



Innovative Financing Models for Maritime Infrastructure Development in Emerging Economies: A Critical Review and Policy Framework

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ARTICLE INFO	ABSTRACT
Submission: May 28, 2026 Revised: June 11, 2026 Accepted: June 26, 2026 Available Online: July 13, 2026 Keywords: maritime infrastructure; port finance; emerging economies; public-private partnerships; blended finance; blue finance; climate resilience Corresponding author: danishaman@hotmail.com	Maritime infrastructure in emerging economies has become a strategic financing challenge because ports, terminals, channels, breakwaters and hinterland interfaces now determine trade competitiveness, climate resilience and integration into global value chains. The problem is not merely capital scarcity, but the difficulty of transforming risky and politically sensitive maritime projects into bankable assets with credible revenues, balanced risk allocation and enforceable environmental and social safeguards. This paper reviews literature and institutional evidence published between 2010 and 2026 to examine how innovative financing models are being used for maritime infrastructure development in emerging economies. Using a structured narrative review and thematic synthesis, the paper analyses public-private partnerships, port concessions, blended finance, green and blue bonds, sustainability-linked instruments, infrastructure funds, sukuk, multilateral guarantees, user-fee structures and emerging digital-finance mechanisms. It further compares cases from Ghana, Nigeria, Bangladesh, Indonesia, Sri Lanka and Peru to identify the conditions under which financing innovation improves project delivery and long-term performance. The analysis shows that no single instrument is universally superior. Successful maritime finance depends on matching instruments to asset economics: public or concessional finance is more suitable for non-bankable marine access works, while private capital is better suited to terminals and logistics facilities with clearer revenue streams. Climate resilience, tariff credibility, local-currency depth and institutional quality shape bankability. The paper contributes by proposing a portfolio-based financing framework that links instrument choice, governance capacity, risk allocation and sustainability outcomes. It concludes that emerging economies should prioritise project preparation, blended risk mitigation and transparent monitoring over complex financial engineering.

Introduction

Seaports and related maritime infrastructure are central to the development prospects of emerging economies. They connect domestic producers to international markets, reduce trade costs, support coastal industrialisation and shape the competitiveness of export-oriented sectors. For many lower- and middle-income coastal states, maritime infrastructure also performs a strategic public function: it links landlocked hinterlands, supports food and energy security, anchors special economic zones and enables participation in regional value chains. However, the financial demands of modern maritime

systems have expanded sharply. Deeper drafts, larger vessels, automated equipment, climate-resilient breakwaters, dredging, shore power, low-emission cargo-handling systems and digital port community systems require capital commitments that often exceed the fiscal space of emerging economies.

The financing issue is therefore more complex than a simple shortage of funds. Large pools of global infrastructure capital exist, yet many maritime projects in emerging economies remain unable to reach financial close because they lack reliable traffic forecasts, transparent tariff regimes, credible land acquisition arrangements, bankable concession design or enforceable environmental and social safeguards. Financing innovation in this context should not be understood as the use of new instruments for their own sake. It should be understood as the design of financing structures that improve bankability, allocate risk to parties able to manage it, mobilise longer-tenor capital, strengthen climate resilience and maintain public value.

The period from 2010 to 2026 is especially important. Early debate focused largely on port reform, private participation and the landlord-port model. During the 2010s, the discussion broadened towards institutional-investor mobilisation through project bonds, infrastructure funds and sukuk. In the 2020s, climate finance, blue economy finance, sustainability-linked debt, multilateral guarantees and blended finance became more prominent. At the same time, digitalisation reshaped port operations, although digital finance remains less mature in maritime infrastructure than in operational port systems. Recent institutional literature from the World Bank, OECD, UNCTAD, IFC and other development finance institutions increasingly treats infrastructure finance as a question of project preparation, regulatory credibility and resilience rather than instrument novelty alone.

This paper examines innovative financing models for maritime infrastructure development in emerging economies. It asks three guiding questions. First, which financing models are most relevant to different categories of maritime infrastructure? Second, what institutional and project-level conditions determine whether such models succeed? Third, how can emerging economies design maritime finance portfolios that combine public finance, private capital, multilateral support and sustainability-oriented instruments? The paper contributes to the literature by integrating fragmented debates on port concessions, blended finance, climate finance, Islamic finance, infrastructure funds and digital finance into a single analytical framework for maritime infrastructure.

Methodology

This paper adopts a structured narrative review supported by thematic synthesis. The review covers academic and institutional literature published between 2010 and 2026. This period was selected because it captures the post-global-financial-crisis expansion of infrastructure finance, the rise of institutional-investor mobilisation, the mainstreaming of public-private partnerships in port systems, and the more recent emergence of green, blue and resilience-oriented finance. The review focuses on maritime infrastructure in emerging economies, broadly defined to include ports, container terminals, multipurpose terminals, dredging, access channels, breakwaters, quay walls, land reclamation, port-community systems, hinterland interfaces and logistics-enabling assets.

The search strategy combined peer-reviewed academic literature with authoritative institutional sources. Academic sources were selected from major databases and publishers commonly used in transport, maritime policy, infrastructure finance and development studies, including ScienceDirect, SpringerLink, Taylor & Francis, Wiley, Emerald and Scopus-indexed journals where accessible. Institutional sources were drawn from the World Bank, IFC, MIGA, OECD, UNCTAD, JICA, ICMA, Climate Bonds Initiative and relevant public-private partnership authorities. Search terms included combinations of: maritime infrastructure finance, port finance, port concession, public-private partnership, blended finance, green ports, blue bonds, climate-resilient ports, infrastructure funds, sukuk infrastructure, multilateral guarantees, port digitalisation and emerging economies.

The inclusion criteria were: relevance to maritime or transport infrastructure financing; publication within 2010-2026; direct relevance to emerging economies or transferable analytical value; evidence on financing instruments, governance, sustainability or project delivery; and verifiable bibliographic information. Sources were excluded where they were promotional without analytical substance, unverifiable, duplicated, unrelated to maritime infrastructure, or focused only on technical engineering without financing relevance. Case evidence was selected purposively rather than statistically. Ghana's Tema expansion, Nigeria's Lekki Deep Sea Port, Bangladesh's Patenga and Bay Terminal programmes, Indonesia's Patimban Port, Sri Lanka's Colombo West International Terminal and Peru's Callao Norte concession were chosen because they represent different regional contexts and financing architectures, including concessions, PPPs, sovereign-development finance, multilateral mobilisation and sponsor-led structures.

The analytical approach followed thematic synthesis. First, the literature was grouped into major financing themes: PPPs and concessions, blended finance, capital-market instruments, green and blue finance, Islamic finance, multilateral guarantees, user-fee models and digital-finance innovations. Second, each theme was assessed in relation to maritime asset economics, especially the distinction between commercially bankable terminal assets and weakly cash-generating marine public works. Third, the case evidence was used to identify cross-regional lessons on risk allocation, tariff credibility, climate resilience and institutional capacity. This approach is suitable for a conceptual and policy-oriented paper because the objective is not to estimate causal effects statistically, but to develop an integrated financing framework grounded in documented literature and cases.

Scope and Analytical Framing

Maritime infrastructure cannot be treated as a single asset class. A container terminal, an access channel, a breakwater, a port-community system and a road connection to a hinterland logistics zone have different revenue characteristics and risk profiles. Terminal superstructure and cargo-handling equipment may generate direct user-fee revenue and therefore support concessions, leases, corporate finance or project finance. By contrast, marine access works such as dredging, channels and breakwaters often produce system-wide benefits but weak standalone cash flows. These assets frequently require public, sovereign, municipal or concessional finance, possibly combined with later private terminal concessions. This distinction is central to the financing logic of maritime infrastructure.

In emerging economies, bankability is shaped by five interacting conditions. The first is revenue credibility, including realistic traffic forecasts, transparent tariff-setting and enforceable collection mechanisms. The second is risk allocation, particularly the division of construction, demand, foreign-exchange, political, environmental and force-majeure risks. The third is maturity matching, because maritime assets require long repayment horizons while domestic financial markets in emerging economies often provide short-tenor credit. The fourth is institutional credibility, including procurement quality, dispute resolution, concession enforcement and regulatory independence. The fifth is environmental and social legitimacy, which is increasingly material to lender due diligence, climate finance eligibility and long-term project stability.

The term innovative financing is therefore used in this paper in a disciplined sense. A model is innovative when it improves mobilisation of additional capital, reduces the mismatch between asset life and financing tenor, allocates risk more efficiently, deepens local-currency finance, embeds climate resilience or strengthens accountability. Under this definition, older instruments such as concessions and tariff-backed finance may remain innovative when redesigned around performance standards, resilience obligations and transparent regulation. Conversely, newer instruments such as tokenised infrastructure finance cannot be considered transformative unless they demonstrate real deployment at maritime-project scale.

Literature Review: Thematic Synthesis, 2010-2026

The literature on maritime infrastructure finance has evolved from a narrow focus on ownership reform to a broader concern with bankability, sustainability and institutional design. Early post-2010 work continued to examine the efficiency implications of private participation and landlord-port arrangements. Port reform literature generally argued that private operators can improve terminal productivity where contracts are well designed and regulators can manage competition, tariffs and service quality. However, later literature became more cautious, recognising that privatisation or concessioning alone does not guarantee better outcomes. Caldas et al. (2024) associate container-port efficiency with scale and private-sector participation, but also emphasise the lumpy and risky nature of port investment. Andersen et al. (2023) show that port governance models continue to evolve and cannot be transferred mechanically across contexts. Mdanat et al. (2024) further demonstrate that competitiveness drivers differ across income groups, meaning that financing structures must be adapted to institutional maturity and market size.

Public-private partnerships and concessions remain the dominant financing models for commercially viable maritime assets. The landlord-port model separates public ownership of port land and regulatory oversight from private terminal operations. This model is attractive because it allows the public sector to retain strategic control while mobilising private investment and operating expertise. Yet the literature also identifies recurring weaknesses: optimistic demand forecasts, politically constrained tariff adjustments, inadequate termination provisions, renegotiation risks and limited competition in gateway ports. In emerging economies, these risks are amplified by weak dispute-resolution systems, foreign-exchange exposure and limited public-sector capacity to prepare and monitor contracts. The most effective concessions therefore combine clear performance obligations, realistic traffic assumptions, transparent tariff indexation and credible mechanisms for expansion, renegotiation and handback.

A second body of literature concerns capital-market mobilisation. World Bank work on infrastructure finance after 2010 highlighted project bonds, infrastructure debt funds, sukuk and other fixed-income instruments as ways to mobilise pension

funds, insurers and sovereign wealth funds for long-term infrastructure. In principle, port assets with stable cash flows and long concessions should suit institutional investors. In practice, however, project-bond finance remains constrained in many emerging economies by weak credit ratings, shallow domestic bond markets, currency mismatch, insufficient disclosure and limited secondary-market liquidity. This explains why bank-led project finance, development-finance mobilisation and sponsor balance sheets still dominate many maritime transactions. Infrastructure funds may provide patient equity and portfolio-level diversification, but fundraising has often remained concentrated in developed markets, leaving many emerging-economy port projects dependent on development finance institutions and strategic sponsors.

Blended finance has become increasingly important because many maritime projects contain both public-good and commercial components. Blended finance uses concessional or development finance to mobilise additional commercial capital that would not otherwise participate on acceptable terms. In ports, this is especially relevant where public marine works create the platform for later private terminal concessions. The Bangladesh Bay Terminal programme illustrates this logic: public and IDA financing supports breakwater and marine access works, while future private operators are expected to finance terminal development. The advantage of this structure is that it avoids forcing non-bankable public works into purely commercial finance while still creating a pathway for private investment. The risk is that blended finance can become a subsidy without additionality if concessional funds replace rather than mobilise private capital. Therefore, strong transparency, ex ante additionality tests and ex post monitoring are essential.

Green, blue and sustainability-linked finance form a third major theme. Ports are exposed to sea-level rise, storm surges, coastal erosion and extreme weather, while also contributing to emissions through vessels, equipment, trucks and electricity consumption. The literature on green ports and port decarbonisation shows that investment in shore power, electrified equipment, renewable energy, digital traffic management and resilient marine works is increasingly necessary. Le et al. (2023) argue that green-port development in emerging economies is constrained by finance and governance. Alamoush et al. (2023) identify fragmented incentives, regulatory gaps and technology uncertainty as barriers to port decarbonisation. UNCTAD (2022) emphasises that adequate finance for climate-resilient seaports remains a major challenge for developing countries. The implication is that climate-labelled bonds may help, but only where proceeds are tied to credible projects, reporting frameworks and measurable resilience or emissions outcomes.

Blue finance extends the green-finance agenda to ocean-related activities. Blue bonds and blue-economy instruments can support sustainable fisheries, marine conservation, coastal resilience and cleaner maritime transport. For port infrastructure, their strongest relevance lies in climate-resilient marine works, pollution reduction, shore power and low-carbon logistics. However, the market remains smaller and less standardised than the green-bond market. ICMA's blue-finance guidance and Climate Bonds' sector criteria help create taxonomic discipline, but emerging economies still require project pipelines, reporting capacity and investor confidence. Without these conditions, the label can become reputational rather than financial innovation.

Islamic finance and sukuk offer another important pathway, particularly for Muslim-majority coastal emerging economies. Sukuk structures can be asset-backed or asset-based and can align with infrastructure assets that generate predictable cash flows. They may widen the investor base, attract Gulf and Islamic institutional investors and provide long-tenor financing compatible with infrastructure needs. World Bank and IsDB work has also explored the role of Islamic finance in climate-aligned investment. Nevertheless, sukuk deployment for port infrastructure depends on legal enforceability, standardisation, Shariah governance, credit enhancement and availability of clearly identifiable assets or usufruct rights. The literature suggests strong conceptual fit, but documented port-specific deployment remains less extensive than conventional concession and development-bank financing.

Multilateral guarantees and credit enhancement are increasingly central to emerging-economy maritime finance. Political-risk insurance, partial credit guarantees, payment guarantees and breach-of-contract coverage can reduce investor concerns about policy reversals, expropriation, convertibility restrictions or state-owned-enterprise payment risks. MIGA and the World Bank Group guarantee platform demonstrate how guarantees can extend tenor, reduce risk perception and help mobilise commercial lenders. For port projects, guarantees are particularly useful where demand appears plausible but country risk, regulatory uncertainty or public-counterparty risk prevents financial close. They cannot, however, compensate for fundamentally weak project economics or unrealistic traffic assumptions.

The literature on digitalisation is more advanced for port operations than for finance. Port community systems, digital customs interfaces, terminal operating systems, automated gates and data platforms have measurable effects on efficiency and competitiveness. Tijan et al. (2021) link port authority roles to port community system implementation, while Li et al. (2025) find positive long-run effects of digital transformation on port throughput. Digital finance, by contrast, remains exploratory. Tokenised infrastructure debt, blockchain-based securities settlement and digital reporting platforms could

eventually broaden investor access and improve transparency, but sectoral evidence through 2026 remains limited. The prudent conclusion is that digital finance should be treated as a future opportunity rather than a present substitute for bankability, governance and credit enhancement.

Overall, the literature converges on a common finding: financing outcomes depend less on the label attached to an instrument than on the institutional environment in which it is used. PPPs, bonds, sukuk, blended finance and guarantees can all fail if demand is overstated, tariffs are politically manipulated, procurement is opaque or environmental and social risks are ignored. Conversely, conventional instruments can become innovative when embedded in strong project preparation, credible regulation and climate-resilient design.

Research Gap and Contributions

Existing research has examined port governance, PPPs, green ports, infrastructure finance and climate resilience as related but often separate fields. Studies of port efficiency tend to focus on ownership, scale and operational performance; studies of sustainable ports focus on emissions, energy and resilience; and infrastructure-finance literature often treats transport as a broad sector without examining the asset-level differences within maritime infrastructure. There is therefore limited integrated analysis of how financing models should be matched to different maritime assets in emerging economies.

A second gap concerns the relationship between financing innovation and institutional capacity. Much of the policy discourse presents instruments such as green bonds, blue bonds, blended finance or tokenisation as solutions. Less attention is given to the conditions that make these instruments credible: project preparation, tariff regimes, risk allocation, environmental and social safeguards, local-currency market depth and monitoring systems. A third gap is regional. While individual port projects in Asia, Africa and Latin America are documented, cross-regional synthesis remains limited.

This paper addresses these gaps in four ways. First, it develops a portfolio-based framework that links financing instruments to maritime asset economics. Second, it integrates sustainability and climate resilience into the analysis of bankability rather than treating them as external requirements. Third, it compares selected emerging-economy cases to identify transferable lessons. Fourth, it proposes policy implications for governments, port authorities, development finance institutions, private investors and climate-finance actors.

Comparative Analysis of Innovative Financing Models

The comparative evidence indicates that financing models should be selected according to asset economics and risk profile. Public-private partnerships and concessions are most suitable for assets with direct and predictable cash flows, such as container terminals, multipurpose terminals, dry ports and logistics platforms. They allow governments to mobilise private capital and operational expertise while retaining strategic ownership of port land. However, PPPs are not a universal remedy. They perform poorly where demand forecasts are inflated, public authorities cannot enforce contracts, tariff adjustments are politically blocked or complementary infrastructure is missing.

Blended finance is particularly valuable for maritime systems that combine public-good marine works with commercially viable terminal operations. In such cases, public or concessional finance can fund breakwaters, channels, dredging and land formation, while private capital enters later through terminal concessions. This structure is more realistic than expecting private investors to finance all components of a port system, including assets that generate broad economic benefits but limited direct revenue. The challenge is to ensure that concessional resources are used to mobilise additional private investment rather than to subsidise commercially viable assets unnecessarily.

Green bonds, blue bonds and sustainability-linked instruments are best suited to clearly measurable environmental and resilience investments. Examples include shore power, electrified cargo-handling equipment, renewable-energy systems, low-carbon terminal equipment, resilient breakwaters, drainage and flood protection. Their contribution lies not only in raising capital but also in imposing reporting discipline. Yet thematic finance cannot overcome weak revenue models by itself. Investors still require creditworthy issuers, credible use-of-proceeds frameworks and transparent impact reporting.

Infrastructure funds and project bonds are promising but require maturity. They are more feasible for brownfield assets with stable revenue histories than for greenfield ports with uncertain demand. Project bonds usually need investment-grade ratings, credit enhancement or partial guarantees, while infrastructure funds prefer scalable platforms or portfolios rather than isolated small assets. Islamic finance and sukuk can widen the investor base in relevant markets, especially where port assets can be structured around leases, usufruct or asset-backed arrangements. Their wider use depends on legal clarity, standardisation and project pipelines.

Multilateral guarantees are often decisive in frontier and high-risk markets. They do not create demand, but they can reduce political and contractual risks that prevent lenders from entering otherwise viable projects. User-fee and tariff-backed finance remains foundational because even innovative instruments ultimately require repayment sources. Tariff credibility, collection efficiency and transparent economic regulation are therefore essential. Digital-finance tools, including tokenisation, digital bonds and blockchain-based settlement, may eventually improve transparency and market access, but current evidence suggests that they remain supplementary rather than central to maritime infrastructure finance.

Table 1. Comparative assessment of innovative maritime infrastructure financing models

Financing model	Best fit	Core strength	Main risk	Assessment for emerging economies
PPP/concession	Container terminals, dry ports, specialised cargo facilities	Mobilises private capital and operating expertise	Weak tariff policy, renegotiation, demand risk	Most established model where regulation and traffic are credible
Blended finance	Breakwaters, access channels, dredging linked to future private terminals	Crowds in private finance by non-bankable enabling works	Subsidy without additionality	Highly suitable when public marine works enable private terminal investment
Green/blue bonds	Shore power, electrification, resilient marine works, pollution control	Expands sustainability-oriented investor base and reporting discipline	Weak taxonomy or greenwashing risk	Useful where proceeds and impacts are measurable
Project bonds/infrastructure funds	Brownfield terminals and scalable port-logistics platforms	Mobilises institutional investors and longer-tenor capital	Requires ratings, disclosure and stable cash flows	Promising but often needs credit enhancement
Sukuk/Islamic finance	Ports in Muslim-majority markets with identifiable assets and revenues	Broadens investor base and matches long-term assets	Legal and standardisation constraints	Strong potential but underused in port cases
Multilateral guarantees	Frontier-market PPPs and state-linked concessions	Reduces political, contractual and payment risks	Cannot fix weak project economics	Often decisive for financial close in high-risk markets
User-fee/tariff-backed finance	Commercial ports with transparent dues and charges	Provides repayment source for debt and reinvestment	Political resistance to tariff adjustment	Foundational requirement for most models
Digital finance	Potential future debt placement and reporting systems	May improve transparency and market access	Legal, cyber, custody and regulatory uncertainty	Nascent; supplementary rather than central through 2026

Cross-Regional Case Evidence

The selected cases reveal that maritime finance works best when public and private roles are sequenced rather than blurred. Ghana's Tema Port expansion illustrates the mature PPP/concession model in Africa. The project combined private sponsors,

multilateral mobilisation and major marine and terminal works. It demonstrates that large gateway-port PPPs can attract significant capital when traffic prospects, sponsors and lender confidence align. At the same time, social and environmental complaints associated with large port projects show that bankability cannot be separated from legitimacy. Resettlement, compensation, labour safety and community engagement are financing variables because unresolved social risk can delay projects and damage lender confidence.

Nigeria's Lekki Deep Sea Port demonstrates both the strengths and limitations of sponsor-led PPP finance. The port reached operation with long-term external funding and a PPP structure that limited direct sovereign debt for the port itself. However, later attention to road financing shows that the port's value depends on corridor connectivity. A deep-sea port without sufficient road, rail or inland logistics capacity cannot fully realise its revenue potential. This reinforces the argument that maritime finance should be designed at corridor level rather than at terminal level alone.

Bangladesh provides two complementary examples. Patenga Container Terminal shows how an operating concession can introduce foreign terminal expertise and improve management capacity. Bay Terminal illustrates a more strategic blended model in which public-development finance supports marine infrastructure and creates conditions for future private terminal investment. This sequencing is highly relevant for emerging economies because it recognises that breakwaters, dredging and navigation channels are difficult to finance commercially but essential for private terminal bankability.

Indonesia's Patimban Port follows a similar staged logic. JICA-supported sovereign finance helped establish the initial platform, access and marine works, while later phases were positioned for private participation. This model is appropriate where early demand and operational conditions remain uncertain but long-term logistics needs justify public investment. Sri Lanka's Colombo West International Terminal adds a different lesson: strategic port projects may proceed despite financing shocks if sponsors have sufficient balance-sheet capacity, but geopolitical concerns can alter the composition of finance. Peru's Callao Norte concession shows that brownfield assets with established demand can mobilise long-tenor private finance more easily than greenfield frontier projects.

Across regions, the main lesson is that innovative finance is rarely a single instrument. It is usually a layered architecture: public anchoring for enabling assets, private participation for operational assets, guarantees for political and contractual risks, and sustainability-linked or climate-aligned instruments for resilience and decarbonisation components.

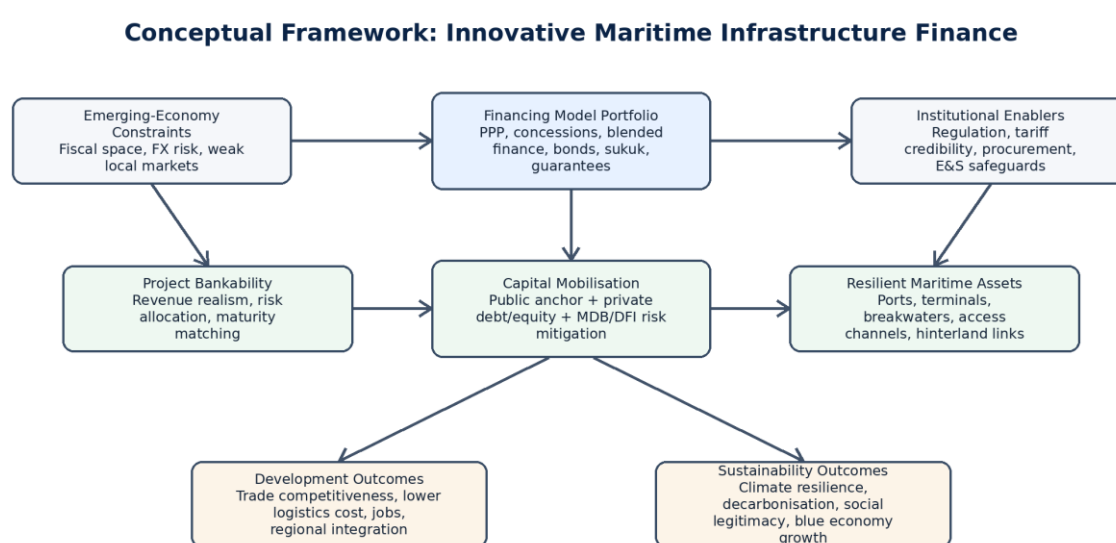
Table 2. Cross-regional case evidence from selected emerging economies

Region/country	Project	Financing logic	Main lesson
Ghana	Tema Port Expansion	Large PPP/concession with sponsor and multilateral mobilisation	Gateway-port PPPs can scale when sponsors, traffic and lender confidence align, but E&S risk must be managed early.
Nigeria	Lekki Deep Sea Port	Sponsor-led PPP with long-term external finance	Port finance must be matched with corridor and hinterland infrastructure.
Bangladesh	Patenga Container Terminal	Operating concession to international terminal operator	Concessions can import operational expertise, but wider institutional readiness remains essential.
Bangladesh	Bay Terminal	Public/IDA finance for marine works plus future private terminal investment	Sequenced blended finance can make non-bankable marine works support later private capital.
Indonesia	Patimban Port	ODA-supported early phase with later PPP/private expansion	Public finance can de-risk early infrastructure and prepare the ground for private participation.
Sri Lanka	Colombo West International Terminal	BOT concession with sponsor-led funding after financing changes	Strategic projects may proceed after financing shocks, but geopolitical risk can alter funding sources.
Peru	Callao Norte	Brownfield concession with IFC-mobilised debt	Existing traffic and concession cash flows support long-tenor private finance.

Conceptual Framework

The conceptual framework developed in this paper links emerging-economy constraints to financing-model selection, institutional enablers, project bankability and development outcomes. Emerging economies face fiscal constraints, foreign-exchange risk, shallow local capital markets and institutional weaknesses. These constraints shape the feasible financing portfolio. A government may use sovereign or concessional finance for non-bankable marine works, concessions and PPPs for terminals, guarantees to reduce political risk, and thematic bonds or sustainability-linked instruments for climate-aligned investments. However, financing instruments only produce value when supported by institutional enablers: transparent procurement, credible tariff regulation, enforceable contracts, environmental and social safeguards and effective monitoring.

The framework emphasises that bankability is an intermediate condition rather than an automatic result. Financing models must create credible revenue, allocate risks properly, match debt maturity with asset life and satisfy lender due diligence. When these conditions hold, capital mobilisation becomes possible and maritime assets can deliver development outcomes, including lower logistics costs, trade competitiveness, employment, regional integration, climate resilience and blue economy growth.



Source: Author synthesis based on reviewed literature and cases (2010-2026).

Figure 1. Conceptual framework for innovative maritime infrastructure finance in emerging economies.

Policy Implications

For governments, the key policy implication is to build bankable maritime pipelines rather than isolated projects. This requires national port strategies, realistic demand forecasting, integrated corridor planning, transparent land acquisition, predictable tariff policy and early environmental and social screening. Governments should avoid using sovereign borrowing for all assets where private capital can be mobilised, but they should also avoid transferring non-commercial risks to private investors in ways that make projects unbankable. A disciplined split between public marine works and private terminal operations is often the most practical architecture.

For port authorities, the priority is regulatory and operational credibility. Port authorities must develop capacity in concession design, contract monitoring, performance measurement, tariff adjustment, stakeholder engagement and climate-risk management. They should also improve data transparency because investors require reliable information on throughput, dwell time, vessel turnaround, tariffs, operating costs and expansion needs. Digital port systems can support finance indirectly by improving efficiency and data quality.

For multilateral development banks and development finance institutions, the most important role is catalytic rather than purely lending-based. MDBs and DFIs can fund project preparation, provide guarantees, structure blended finance, support

local-currency solutions and embed environmental and social standards. They are particularly valuable where a project is economically justified but commercially marginal because of policy risk, early-stage marine works or climate-resilience costs.

For private investors, the analysis suggests that terminal concessions, brownfield upgrades and integrated port-logistics platforms offer the clearest revenue basis. Investors should evaluate not only terminal demand but also hinterland access, customs performance, tariff governance and climate exposure. For climate-finance institutions, ports should be treated as adaptation and transition assets. Climate-resilient breakwaters, shore power, electrification and low-carbon logistics systems can justify green or blue finance when supported by measurable indicators and transparent reporting.

Monitoring and Evaluation

Monitoring should be built into financing structures from the beginning. A credible monitoring system should track capital mobilisation, financial performance, operational efficiency, public value, climate resilience and social safeguards. Key financial indicators include private capital mobilised, leverage ratios, debt tenor, weighted cost of capital, local-currency share, debt-service coverage and traffic deviation from base-case forecasts. Operational indicators include vessel turnaround time, berth productivity, crane productivity, dwell time, cargo throughput and gate efficiency.

Public-value indicators are equally important where sovereign finance, concessional resources or guarantees are used. These include royalties, tax receipts, employment, trade-cost reduction, logistics reliability and benefits to inland producers. Environmental and social indicators should include emissions reductions, shore-power usage, climate-resilience milestones, resettlement completion, stakeholder engagement, labour safety and grievance resolution. Institutional indicators should measure procurement timelines, tariff-adjustment timeliness, dispute-resolution performance and transparency of reporting. Such a scorecard allows financiers and regulators to determine whether an instrument has genuinely improved outcomes or merely relabelled existing finance.

Limitations

This paper has limitations. First, it is based on a structured narrative review rather than econometric analysis. It synthesises evidence from academic and institutional sources but does not statistically estimate the causal effect of specific financing models on port performance. Second, documentation is uneven. PPPs, sovereign loans and multilateral guarantees are relatively well documented, while direct maritime applications of diaspora bonds, tokenised infrastructure and some forms of blue finance remain limited in publicly available English-language sources. Third, several recent projects, including Bay Terminal, later Patimban phases and Colombo West, are still under implementation, so their long-run financial and operational outcomes cannot yet be fully assessed.

A further limitation is that the analysis focuses on selected representative cases rather than an exhaustive global database of maritime projects. The cases were chosen to illustrate different financing models and regions, not to establish statistical representativeness. Finally, while the paper discusses environmental and social safeguards, it does not conduct independent environmental or social impact assessment of individual projects.

Future Research Directions

Future research should move in five directions. First, empirical studies should compare the performance of port PPPs, concessions, sovereign-funded projects and blended-finance structures using consistent indicators such as cost overruns, time overruns, throughput growth, tariff stability, debt-service performance and environmental outcomes. Second, more research is needed on corridor-level finance. Ports cannot be analysed separately from roads, railways, dry ports, customs systems and industrial zones. Third, researchers should test whether green, blue and sustainability-linked instruments reduce the cost of capital for maritime assets or mainly expand the investor base without pricing advantages.

Fourth, Islamic finance and sukuk deserve deeper investigation in Muslim-majority coastal emerging economies. Studies should examine legal structures, investor appetite, credit enhancement and compatibility with port revenue models. Fifth, digital finance should be studied cautiously but seriously. Tokenised debt, digital bonds, revenue-escrow systems, AI-assisted credit assessment and digital reporting platforms could improve transparency and investor access, but they also create cyber, legal, custody and regulatory risks. Future research should therefore assess not only their technological feasibility but also their governance implications.

Conclusion

Maritime infrastructure financing in emerging economies has become more diverse, but also more demanding. Traditional sovereign borrowing remains important, especially for marine access works and strategic public infrastructure. However, it is

increasingly complemented by PPPs, concessions, blended finance, thematic bonds, infrastructure funds, sukuk, user-fee structures and multilateral guarantees. The evidence reviewed in this paper shows that no single model is universally best. The correct financing structure depends on the asset's cash-flow profile, risk allocation, institutional environment, climate exposure and public-value justification.

The most effective approach is a portfolio model. Public or concessional finance should support non-bankable enabling works such as breakwaters, access channels and dredging. Private capital should be mobilised for terminals, equipment and logistics facilities with clearer revenue streams. Guarantees should be used where political or contractual risk prevents otherwise viable projects from reaching financial close. Green, blue and sustainability-linked instruments should finance measurable resilience and decarbonisation investments. All models require transparent procurement, credible tariffs, realistic traffic assumptions, environmental and social safeguards and rigorous monitoring.

For emerging economies, the next frontier is not complex financial engineering, but disciplined project preparation and institutional credibility. Innovative finance succeeds when it makes maritime infrastructure more bankable, resilient, inclusive and accountable. It fails when new labels are attached to weak projects. Governments, port authorities, MDBs and private investors should therefore treat financing innovation as part of a broader governance and development framework for sustainable maritime infrastructure.

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