



Comparative analysis of Climate Finance Models: Recharge Pakistan and Delta Blue Carbon

Abdul Rauf^{1*}, Noshaba Zulfikar¹, Alina Ikram¹, Mohammad Essa¹, Rajwa Tariq¹,
Mohammad Hasnain¹

¹. School of Management Sciences, GIK Institute of Engineering Sciences and Technology
Topi, Pakistan;

raufnasar.adv@gmail.com

Article Information	Abstract
Article history: Submitted: 13 th June, 2026 Accepted: 26 th June, 2026 Published: 30 th June, 2026	<i>Pakistan is one of the most climate-prone countries in the world despite contributing less than 1% of Global greenhouse gas emissions. In recent year 2025, excessive monsoon flooding in the country affected over 6.3 million people, displaced almost 3 million people and caused economic losses over Rs 822 billion. Simultaneously, there is an estimated climate financing gap of USD 200-348 billion in Pakistan by 2030 following continuously low inflows of international climate finance. This study portrays qualitative comparative analysis of two climate finance models in Pakistan (Recharge Pakistan and Delta Blue Carbon) to assess their effectiveness, financial viability, and policy applicability with the context of a fiscally constrained country. With the help of project documentation, financing structures and verified impact data, the research assesses the effectiveness of the public grant-based adaptation finance and market-based mitigation strategy in dealing with the climate risks in Pakistan. The largest ecosystem-based adaptation project in the country is Recharge Pakistan, which is entirely grant-based (USD77.8 million) and exhibits excellent resilience results due to the large-scale ecosystem restoration and flood risk reduction, though the project still requires periodic funding over the years. Delta Blue Carbon, on the other hand, presents the largest mangrove-based blue carbon project in the world, operates under the market driven carbon finance model, having sequestered more than 3.2million tCO₂e and earned USD 40-50 million in revenues, but the project is susceptible to the market and climatic conditions. The research finds that these models are complementary rather than substitutive and supports a blended climate finance framework integrating public adaptation grants with market-based mitigation finance to enhance resilience, fiscal sustainability, and long-term climate outcomes in developing economies.</i>
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Introduction

Pakistan is now ranked among top ten most climatically threatened countries in the world, which is worsened by the fact that the country also has a very specific geography of being the foothills of the Himalayas ([Mettis-Global, 2025](#)). This was severely proven in the 2022 monsoon season that provided more than 190 percent of the usual amount of rainfall that flooded one-third of the nation, forcefully displacing 33 million individuals ([WWF, 2023](#)). The economic cost of this kind of event is amazing as the 2022 floods alone

cost more than 30 billion dollars and imposed an estimated cost of 9.5% of national GDP annually ([Mettis-Global, 2025](#)). The use of traditional or grey infrastructure has not been enough to deal with such drastic hydrological changes in Pakistan([Green Climate Fund, 2023](#); [The Coca-Cola Company, 2024](#); [WWF, 2024](#))

There is existential threat in the agricultural sector which contributes almost 20% of GDP and provides employment to 38% of the labor force. Catastrophic monsoon floods of 2025 resulted in the death of at least 972 people, more than 6.3 million people were affected, and close to 3 million displaced in order to cause economic losses estimated to be around Rs 822 billion. The Government of Pakistan is confronted by a future contraction in its GDP of 18-20% by 2050 (because of the climate risks), and thus it has shifted to Nature-based Solutions (NbS) and Ecosystem based Adaptation (EbA) as the new national strategy ([Green Climate Fund, 2023](#)). This transition is in place of reactive disaster recovery to proactive-based green infrastructure that is geared to decelerate, absorb, and redirect floodwaters and recover degraded ecosystems. This is the key change involved in the Living Indus Initiative, which aims to reclaim the ecological well-being of the Indus River Basin. Pakistan is also exploring two alternative financial structures to fill a climate financing gap of between 200-348 billion dollars by 2030 ([Green Climate Fund, 2023](#)).

The Grant-Multilateral Model:

The example of Recharge Pakistan makes use of big international grants (e.g., through the GCF) to finance non-commercial adaptation projects that create public goods such as disaster risk reduction ([Green Climate Fund, 2023](#)).

The Market-Driven Public-Private Partnership Model:

This model is based on the voluntary carbon market and makes use of the high-integrity carbon credits to create self-sustainable revenue by selling them on the high-value carbon market ([Verra, 2025](#)).

Pakistan's National Climate Finance Strategy (NCFS) 2024 articulates a comprehensive framework built on seven pillars, including five core pillars (climate proofing sectoral policies, mobilizing domestic revenue, diversifying finance sources, strengthening capacity, and integrating climate into development) and two cross-cutting pillars (gender responsiveness and research & development). The NCFS emphasizes a "whole-of-government" approach, blended finance mechanisms combining grants and market-based instruments, and private sector engagement through public-private partnerships ([Ministry of Climate Change and Environmental Coordination, 2024](#)).

This paper compares grant-based and market-based PPP frameworks in realizing sustainable climate outcomes, regarding adaptation and mitigation. It assesses the key risks such as carbon integrity, delay in disbursement, and the permanence in ecology and examines the forms of funding and risk-sharing. This research paper also evaluates the socio-economic impacts on local communities and draws policy lessons to assist in helping Pakistan's shift to blended Climate Finance.

Literature Review

In Pakistan, the use of remote sensing methods has been popular in determining the degree of mangroves and their spatiotemporal changes ([Gilani et al., 2021](#)). We were able to assess the cover of Pakistan national-scale mangrove cover thoroughly in all five areas of mangrove in the country including Indus Delta, using Landsat 30m satellite images in five-year intervals between the years 1990 and 2020. Their results showed that the mangrove area has grown significantly over 477.22km² in 1990 to 1463.59km² in 2020

with average growth rate of 3.74% per annum. The fragmentation analysis also demonstrated increased canopy density and patch connectivity, which implied that mangrove recovery had both spatial and qualitative improvement of the ecosystem. These favorable dynamics were mostly due to plantation projects and enhanced conservation activities (Gilani et al., 2021).

Nevertheless, even more recent findings tell us that mangrove expansions are not always accompanied by better health of the ecosystem (Raza et al., 2024). Despite the increase in mangrove cover to about 1210 km², the analysis based on Normalized Difference Vegetation Index (NDVI) showed that the vegetation health had dramatically dropped and 88.8% of mangrove pixels had negative NDVI trends. These results show that the spatial increase in itself can obscure underlying ecological decrease because of anthropogenic stressors and sea-level increase, which points to the shortcomings of area-based metrics to assess ecosystem recovery (Raza et al., 2024). (Masood et al., 2024) studied the dynamics of the LULC of the Indus River Delta between the years 1990 and 2020 by analyzing the remote sensing data and machine learning algorithm. The research offers a useful understanding of the causes of ecological stress in the Indus Delta, but it fails to estimate the success of the restoration or climate adaptation initiatives.

Coastal ecosystems have been observed to have greater potential in climate mitigation and adaptation at the national policy level. The Blue Carbon Rapid Assessment of Pakistan commissioned by the World Bank to assist in the review of the Nationally Determined Contributions of Pakistan under the Paris Agreement places emphasis on the role of mangroves, tidal marshes and seagrass ecosystems as important blue carbon systems (World-Bank, 2021). This report offers a first country-wide assessment of blue carbon stocks, underscoring the value of coastal ecosystems in carbon sequestration, shoreline protection and long-term resilience. Nevertheless, it is policy-based and strategic and does not evaluate the performance or the outcomes of individual blue carbon projects on the ground (Verra, 2023). Under this larger blue carbon, large-scale coastal restoration projects in Pakistan are documented at the project level. Delta Blue Carbon project, which is a registered project under the Verra Verified Carbon Standard and Climate, Community and Biodiversity Standards is a community-based mangrove restoration project located in the Indus River Delta. The initiative aims to restore tidal lands (mangrove forests, inter tidal zones, tidal creeks) through afforestation, reforestation, and revegetation of degraded ones with mechanisms connecting ecosystem recovery with performance-based climate finance in the form of voluntary carbon markets (Verra, 2023).

The local communities are involved in restoration, monitoring and maintenance processes and the carbon credits are generated according to the confirmed carbon dioxide removals. Although the project documentation promised anticipated carbon sequestration and co-benefits, it generally gives projected and confirmed accounting results instead of uncritically independent apprehensions of ecological or socio-economic impacts and fails to place the project performance in a comparative national context (Arshad et al., 2023). In addition to the coastal ecosystems, PCRWR (2023) says that the accelerated population increase, urbanization, agricultural intensification, and industrial growth have increased the disparity between the water demand and supply, which results in massive groundwater abstraction.

Existing studies collectively provide a solid foundation and act as strong evidence for understanding Pakistan's mangrove dynamics and land use ground water stress, while offering actionable concepts for nature-based adaptations in Pakistan. These studies are however mostly sector-specific as there has been no comparative analysis of coastal blue carbon projects like Delta Blue Carbon and inland EbA-MAR projects like Recharge

Pakistan based on shared ecological, hydrological and governance standards. This does not present sufficient comparative analysis, which is a critical gap that the current study aims to fill.

Research Methodology

Data Collection and Source Analysis:

The methodology of this research is a qualitative approach to case-study that uses a wide range of both primary and secondary sources:

- **Government Policy Documents:** Containing the Pakistan Policy Guidelines to Trading in Carbon Markets 2024 and Updated NDCs 2021 ([Ministry of Climate Change and Environmental Coordination, 2024](#)).
- **Multilateral and NGO Reports:** The technical information of the Green Climate Fund, WWF-Pakistan, and Verra ([Green Climate Fund, 2023](#); [Verra, 2025](#)) is available.
- **Journalistic and Academic Critiques:** Investigative articles by DAWN and The Express Tribune, and the International Growth Centre (IGC) ([United Nations in Pakistan, 2025](#)).

Comparative Analytical Framework:

The paper compares the two paradigms in terms of four major dimensions of analysis. First, it makes a comparison of their financial arrangements, with unidirectional grant-based funding in contrast with bidirectional performance-based revenue packages. Second, it separates their main ecological target, distinguishing between the results of an adaptation, including the prevention of losses of climate, and the results of mitigation, including the objectively recorded carbon removals. Thirdly, it examines the distribution of various classes of risks such as commercial, implementation and permanence risks by stakeholders. Lastly, it covers governance mechanisms of both Models.

Scope and Limitations:

The scope is on Indus River Basin and Indus Delta. One of such limitations is the so-called trust deficit commonly linked to climate finance in developing countries where promised assistance might not correspond to real-world performance ([United Nations in Pakistan, 2025](#)). Also, since such initiatives as Recharge Pakistan are still in the initial stages of implementation (launched September 2024), performance data on a long-term basis are only coming out ([The Coca-Cola Company, 2024](#)).

Model I: Recharge Pakistan, Ecosystem Based Adaptation through Public Grants

Project Objectives, Scope, and Location:

Recharge Pakistan is the biggest ecosystem-based adaptation investment to ever take place in the history of Pakistan and has a transformational goal: to change the paradigm of flood and water resource management within the country through reliance on grey infrastructure (dams, embankments, etc.) to the use of nature-based solutions that combine green infrastructure and community-based natural resource management. The development is aimed at the Indus Basin located 1,300 kilometers in Khyber Pakhtunkhwa, Punjab, Balochistan, and Sindh provinces and includes four priority watersheds that are chosen according to flood risks, climate forecast, water storage opportunities, and community demands ([Green Climate Fund, 2023](#); [WWF, 2023](#)). The work focuses on four main primary locations: Watersheds Dera Ismail Khan (DI Khan), Watersheds Ramak Watershed, Watersheds Chakar Lehri and Watersheds Manchar Lake

(Qambar Shahdadkot District, Sindh). The project includes the implementation period of 7 years (2024-2031) under the lifespan of 30 years segmented into three successive 10-year periods ([Green Climate Fund, 2023](#)).

Implementing Institutions and Governance:

Recharge Pakistan is a multi-stakeholder partnership an unprecedented multistakeholder partnership that draws on the power of the public and the development expertise:

Table 1: Implementing Partners of Recharge Pakistan

Partner Group	Partner Name	Role / Focus
Govt. Partners	Federal Flood Commission (FFC) under the Ministry of Water Resources (MoWR)	Technical flood management expertise
Govt. Partners	Ministry of Climate Change and Environmental Coordination (MoCC)	National policy coordination
Govt. Partners	Provincial Disaster Management Authorities (PDMAs)	Disaster risk reduction coordination
Govt. Partners	Provincial Govts. & Depts. (Sindh, Punjab, KPK, Balochistan – Agriculture, Forests, Wildlife, Fisheries, Environment)	Irrigation, Forests, Wildlife, Fisheries, Environment, Agriculture
Technical & Donor Partners	International Water Management Institute (IWMI)	Climate science & Water resource management
Technical & Donor Partners	Pakistan Meteorological Department (PMD)	Climate and weather data support
Technical & Donor Partners	World Wildlife Fund (WWF)	International technical support

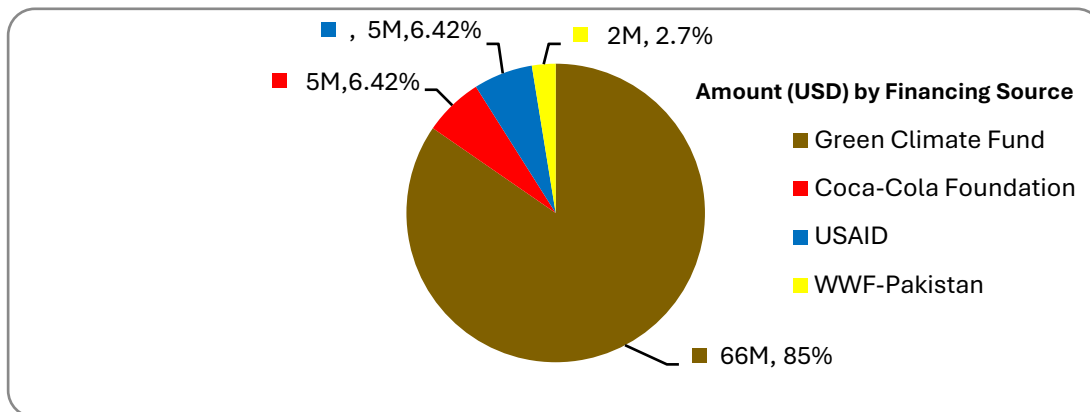
Lead Implementing Entity:

WWF-Pakistan is the accredited organization to the Green Climate Fund that provided the overall project management, coordination, as well as reporting ([WWF, 2023](#)).

Total Project Cost and Funding Architecture:

Recharge Pakistan is a grant-funded organization: it eliminates debt repayment requirements and leaves fiscal space for development:

Figure 1: Total Project Cost and Funding Architecture



The GCF contribution of 66 million US dollars is one of the highest individual climate adaptation investments that has been approved by the GCF to South Asia. The structure of co-financing disperses the risk among a variety of donors who have their areas of specialization: USAID focuses on resilience programmes, Coca-Cola Foundation invests in water security, and WWF implements and manages it ([Green Climate Fund, 2023](#); [WWF, 2023](#)).

Specific Climate and Economic Benefits:

The project initiative will rehabilitate damaged natural systems of various habitats. It will rehabilitate about 14,215 hectares of the degraded watersheds in the Dera Ismail Khan (DI Khan) district and related locations and will deal with the historical deforestation and wetland transformation ([WWF, 2023](#)). Moreover, approximately,

34 kilometers of natural and artificial water flow paths will be repaired in the Ramak Watershed and Manchar Lake, as well as hydrological connection will be restored and flood movement enhanced ([WWF, 2023](#)). The project shall also design 127 green infrastructure projects, such as recharge basins, retention sites, and hill-torrent management systems in DI Khan, Ramak, Manchar, and Chakar Lehri to improve water management and ecosystem resilience ([WWF, 2023](#)).

Risk Minimization of Floods and Droughts:

These EbA interventions can provide a physical risk reduction in a variety of ways. The natural retention system is represented by restored wetlands, floodplains, and depressions, which contain excess water throughout peak floods and release this water through dry seasons. The project will help decrease the exposure of vulnerable communities to flood risks on about 50,000 hectares of the Indus Basin, which directly impact the areas that have recorded a history of floods. At the same time, improved groundwater recharge by restoring wetlands and using managed aquifer recharge deals with chronic water shortage and facilitates agricultural output and domestic water security during droughts.

Climate Change Mitigation (Co-benefit):

Although adaptation is the major focus of the project, there are major co-benefits of the project in terms of mitigation through carbon sequestration. Recharge Pakistan is supposed to attain:

Reduction of GHG emissions every year: 26,450 metric tons of CO₂-equivalent each year of restored forests and controlled lands ([WWF, 2023](#)).

Cumulative 40-year sequestration: 1,037,928 tons of CO₂-equivalent ([WWF, 2023](#)).

Such reductions of emissions will directly help achieve the NDC of Pakistan of 50% of emissions reduction by the year 2030 ([Government of Pakistan, 2021](#)).

Livelihood and Social Outcomes:

The project explicitly focuses on vulnerable populations and enhances the financial stability of the rural population. Directly targeting the on-ground activity and watershed management activities, the project directly reaches approximately 687,336 people. In addition to that it has an indirect impact on almost 200 million people in 50 vulnerable districts through policy enhancement, enhancing knowledge exchange and increasing ecosystem-based adaptation (EbA) strategies. The project also encourages seven local companies in the agriculture and forestry industries to implement climate smart actions that eliminate the strain on the natural ecosystems. Also, it supports the participation of women by directing them to specific jobs in forestry and natural resource management. ([WWF, 2023](#)). Co-benefits of wetland and riparian habitat restoration create a large amount of biodiversity. Manchar Lake will sustain populations of commercially valuable fish and migratory shorebirds, and a greater forest cover will result in an increase in wildlife connectivity and corridors.

Model II: Delta Blue Carbon, Market Based Mitigation through Carbon Finance

Project Design, Geographic Scope, and Development Timeline:

Delta Blue Carbon is the world's largest mangrove restoration project and will be carried out on a scale comparable to national afforestation efforts. The project covers 350,000 hectares of tidal wetlands in the Indus River Delta in Thatta and Sujawal districts in Pakistan's Sindh Province, the south-eastern coastal region. This geography places the project at the intersection of terrestrial and marine ecosystems, tapping into the special carbon sequestration ability of coastal blue carbon habitats ([Choudhary et al., 2024](#); [Verra, 2025](#)). The project structure follows a 60-year timeline of implementing the project from 2015 to 2075, with the possibility of extending to 100 years based on the growth rate of mangroves and environmental conditions. Phase 1 (DBC-1) has been ongoing since 2015 with around 75,000 hectares already regenerated to date and over 2 billion mangrove trees planted in different project areas ([IDC, 2024](#)).

Verra Verified Carbon Standard (VCS) Methodology:

Delta Blue Carbon operates in the globally most popular voluntary carbon crediting program, the Verra Verified Carbon Standard (VCS) program, based on the special purpose Verra Methodology 0033 (VM0033) to restore and conserve tidal wetlands. According to the Verra Verified Carbon Standard, carbon credits (Verified Carbon Units, VCU) must come in the form of verifiable, additional, real, and permanent cuts of greenhouse gas emissions, verified through the process of third-party auditing ([Verra, 2025](#)).

Certification Pathway: Delta Blue Carbon has been Certified at Triple Gold Level; this is the highest rating of climate, environmental and social integrity on Verra system Social ([Verra, 2025](#)).

Carbon Credit Performance and Market Reception:

The Delta Blue Carbon project is expected to sequester a total of around 142 million metric tons of CO₂-equivalent over its lifetime of 60 years, with an estimated GHG sequestration of 262 million tonnes considering the full project life and possible extension.

Current progress for about 3.2 million tCO₂e already sequestered to date from 75,000 hectares regenerated (Verra, 2025).

Delta Blue Carbon has met fantastic success in the voluntary carbon market with several vintage years and cumulative issues of over 5-6 million VCUs to date (as of

2024), the highest single-project issues in the global voluntary carbon market (BeZero Carbon, 2023; Verra, 2025). Demand outpaced available supply by over 50% in 2020, suggesting that there is strong demand relative to the scarcity of supply. Carbon credits have attracted large price premiums over terrestrial forestry credits, with the highest public auction in November 2022 fetching \$27.80 per VCU for 250,000 credits (2021 vintage), and an average trading range of \$13-\$35 per VCU, with some credits fetching \$40-50 per tonne. Over 60% of the 2020 issuance successfully bid at prices above \$30/tonne and over 30% of bid volumes were above \$35/tonne. These kinds of price premiums, 100% –150%, indicates the perceived greater integrity, permanence and co-benefits.

Revenue Model and Private Sector Involvement:

Delta Blue Carbon is an operation of a performance-based revenue model: carbon credits are issued and revenues directly depend on the verified mangrove survival, growth and carbon accumulation. Project performance to date:

Cumulative Carbon Credit Revenue: The total sales of 40-50 million are gained by 2024 (IDC, 2024).

Annual Revenue Potential: The estimated annual revenue at the present track is 20-50 million.

Lifetime Revenue Projection: It has a potential of billions of dollars throughout the project life of 60 years according to the current price trend and issuance rate.

The project is a formalized public-corporate association:

Government of Sindh: Regulatory framework, forest department policing, land accessibility, legal power of the mangroves.

Indus Delta Capital Limited (IDC): Founded in 2015 by Nadeem Raza Khan, a company specializing in the development of the private sector; under the responsibility of on-ground implementation, mangrove restoration activities, carbon credit marketing and revenue management (IDC, 2024). The position of IDC as a private implementing partner opens several advantages: the application of professional project management standards, knowledge of the carbon market, seeking international recognition and responsibility to the stakeholders of the revenues. The commercial risk (volatility of market prices, delays in verification, threats of permanence) are transferred to the private sector, who has the financial benefit of revenue generation.

Community Benefits and Social Revenue Sharing:

A significant part of the carbon revenues is channelized to community beneficiaries through direct employment of over 10,000 local community members in mangrove restoration activities with more than 18,000 targeted for skills training in natural resource management (IDC, 2024). Revenue is re-invested in community infrastructure, comprising five reverse osmosis (RO) plants built and maintained by IDC in partnership with village development committees to supply clean water to over 100,000 people in 60 villages, basic health units in remote villages, education support programs, and women's economic empowerment programs. Communities are also supported to diversify livelihoods by shifting from unsustainable extraction of mangroves towards sustainable mangrove stewardship, crab and shellfish harvesting, and project-based employment. Revenue-sharing arrangements are designed to ensure that the value of the carbon market

generates tangible local benefits beyond the profitability of Indus Delta Capital, addressing the equity concerns that are often raised about carbon finance projects.

Comparative Analysis

Public vs. Market-Based Finance: Structural Comparison:

These two models represent fundamentally different ways to mobilizing climate finance:

Table 2: Public vs. Market-Based Finance: Structural Comparison		
Aspect	Recharge Pakistan (Public Grants Model)	Delta Blue Carbon (Market-Based Carbon Finance Model)
Capital Source	Development assistance budgets of GCF, bilateral donors (The Coca-Cola Company, 2024 ; WWF USAID, 2023), and development organizations (WWF, 2024).	Voluntary carbon market buyers (corporations, financial institutions, carbon fund managers) looking for emissions offsets
Capital Flow	One-way flow from donors to implementing entities; no repayment obligation; no commercial return requirement	Bidirectional: project creates credits based on verified carbon sequestration; credits sold for revenue; revenue keeps operations running
Risk Bearer	GCF and co-financers assume the implementation, political and climate risk; Pakistan government assumes operational risk	Private sector, Market price risk, permanence risk, verification delays Sindh government Regulatory framework (WWF, 2024)
Scalability Constraint / Potential	Limited by donor budgets, competing priorities for climate finance, and political cycles in donor countries	Theoretically unlimited scaling in successful project performance; carbon price dynamics and global climate commitments drive market expansion

Sustainability Model	Dependent on recurrent funding; requires ongoing grant securing for continued operations after initial implementation	Self sustaining from continuous revenue generation from carbon credit sales
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Risk-Sharing and Risk Allocation Mechanisms

Table 3: Risk-Sharing and Risk Allocation Mechanisms

Aspect / Risk Type	Recharge Pakistan Risk Architecture	Delta Blue Carbon Risk Architecture
Donor / Private Sector Risk	GCF is taking significant fiduciary and implementation risk through large upfront capital commitment (\$66M grant). However, this risk is partially mitigated by: Co-financing diversification, Accredited Entity capacity (WWF has a substantial development implementation experience). Phased disbursements linked to accomplishment of project milestones. GCF's strict project oversight and monitoring requirements	Indus Delta Capital bears: Market Price Risk: Carbon pricing fluctuates according to voluntary market dynamics, changes in policy regarding carbon regulations and buyer • Price decreases lower project profitability • Verification/Issuance Risk: Delays in the verification by third parties extend the time between carbon sequestration and revenue realization; verification failures would eliminate revenue stream • Permanence Risk: Environmental threats to mangrove permanence (Sea level rise, storms, deliberate conversion) create liability if carbon is re-released • Reversal Risk: Large-scale deforestation or ecosystem degradation could result in VCU retirement or cancellation
Government Risk	Institutional implementation risk is carried by Pakistan's Ministry of Climate Change and Federal Flood Commission. Political economic risk is carried by provincial coordination risks and climate uncertainty risk is carried by floods exceeding adaptation capacity	Government Risk (Sindh): Regulatory framework responsibility; Potential conflict between carbon revenue maximization and other environmental priorities

Community Risk	Intended beneficiaries are exposed to adaptation outcome uncertainty; project benefits are contingent on successful ecosystem restoration, which are subject to ecological and hydrological uncertainty	Benefits tied to ongoing financial viability of project; if project becomes unprofitable, investment in community infrastructure and employment may end
Verification / Methodological Risk	—	Both projects and buyers rely on Verra's continued credibility and integrity of VCS standards; if Verra's reputation suffers, credit values decline

Monitoring, Verification, and Transparency Systems

Table 4: *Monitoring, Verification, and Transparency Systems*

Aspect	Recharge Pakistan Monitoring Framework	Delta Blue Carbon Monitoring and Verification
Institutional Oversight / Fiduciary Standards	- GCF fiduciary standards for transparent financial reporting and project implementation tracking - Disbursement conditional on achievement of agreed-upon milestones and satisfactory performance of project - GCF dashboard to provide public information on project status, expenditures and outcomes	- Independent Third Party Verification by Validation/Verification Bodies (VVBs) - VVBs are independent from project proponents and Verra accredited
Technical Monitoring	Project-specific M&E plan with defined indicators for ecosystem restoration (hectares restored, water flow pathways rehabilitated, green infrastructure installed), beneficiary reach, GHG reductions and socioeconomic outcomes	VVBs assess: - Baseline scenario set up and proof of additionality - Monitoring data accuracy and GHG calculation methodologies - Mangrove survival rates, growth measurements, soil carbon quantification - Permanence provisions and adequacy of buffer reserve

Transparency Mechanisms	• GCF project database available to the public with funding proposals, project documents and performance reports • Reporting by Government of Pakistan via National Climate Change Policy frameworks and NDC Implementation reporting to UNFCCC.	• All project documents (Project Design Document, monitoring reports, verification audits) are publicly available on Verra Registry. Each VCU tracked with unique • serial number to avoid double counting • Real-time tracking of credit issuance/retirement for verification
Market-Enforced Transparency / Verification	-	• Carbon credit buyers do their due diligence before buying: VCS documentation review, track record of project, environmental risks • BeZero Carbon offers credit qualities ratings; Delta Blue Carbon "AA" rating • Price premiums - reflect the market perception of transparency and credit integrity
Limitations	-	• Verification timelines lead to 2-4 years of delay between carbon sequestration and public credit issuance • Market concentration: Verra credibility central to VCS system; regulatory failure or scandal would undermine transparency.

Policy Implications and Strategic Recommendations

Blended Climate Finance: Combining Public and Market Based Strategies:

The complementary pillars to a blended climate finance approach, Recharge Pakistan and Delta Blue Carbon, are supplementary respond to the idiosyncratic requirements of the climate vulnerability of Pakistan and the financial limitations in the country. An effective framework is a blending of the public adaptation finance, market-based mitigation finance and catalytic risk-sharing.

Tier 1: Public Adaptation Finance (Foundation):

Public finance covers critical, non-commercial adaptation demands like water security, food systems and disaster risk reduction, mostly through concessional grants and loans from the GCF, multilateral development banks and bilateral donors. Returns are gauged in terms of resilience outcomes instead of financial gains, with annual needs estimated at being USD 7-14 billion ([World-Bank, 2017](#)).

Tier 2: Market-Based Mitigation Finance (Revenue Generation):

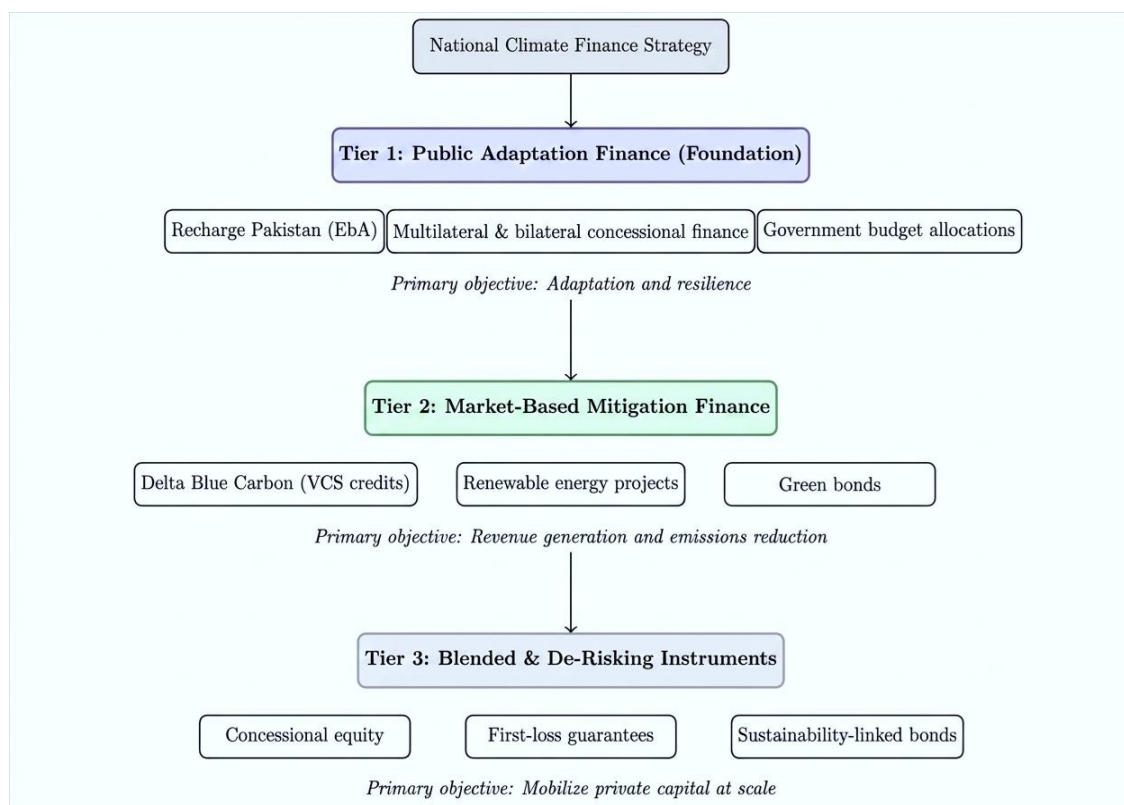
Market based mechanisms trigger private capital for commercially viable mitigation activities, including carbon removals projects. Financing is driven by carbon credit revenues which enables financial sustainability alongside climate benefits, with the potential for scaling through carbon markets, green bonds and private climate investment.

Tier 3: Blended and De-Risking Instruments (Catalytic):

Risk-sharing instruments such as concessional equity, first-loss guarantees and sustainability-linked bonds mean investment risk can be reduced and crowd in private investment where returns are uncertain. Public catalytic finance makes private participation at scale happen by improving risk-return profiles.

Implementation Architecture for Pakistan:

Figure 2: Implementation Architecture for Pakistan



The proposed blended finance structure for Pakistan is based on existing international practice. In Colombia, the Cispatá Bay mangrove project sold all the issued credits at a premium over the market price within eight months of issuance through a combination of public and philanthropic grants and Verra-certified blue carbon revenues ([Palao et al., 2022](#)). In Indonesia, GEF grants have been combined with private carbon investment to fund mangrove restoration on 100, 000 hectares with compulsory community revenue-sharing ([Convergence, 2023](#)). These precedents affirm that combining public grants with

market-based mitigation finance is a field-tested model for fiscally constrained developing economies, validating the model this study proposes to Pakistan.

Synergies from Blended Approach:

1. **Fiscal Space Preservation:** Market-based mechanisms (DBC) - generate revenues allowing self-sustained operations; public grants (Recharge Pakistan) - focused on adaptation where markets fail; reduce overall public sector climate finance burden
2. **Risk Diversification:** Portfolio approach reduces dependency on single financing source; both the commitment cycle of donors and the dynamics of carbon market drive portfolio resilience
3. **Institutional Capacity Building:** Parallel projects help build government expertise in both concessional climate finance (GCF engagement) and market-based mechanisms (VCS compliance, carbon accounting)

Prioritize Adaptation Finance with Scaling Blue Carbon and Coastal Mitigation:

Given Pakistan's adaptation financing need of \$7-14 billion annually, and current annual climate investments of \$4 billion, near-term climate finance policy should focus on significant scaling of adaptation investment and simultaneously building mitigation infrastructure. This involves bilateral engagement as well as mobilizing by the private sector (blue carbon, green bonds, climate venture capital). The adaptation process should not be competitive with the mitigation of the scarcity of public resources but rather, it should follow both avenues simultaneously ([Green Climate Fund, 2024](#); [World-Bank, 2017](#)). The success of Delta Blue Carbon also provides a model to be followed in replicating market-based blue carbon in the rest of Pakistani mangrove potential (Balochistan) along its coastline. Policy should include:

- **Regulatory Support:** Accelerate Verra VCS certification of other mangrove projects; stipulate their benefit sharing with the coastal communities.
- **Capacity Building:** Educate the workers of federal/provincial on blue carbon accounting, monitoring and verification procedures.
- **Market Access:** Support the introduction of Pakistani projects into the voluntary carbon markets; assist the carbon buyers build the relationships with the international corporations.

Address Financial Sustainability Beyond Initial Implementation:

Recharge Pakistan's design emphasizes on demonstration and policy catalysis but lacks adequate mechanisms for long-term financial sustainability. The government should put in place explicit policy mechanisms to ensure recurrent budget provision for EbA operations and maintenance beyond 2031.

This includes ensuring EbA is incorporated in the National Water Policy, and that the provincial adaptation plans incorporate sustained funding for ecosystem management. Additionally alternative revenue mechanisms should be considered to fund the maintenance of EbA, for example through water pricing schemes and through the recycling of carbon credit revenues. In the meantime, Pakistan should also consider the debt for climate swaps mechanism creating fiscal space for long-term sustainability. Coastal accommodation in Pakistan, such as the restoration of mangroves of Delta Blue Carbon, is threatened by rising sea-level. Policy should include:

- **Integrated Coastal Planning:** Tie Delta Blue Carbon with other investments, facilitating coastal resilience (storm surge barriers, mangrove-friendly fishing systems, inland migration routes) together.

- ***Adaptation Finance for Permanence:*** Finance climate adaptation project (for enhancement of mangrove) to the rise in sea-level

Establish Carbon Market Governance and Oversight:

The new position of Pakistan in the voluntary carbon markets need good governance systems to ensure green washing is avoided and maintain integrity of the market. The government ought to establish a national carbon registry, which will centralize all the carbon projects in Pakistan including the blue carbon, renewable energy, and the REDD+ initiatives so that they do not count in the projects and programs. The transparent benefit sharing standards must be designed in such a way that the revenues on carbon are directed to the local communities and populations depending on the forests.

Conclusion

The climate challenge that Pakistan faces will require the scale-up of both the public and the private climate finance. Recharge Pakistan and Delta Blue Carbon can be seen as examples of complementary approaches to working: the grant based public adaptation finance and the market-based mitigation finance. Both are not enough, and a combination is essential. Recharge Pakistan demonstrates how ecosystem-based public investment can support climate resilience and support policy shifts to the green infrastructure. Delta Blue Carbon shows that carbon markets can be used to motivate the mobilization of the private capital based on self-sustaining mitigation projects, which rely on the stability and persistence of the ecosystem in the market demand. This combination of climate finance models puts Pakistan in a position to fulfill the needs of adaptation and mitigation efforts, as well as balance its available budget; and is one of the viable alternatives to bridge the estimated USD 200-348 billion climate finance gaps faced by Pakistan by 2030.

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