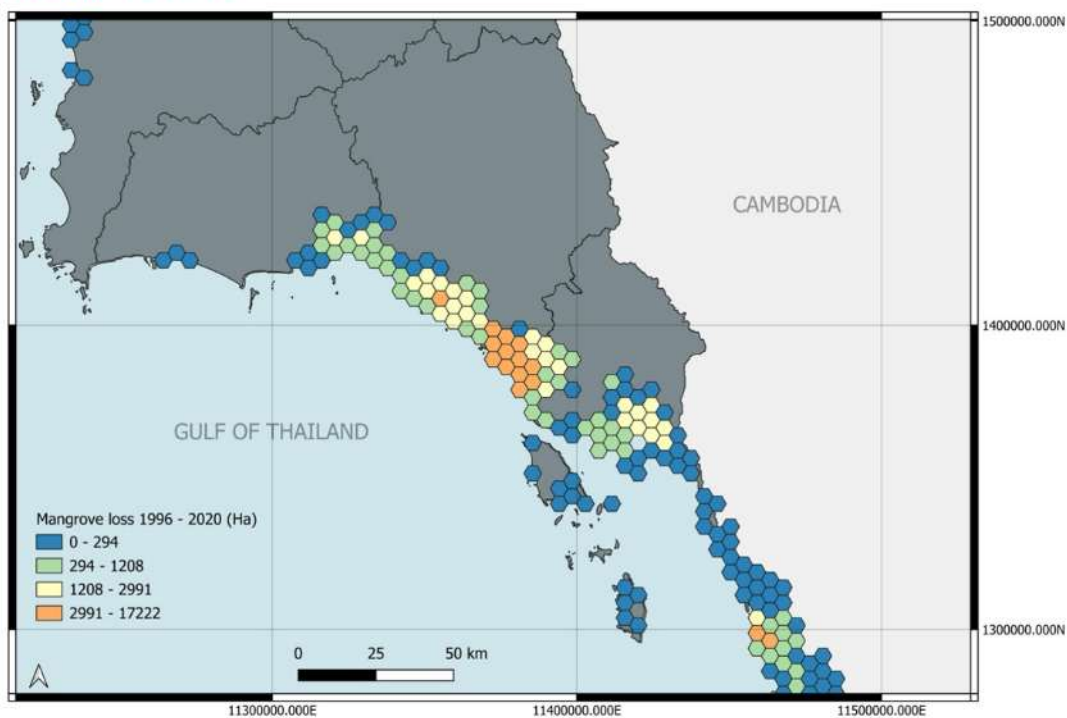


Figure 2 Areas of high mangrove loss in Thailand (shaded dark grey) along the Gulf of Thailand and Andaman Sea according to Global Forest Watch.



SECTION 02

The instrument at a glance

The bond design, its theory of change, the prototype structures, the KPI framework and where the legal obligations sit.

The instrument at a glance

2.1 Bond design

Our proposed financial instrument is a performance-based outcomes bond, with a highly rated public or quasi-public issuer, principal-protected private investor capital, and outcome payments from public or philanthropic funders linked to independently verified mangrove indicators (e.g., hectares restored or protected and survival rates over an agreed verification period). Only mangrove outcomes trigger payments; secondary or proxy outcomes are not monetised. Aquaculture-related enabling measures, such as buffer zones or hydrological improvements, may be supported where they protect mangrove durability, drawing on the same supply-chain concerns flagged by FAO and APRACA (2023) and DOL (2024). Gender-disaggregated indicators, including women's participation in restoration planning, representation in co-management, and share of benefit-sharing, could also be tracked alongside ecological indicators.

2.2 Theory of change

Our Theory of Change (ToC; Figure 3) follows the same results-chain logic ZSL uses across its outcomes bonds, most directly the Human-Wildlife Conflict bond. There are four main themes of work each that drive one outcome: 1) restoration and protection delivery; 2) legal protection and tenure; 3) monitoring and ecology; and 4) community and livelihoods programming. Two of those outcomes are payment-linked (M6–M8, the hectares that get restored, survive, and stay protected), while the other two are durability enablers (M9–M14, tracked and reported but not paid on). Under each theme, key activities need to be co-designed with stakeholders based on the selected landscape.

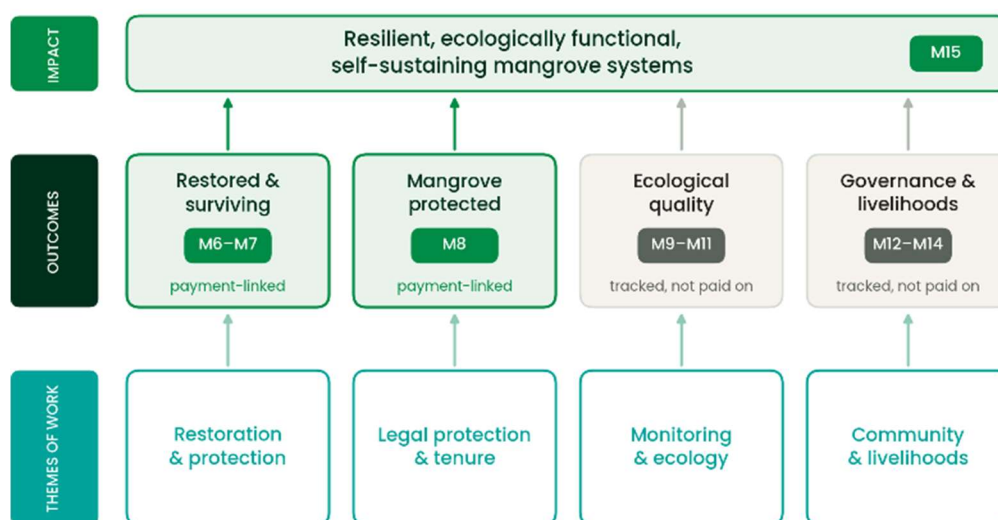


Figure 3 Mangrove Restoration Outcomes Bond Theory of Change

2.3 KPI framework

The KPI framework is a core component of the outcome-based bond, with pre-defined biodiversity KPIs assessed by an Independent Evaluator using the Theory of Change methodology. KPI performance affects only the Success Payment made by the Outcome-Based Funder to investors and does not affect repayment of the principal by the Issuer. Full achievement of the KPIs triggers the full Success Payment, while partial achievement results in a graduated, prorated payment based on the level of outcomes achieved, avoiding an all-or-nothing threshold. If the KPIs are not achieved, no Success Payment is made, although investors still receive their principal repayment. The specific KPI thresholds, verification milestones and tiered payment structure can be finalised during the detailed structuring phase. We propose 15 indicators across four levels that are aligned with ICMA's Sustainability-Linked Bond Principles: each one relevant and material, measurable, externally verifiable, and benchmarkable against a baseline. The payment-linked set (M6–M8) is the most stringent since returns to the investor(s) are contingent on it.

Output indicators: conditions in place (M1–M5)

M1–M5	Indicator	Verification / type
M1	Number of sites where degradation drivers and restoration constraints are identified	Site assessment, literature
M2	Number of sites with baseline ecological, hydrological and tenure data established	Field baseline, tenure mapping
M3	Number of sites where the restoration approach is matched to site conditions (ANR / planting / hydrological repair)	Technical site diagnosis
M4	Number of sites where community agreements, capacity and resources are in place	Partner agreements, MoUs
M5	Hectares brought under active restoration or protection	Project records

Outcome indicators: payment-linked (M6–M8)

These three trigger the success payment. M7 is the headline composite metric.

M6–M8	Indicator	Verification / type
M6	Hectares restored / under assisted natural regeneration	Remote sensing + field
M7	Hectares surviving and establishing at 24 months, within legally protected status (headline composite metric, payment trigger)	Independent evaluator
M8	Hectares of existing mangrove under durable protection / avoided loss	Remote sensing, legal status

Outcome indicators: ecological quality & durability enablers (M9–M14)

Tracked and reported, not paid on. They protect the durability of M6–M8 and feed adaptive management.

M9–M14	Indicator	Verification / type
M9	Canopy cover and establishment trajectory	Remote sensing
M10	Biodiversity / ecological function (faunal recovery) where feasible	Site-dependent
M11	Coastal resilience proxy (shoreline change, wave attenuation) where relevant	Site-dependent
M12	Inclusive and equitable governance across access, participation, leadership and benefit distribution	2X-aligned, disaggregated
M13	Community livelihood benefits realised (sustainable aquaculture, pond reversion, benefit-sharing receipts)	Field + records
M14	Community stewardship strengthened / re-conversion pressure reduced	Survey, monitoring

Impact indicator (M15)

M15	Indicator	Verification / type
M15	Resilient, ecologically functional, self-sustaining mangrove systems with coastal communities deriving lasting benefit and protecting them beyond the bond term	Long-term evaluation

2.4 Legal and payment obligations

The Issuer remains legally responsible for repaying the principal at maturity and paying the pre-agreed base coupon, with these obligations representing standard debt commitments backed by the Issuer's credit. Separately, the Outcome-Based Funder is responsible only for the conditional Success Payment, which is triggered by independently verified achievement of the agreed KPIs and does not constitute a guarantee of the bond. The two arrangements therefore represent separate legal relationships and risk exposures for investors. If the Issuer defaults on principal or the base coupon, standard bond default provisions apply, and the outcome-based mechanism does not provide any guarantee or backstop against this Issuer credit risk.



SECTION 03

Validation findings

What stakeholders said when the prototype was put to them, grouped by theme.

Validation findings

A Focus Group Meeting was conducted to validate the proposed bond prototype during 2 events: a "Outcomes-Based Financing for Mangrove and Dugong Conservation" side-event at the 16th National Mangrove Symposium, on 11 May 2026 and the on 13 July 2026. We provide the consolidated feedback below.

The mangrove bond is more complex than the Rhino Bond

A participant noted that the Rhino Bond (Box 1) is relatively straightforward because it tracks a single animal species, whereas mangroves involve a habitat with multiple dimensions. The participant stated directly: "The rhino example is the simplest. It's one animal. The mangrove is primarily a forest habitat. It is always more complicated."

BOX 1

Rhino Bond

The first Wildlife Conservation Bond, or informally the "Rhino" Bond saw proceeds fund conservation in two South African parks; instead of coupons, a final success payment (funded by the Global Environment Facility) is paid if verified data shows rhino population growth. IBRD, the lending arm of the World Bank, guarantees principal back to investors. ZSL, with the IUCN/SSC African Rhino Specialist Group, built a rhino-specific Theory of Change yielding seven KPIs, but linked only one (increased rhino population over five years) to payment; the other six incentivised the monitoring rigour needed to measure it with confidence. This represents a useful design principle, demonstrating that not every KPI needs to be a payment trigger.



Figure 4 How the Wildlife Conservation Bond routes investor capital, conservation delivery and the outcome payment

A participant noted that mangroves potentially more valuable than Rhino Bond, but more complex. The mangroves offer multiple sources of environmental value, including carbon sequestration, storm protection, and fisheries support, suggesting the mangrove bond could potentially be more valuable than the Rhino Bond, but also more complex in terms of partnerships and attributing which stakeholder supports which aspect of the return.

The marine and coastal resources agency noted that government practice generally evaluates mangrove restoration after roughly six years. A technology and environmental services firm, drawing on a corporate reforestation program in an upland watershed, placed the first meaningful ecological signal at about three years. The domestic bond market association, speaking for investors, called 24 months too short and preferred five. The conservation NGO leading the prototype defended the shorter window on the grounds that the design is meant to test replicability, citing the Rhino Bond as a case where outcome KPIs were assessed within roughly two years, but a participant pushed back on that analogy directly.

The feedbacks point toward a three-to-five-year assessment horizon inside a longer tenor, close to the seven-year maturities the bond market association described as common for blue and green structures.

Question on the source of repayment to investor

A participant asked where the money to repay investors comes from, whether from tourism, commercial activities, or other sources.

It was responded that finding an outcome funder is one of the main challenges for this type of bond structure, and that the team is actively having conversations to identify potential outcome funders, including at a regional level.

It was also noted that Carbon Removal Units (CRUs) tapped from the carbon market are a key potential revenue source to generate returns for investors, distinguishing this bond from conventional structures.

Biodiversity credits were raised as a complementary stream worth exploring. The technology firm reinforced the difficulty from the issuer side, noting that its listed parent company requires certainty on long-term returns before committing to structures with guaranteed interest, and that carbon credit revenue takes considerable time to become commercially reliable. A representative of the multilateral development bank was similarly candid, cautioning that only a small share of proceeds may ultimately reach conservation activity and that most conservation finance still depends on donor money rather than commercial capital.

Commercial activities should be linked to conservation

A participant raised a concern that in the Rhino Bond, commercial activities generating the investment return are fully separated from the conservation activities themselves, the commercial investment is unrelated to conservation; only the coupon is redirected.

The participant cautioned this approach needs careful thought for the mangrove bond. Responses from the group suggested that commercial activities should ideally be linked to conservation and community benefit, for example, honey production from mangrove forests was mentioned as a possible example.

It was also suggested that commercial activities should go through a screening process rather than being any unrelated activity.

One participant observed that the more the discussion developed, the more the concept resembled Payment for Ecosystem Services, a mature mechanism the team could draw on rather than treating the structure as wholly novel. Another framed the complexity positively, noting that mangroves generate carbon sequestration, storm protection, and fisheries value simultaneously, which makes the instrument potentially more valuable than the Rhino Bond but harder to structure in terms of partnerships and attributing which stakeholder underwrites which part of the return.

KPI design

On KPI design, participants converged on fewer and better-defined indicators. The development bank and the bond market association both favoured a small set, with the latter suggesting two to three, each with clear definitions and measurement methodologies. A petrochemical company pressed for every KPI to rest on an accepted methodology, for existing national indicators to be reviewed including those under the forthcoming national economic and social development plan and the national environmental quality management plan, and for government certification to anchor validation.

A bilateral development agency flagged that canopy-based indicators require a defined baseline before they can support performance measurement and recommended consulting a conservation specialist on baseline construction and remote sensing. The development bank qualified this usefully, noting that baseline data need not exist at the outset provided there is a credible monitoring plan.

An international environmental NGO raised attribution as a separate problem, asking whether the framework can distinguish improvements caused by bond-financed activity from those driven by external conditions. The marine and coastal resources agency contributed a siting point with direct bearing on measurable success, observing that planted mangroves in exposed coastal areas often fail and that abandoned shrimp ponds offer higher survival rates.

A participant mentioned that biodiversity credits are another potential revenue stream worth exploring, alongside CRUs, to strengthen the financial case..

The social dimension: citizen science and community data collection

An international conservation union, a national biodiversity coalition, and the development bank all argued that environmental indicators alone are insufficient and that community co-

benefits should be designed in from inception, with existing community-based management recognized rather than displaced. The prototype's lead NGO proposed incorporating its equity and inclusion framework, and participants suggested citizen science tools as a way for communities to contribute verification data as active participants rather than passive beneficiaries. The conservation union also flagged an unresolved tenure question, since some mangrove areas already sit under private concession and private eligibility after development is unclear.

A participant mentioned that citizen science tools and frameworks could help local communities gather and report conservation data to support outcome verification.

The importance of local communities being active participants rather than passive beneficiaries was reinforced.

Legal and regulatory clarity on CRUs still needed

The securities regulator observed that current rules do not accommodate a variable, outcome-linked return of the type proposed and questioned how the fixed interest component would be set. This does not block the prototype, but a regulatory route must be built alongside the technical design, particularly given that the country has not yet issued an outcome bond and the only comparable domestic instrument mentioned was a tiger-focused bond still under development.

A participant summarized the underlying risk plainly, stressing that investors must clearly understand what they are buying. The team closed by noting a focus on stakeholder engagement, prototype finalization expected in October, an upcoming finance forum session, and a donor agency's plan to disseminate final reports and knowledge products in August 2026.

A participant noted that while CRUs have been considered as part of the structure, further clarity on the legal and regulatory framework around them is still needed before the bond can be finalized.

Status of outcome bonds in Thailand

It was asked the audience whether any outcome bond discussion had taken place in Thailand.

It was noted that Thailand is one of the countries in Southeast Asia that has not yet issued this type of instrument.

The response confirmed this, with the only comparable instrument mentioned being a Tiger Bond, described as still under development.

A participant stressed that potential investors must clearly understand what they are buying: "It's very important they understand what they're buying. We have to be very clear about that."

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